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STUDIES ON THE POST-COMMUNIST TRANSITION

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Studies on the Post-Communist Transition

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This work is dedicated to my parents,
and to my brother Marius

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Preface

The studies in this thesis will engage the reader in a journey with three main destinations: 1/ the issue of measurement of the economic and institutional features of the transition process in the post-communist countries in Eastern Europe and Eurasia; 2/ the empirical analysis of factors that can, at least partly, explain the relative economic success of the transition process in these countries; 3/ a theoretical model that links the quality of institutions to tax evasion, and bureaucratic corruption. The first two studies in the thesis are empirical, while the third study is purely theoretical[1].

Study 1 is the result of the frustration I experienced when I first attempted to collect and employ indicators that relate to the economic and institutional dimensions of the transition process. While I found that there is a wealth of such indicators, the empirical handling of a large set of measures proved challenging. The objective in **Study 1** is therefore to introduce and employ the method of Confirmatory Factor Analysis (CFA) in order to estimate latent factors that summarize and reflect the complementary nature of specific dimensions of transition. Such specific dimensions are considered in terms of initial conditions, economic reforms and institutions. The empirical analysis in the study focuses on 25 transition economies in Eastern Europe and Eurasia, and on the transition period until year 2001. The CFA method has the advantage that it supports the empirical testing of the hypothesis that a given set of observed indicators combines into a more abstract theoretical construct in a consistent manner. My analysis in the study produces two main categories of results. First, there are successful cases when the CFA analysis applied on observed measures produces reliable summarizing indicators in the form of latent factors. This is the case of the latent factors constructed for time-invariant initial conditions, liberalization of relative prices, reforms with state-owned enterprises, reforms in the financial system, and the summarizing indicator of political environment. Second, there are also cases when the analysis indicates that aggregation of a given set of observed measures is not warranted by the structure of the sample data. This situation is encountered when an attempt is made to estimate a latent factor of initial structural economic imbalances. Empirical difficulties that can occur in the estimation of latent factors are also illustrated. In instances with acute problems with missing data, the possibility to construct empirical measures of more abstract concepts is impaired. This is despite the fact that the associated CFA measurement model indicates a potentially high validity of the measures employed. I encounter this situation when I analyze the possibility to construct latent factors of state governance (laws and regulations, and political interference in business activities).

Having obtained a set of reliable summarizing indicators of, at least, some of the dimensions of the post-communist transition process, I then turned to the objective of the analysis of determinants of the aggregate economic performance in these countries, as observed until year 2000.

In **Study 2**, the overriding objective is to disentangle the relative roles that initial conditions and the process of reforms and institution building specific to the transition period played in supporting and/or hindering economic activities in the post-communist countries. There are two main defining features of the analysis that I develop. First, in

[1] This thesis is included, in electronic format, in the database '*Doctoral Theses from Göteborg University*', accessible at http://www.ub.gu.se/Gdig/dissdatabas/index.html

the spirit of the theoretical literature of Optimal Speed of Transition, I analyze the issue that observed aggregate growth is the net result of the expansion of the private sector and of the collapse of the state sector. For this purpose I decompose aggregate growth rates into growth in value added in the private sector and the corresponding developments in the state sector. I find that even among the most advanced transition economies there are significant differences in terms of the way in which developments in the two sectors combine into aggregate economic performance. The second main feature of the current analysis is the focus on interactions among the determinants of economic performance of the two sectors. I introduce and employ the method of Path Analysis in order to analyze an empirical simultaneous equation model that connects initial conditions, reforms, institutions, and growth in the private and the state sectors. The advantage of the method of path analysis is that it enables the empirical analysis of direct, indirect and total effects of factors included in the model. This empirical set-up allows me to qualify previous empirical findings in several respects, and to also analyze empirically new hypotheses that have not been tested before. In line with my predecessors, I find sizeable total effects of initial conditions on economic developments in the state and private sectors. However, the effects of initial conditions on growth in the private sector appear to be more of an indirect nature, as they are mediated by reforms and by the process of institution building. On the non-linear effect of reforms, I also find that reforms have positive total effects on activities in the private sector and negative total effects on the state sector. In terms of direct effects, I obtain that reforming the state-owned enterprises and the financial system had a significant influence on the observed activities in the private sector. In this respect I estimate that the largest direct effect is associated with changes in the regulatory and economic conditions in the financial sector. However, price liberalization appears to have only an indirect effect (although sizeable) on the performance of the private sector, mainly due its influence on the other types of reforms. As regards developments in the state sector, I find direct significant negative effects on the growth in the sector for all the economic reforms considered in the analysis. In this respect the largest direct effect is associated with cumulative past changes in reforms in the financial system. The endogenous nature of the reform process is mediated in the model by the role of institutions built during transition. The sample data that I employ support the hypothesis of endogenous institutions. I find significant direct effects from the expansion in the private sector to contemporaneous changes in the political environment. Furthermore, weak economic growth in both sectors (private and state) relate to increases in (international observers') perceptions on pervasive corruption in transition countries. Changes in the institutional environment are further propagated in the system via their feedback effects on the reform process.

In the aftermath of the empirical endeavor in Study 2 I got to understand better that there is more to the process of economic transition than an analysis at the aggregate level of initial conditions, reforms and institutions can reveal. I then focused on the empirical evidence that we have at the firm level in the transition literature, as provided by survey studies. My specific interest related to the role of institutions in enhancing the economic success of transition, and to adverse developments in terms of flourishing shadow activities and pervasive corruption in some of the post-communist countries. In doing so I realized that, in terms of our understanding of the effects of institutions and corruption on economic activities, we would benefit greatly if we combined related empirical results with adequate theoretical models. I therefore engaged in the adventure of building a theoretical model that formalizes the links among institutions, unofficial activities and bureaucratic corruption.

In **Study 3** I emphasize that there are two main hypotheses that can support the empirical observation that the volume of the shadow activities is positively correlated with the levels of corruption in transition economies. The first hypothesis presumes that excessive government regulations and the associated bureaucratic corruption complement taxation as factors that push private firms away from the official sector and into the unofficial economy. This hypothesis is formalized in the theoretical model of Friedman, Johnson et al.(2000). The second hypothesis stands on the belief that, as a result of their illegal activities, private firms that engage in unofficial activities need to also engage in corrupting public officials. This is the cornerstone of the theoretical analysis in Study 3. In a partial equilibrium framework, I find that the effect of taxation on the extent of firms' participation in the unofficial sector is best interpreted if considered in connection with two other aspects: the benefits that firms extract from their legal activities, and the factors that facilitate activities in the shadow sector. In a business environment characterized by a well—functioning financial system, and with high quality of public goods such as contract enforcement and protection of property, firms may be willing to tolerate higher levels of taxes without necessarily migrate to the underground sector. Firms' incentives to be present in the official sector also relate to low incentives that the bureaucrats may have to engage in corrupt deals with non-compliant firms. However, in economic environments with weak institutions and/or with poorly motivated bureaucrats even low levels of taxes may prove high enough to strengthen the temptation to undertake shadow activities. I find that when circumstances are such that activities in the underground are profitable, a government that experiences vanishing tax revenues should concentrate on enticing the non-compliant firms to be active in the official sector, rather than attempt to squeeze more taxes from the existing official activities. Policy implications related to incentives that the bureaucrats may have to engage in corrupt deals with non-compliant firms are also analyzed.

Finally, the reader should be aware of the fact that I now regard the analysis in Study 3 more as a starting point rather than a destination in itself.

Contents

STUDY 1

Dimensions of Transition in the Post-Communist Countries: A Latent Variable Approach

Abstract

While there is a wealth of indicators that reflect specific features of the reform strategies and of the process of institution building implemented in the post – communist countries during the transition period, empirical handling of a large set of such measures proves challenging. The objective in this study is to introduce and employ the method of Confirmatory Factor Analysis (CFA) in order to estimate latent factors that summarize and reflect the complementary nature of specific dimensions of transition. Such specific dimensions are considered in terms of initial conditions, economic reforms and institutions. The empirical analysis in the study focuses on 25 transition economies in Eastern Europe and Eurasia, and on the transition period until year 2001. The CFA method that I employ has the advantage that it supports the empirical testing of the hypothesis that a given set of observed indicators combine into a more abstract theoretical construct in a consistent manner. The current analysis produces two main categories of results. First, there are successful cases when the CFA method applied on specific observed measures produces reliable summarizing indicators in the form of latent factors. This is the case of the latent factors constructed for time-invariant initial conditions, liberalization of relative prices, reforms with state-owned enterprises, reforms in the financial system, and the summarizing indicator of political environment. Second, there are also cases when the analysis indicates that aggregation of a given set of observed measures is not warranted by the structure of the sample data. This situation is encountered when an attempt is made to estimate a latent factor of initial structural economic imbalances. Empirical difficulties that can occur in the estimation of latent factors are also illustrated. In instances with acute problems with missing data, the possibility to construct empirical measures of more abstract concepts is impaired. This is despite the fact that the associated CFA measurement model indicates a potentially high validity of the measures employed. I encounter this situation when I analyze the possibility to construct latent factors of state governance (laws and regulations, and political interference in business activities).

Keywords: transition, latent variable, confirmatory factor analysis, structural equation modeling, initial conditions, reforms, institutions, democracy, Eastern Europe, Eurasia

Dimensions of transition in the post-communist countries: a latent variable approach

INTRODUCTION

Economic policy debates on the transition process in the post-communist countries in Eastern Europe and Eurasia are usually conducted in terms of general concepts such as economic liberalization, structural and regulatory reforms of the productive and the financial sectors, state governance and political institutions. Agendas of empirical research parallel such debates by attempting to disentangle the relative roles of initial conditions, reforms and institutions in spurring economic growth in transition economies. The relative success of the research efforts is often driven by the methodology they employ in order to summarize the multitude of existing measures of specific aspects of the process of economic reforms and institution building into more aggregate indicators, such that they accurately reflect the concerted policy efforts invested in economic and institutional change during the transition process.

While there is a wealth of measures that reflect specific features of the reform strategies and institution building during transition, empirical handling of a large set of such measures proves challenging. Studies that attempt to employ them as separate independent variables in a multivariate regression analysis framework invariably mention that the estimated results are affected by problems of empirical multicollinearity.

In order to circumvent the empirical problems induced by the use of a large set of explanatory variables we need to find ways to summarize the information included in separate indicators into more aggregate indicators, while still preserving their informational content. The objective in this study is to introduce the method of Confirmatory Factor Analysis (CFA) that can be efficiently used for constructing empirical measures of more abstract theoretical concepts. I employ the CFA method in order to estimate aggregate constructs that summarize and reflect the complementarity of various measures of initial conditions at the start of transition, and of the process of economic reforms and institution building in the post-communist countries. The empirical analysis in the study focuses on 25 transition economies in Eastern Europe and Eurasia, and on the period starting with the first year of transition in each country and until year 2001.

The method of Confirmatory Factor Analysis is covariance based and it is currently employed in the fields of psychology, sociology, political science, and to a very limited extent in economics, for the analysis of latent variables. A latent variable can be conceived as a multidimensional theoretical construct for which only partial reflections can be measured. The method of Confirmatory Factor Analysis can help test statistically whether a given set of observed indicators consistently combine into a more abstract theoretical concept. Based on CFA models we can therefore learn whether the aggregation of the observed measures in a summarizing indicator is warranted by the structure of the sample data.

The existing literature on transition economies already includes empirical efforts that focused on the possibilities to summarize information comprised in a given (usually large) set of variables into more aggregate indicators. A representative example is the study of De Melo, Denizer et al(2001) that pioneered the introduction of aggregate indicators of initial condition in the literature on transition. The authors employ the method of principal component analysis in order to extract principal components that summarize information comprised in the given observed measures of initial condition. In the factor analysis literature I find that there is wide acceptance of the fact that, while at the conceptual level the principal components are assimilated to latent variables, the design of the method proves deficient for the construction of latent variables. The shortcomings of the principal components method are discussed in the present study when theoretical fundamentals of Confirmatory Factor Analysis are introduced.

An alternative approach currently employed in order to obtain summarizing indicators consists in the use of subjective weights assigned to the component measures that are to be summarized. In this study I argue that this approach suffers from lack of transparency and limited scope for empirical replication.

Furthermore, a common point that applies to both approaches mentioned above is that they do not allow for statistical testing of the hypothesis that the given set of observed dimensions actually combine in a common summarizing factor in a consistent manner. If the hypothesis is not supported by the data, then their aggregation carries the risk of distorting their informational potential.

The analysis in this study produces two categories of results. First, there are successful cases when Confirmatory Factor Analysis applied on observed measures of fixed initial conditions, and various aspects of implemented reforms and the political environment in transition economies produces reliable summarizing indicators in the form of latent factors. Second, there also cases when confirmatory factor analysis indicates that aggregation of a given set of observed variables is not warranted. This situation is encountered when an attempt is made to estimate initial structural economic imbalances at the beginning of transition. Empirical difficulties in estimating latent factors are also illustrated for cases when acute problems with missing data limit the possibility to construct an empirical measure for a latent factor, despite the fact that the associated CFA model indicates a potentially high validity of measures employed.

The current study is divided in two main parts. Part I is dedicated to the theoretical and empirical aspects related to the method of Confirmatory Factor Analysis. In Section I.1 I discuss various existing definitions for the concept of latent variables. Section I.2 provides the theoretical intuition behind the method of CFA. Empirical problems expected to occur in practical applications of the CFA method are also discussed in the section. Part II of the study concentrates on some possible applications of the CFA method in the case of transition economies. After including brief initial comments on data preparation in Section II.1, I organize the subsequent sections according to the groups of latent factors constructed in the analysis. Section II.2 focuses on latent factors of initial conditions that characterized transition economies in aftermath of the demise of the communist regime; Section II.3 includes models of latent factors of reforms, with an emphasis on three main types of reforms: liberalization of relative prices, reforms in the enterprise sector and reforms in the financial sector. Section II.4 includes that analysis of latent factors of institutions in transition, in the form of latent factors of state governance, corruption and political environment. Section II.5 summarizes the results and concludes.

PART I: Latent Variable Methodology: Concepts, Methods and Empirical Issues

I.1 Definitions of latent variables and modeling approaches

Ever since the dawns of philosophy the human mind has strived to define ideal concepts for which only partial reflections exist in reality. We often exercise our imagination to identify dimensions of conceptual constructs such as happiness and freedom around which we center our existence. In the less philosophical realm of economics, concepts of development and economic freedom are often employed in order to characterize and compare alternative modes of economic organization. Whether we are aware of it or not, we operate with latent concepts both in theory and in empirical analyses whenever we attempt to describe and generalize relationships among classes of events with a higher degree of abstraction. This is not always apparent due to the lack of consensus on what a latent variable actually is. Bollen(2002) summarizes the various attempts to define latent variables into two broad categories: non-formal definitions and formal definitions.

The non-formal definitions of latent variables range from considering latent variables as hypothetical constructs (purely imaginative constructs with little correspondence into reality) to more concrete views that consider latent variables as simply variables that are unobservable or non-measurable, or as devices employed for data reduction.

The definition that addresses the possibility of measuring a latent variable is basically the definition we operate with in empirical economics most of the time. Given a theoretical concept with a broad definition domain, say economic freedom, we try to identify its possible dimensions that can be measured in reality and then approximate the latent construct by aggregating the information across the identified dimensions. The simplest method of aggregation, which often has little theoretical justification, is a simple average of the observed scores for the dimensions of the concept. More elaborated approaches use different subjective weights for the components, but even in that situation there is little transparency and limited possibility of replication of the method employed to identify the weights.

For the theoretical constructs with a more limited definition domain, the measurement definition of a latent variable translates into a formal one stating that even though the concept potentially has a direct representation in reality, we are not able to observe it accurately. This is the ‘expected value’ definition of a latent variables employed in the classical test theory. The latent concept is referred to as a ‘true score’ that would be obtained if we were able to perform an infinite number of replicated experiments and obtain the mean of the observed results. The formal representation of this definition of a latent concept is the following:

$$x_i = X_i^* + \varepsilon_i$$

where:

$x_i =$ the observed indicator of the latent factor

$X_i^* =$ the ‘true score’, which is not observable

$\varepsilon_i =$ measurement error

The true score latent variable model relies on the following assumptions: the scale of the latent factor is defined by the expected value of the observed indicator; the measurement errors are not correlated with the latent factor; and the true score has a proportionally direct effect on the observed measure, but the observed measure does not have any (direct or indirect) effect on the true score.

In a classical regression analysis, we assume that the observed measures are accurate representations of the theoretical concepts, with no measurement errors. This is a widely recognized problem in that, if not true, it adversely affects the estimated results[1].

An alternative formal definition of complex latent variables is introduced in Bentler(1982) in the context of linear systems. As cited in Bollen(2002), ‘a variable in a linear structural equation system is a latent variable if the equations [in the system] cannot be manipulated so as to express the variable as a function of manifest variables only’. Called as ‘a non-deterministic function of observed variables definition’, this definition envisions a multi-dimensional latent construct as a linear combination of some observed measures, while assuming we have limited possibilities to fully measure

[1] See Greene(1997) and Bollen(1989) for extensive discussions on the consequences of ignoring the measurement errors in regression analysis.

all the relevant dimensions. The definition is less restrictive in that it allows for correlated measurement errors and the observed indicators are allowed to directly or indirectly influence each other. Models formulated accordingly allow us to estimate a predicted value for the latent variables, while asserting that an exact prediction is next to impossible to obtain.

A more practical, non-formal, definition of latent variables considers them as data reduction devices. Given the restrictions in terms of degrees of freedom and multicollinearity often imposed by econometric analysis, a latent factor is used as means to summarize a large number of variables in fewer factors. This definition focuses less on the theoretical content of the latent constructs, while addressing their descriptive function. The disadvantage of data reduction methods is that they carry the risk of losing much of the informational content in the original observed variables employed, if those variables have considerably different definitions. The net result is often a latent factor with such a broad definition that it has little substance left and it is difficult to interpret.

In practice, the use of latent concepts usually combines two or more of these alternative definitions. Depending on the degree to which one relies comparatively more on a particular definition, three main advantages of explicit modeling of latent variables can be identified:

- At the conceptual level, the construction of more abstract latent variables allows for the generalization of conclusions related to certain events or processes that are derived from empirical analyses
- With latent factors, we explicitly address the assumption of measurement errors (both systematic and random) in the observed variables employed in empirical studies.
- When used appropriately, latent variables provide means to efficiently summarize observed/collected information, provided that the observed indicators relate to a common theoretical concept in a coherent manner. This has the empirical advantage of reducing the number of variables in econometric analyses, with the associated gains in terms of degree of freedom and reduced collinearity among independent variables

A currently used methodology, specifically dedicated to the analysis of latent variables, is known as Structural Equation Modeling (SEM)[2], and it originates in the method of factor analysis first introduced by Spearman(1904)[3]. Factor analysis was originally conceived to help identifying the main dimensions of an abstract conceptual construct, such as human intelligence. Given a complex set of observed variables, statistical methods of factor analysis use the information comprised in the correlation matrix of the variables in order to group them according to a common underlying trend. A latent factor corresponds to each of the groups that are identified, and it is estimated as a linear combination of the variables assigned to it. In its early variants, factor analysis was based solely on data properties in that it looked at correlations between the observed variables in order to identify the number of latent factors and the dimensions of each resulting factor. Such methods of factor analysis, included in the category of Exploratory Factor Analysis (EFA), parallel the data reduction definition of latent variables only. While useful in a preliminary stage of an analysis, the disadvantage of the EFA methods is that they use little theoretical (if any) criteria in clustering observed variables and assigning them to factors, as they do not offer the possibility of statistical testing of hypothesis related to the construction of factors. The consequence is that there is an infinite number of solutions that can be obtained by rotating factors and there is little guidance in how to select the 'appropriate' solution.

The method of latent variables embedded in Structural Equation Modeling, designated as Confirmatory Factor Analysis, meets most of the definitions on latent variables introduced earlier: it is theory – based when defining the content of a latent variable, it controls for measurement errors (systematic or not) in observed indicators and it also achieves data reduction in a consistent manner with relatively lower risk of informational losses. This methodology is currently used in fields of psychology, sociology and political science, although there have been attempts to introduce it in economics also as early as 1970s (Goldberger(1972), and Goldberger and Duncan(1973))[4]. A variant of SEM models, in the form of MIMIC[5] models, is currently

[2] Alternative names are 'covariance structure models' or 'latent variable path analysis'.
[3] See Kline (1994) for an introduction to the methodology of factor analysis.
[4] For a historical background of SEM see Bollen(1989) and references therein.
[5] Models with observed variables that are Multiple Indicators and Multiple Causes of a single latent variable.

used in the field of empirical economics for obtaining estimates of the underground economy[6].

When using latent variables[7], a SEM analysis includes two main stages[8]: (1) the conceptual definition and empirical construction of latent variables (the construction of measurement models for latent variables), and (2) the specification of a model that includes structural links among the latent factors identified at stage (1).

In this study I concentrate on the first stage of a SEM analysis only: the construction of measurement models for latent variables. As mentioned, this type of analysis is often referred to as Confirmatory Factor Analysis in order to reflect the fact that it helps confirming prior hypothesis on the definition of a latent factor, rather than achieving an ad-hoc mixture of observed variables. The following section introduces the basic intuition and the main theoretical fundaments on which CFA models are based.

I.2 Theoretical fundamentals of CFA Measurement Models[9] and empirical issues

When working with the concept of latent variables a first question that can be asked is the following: what are the main observed dimensions that can be attributed to a latent (unobserved or abstract) concept. In early 1900s Spearman focused on the possible dimensions of human intelligence. He considered the positive correlations of human abilities such as achievement in school, social class, ability to concentrate and the quality of education, and designed the method of factor analysis in order to identify the dimensions that would combine best in explaining the positive correlations observed between the specific dimensions of human abilities. This would later have important implications for the field of human psychology.

The most common view of observed dimensions of a latent variable is as reflections of the latent concept. What we observe in reality however is often an imperfect

[6] See Schneider and Enste(2000) for a review of the empirical literature on the shadow economies.
[7] SEM methods also include path analysis of observed variables only, which is very similar to the technique of simultaneous equation systems. For a description of the method of path analysis see the next study in this thesis.
[8] For introductory texts on SEM methods see Bollen(1989), Maruyama (1998), Kline (1998) and also Steiger(2001) on critical comments on the existing introductory SEM literature. Advanced topics in the area are to be found in Marcoulides and Schumacker(1996).
[9] The material in this section relies on Bollen(1989) and Kline(1994).

reflection of the abstract concept we operate with theoretically. Depending on how broad is the definition of a latent concept there are several reasons why its observed dimensions we operate with do not perfectly combine to characterize the concept. A first reason is that we cannot observe all the relevant dimensions of the concept, and therefore obtain only a partial characterization of it. A second reason may be that the observed indicators that we employ may not be homogenous enough in their informational content, such that they can also be assigned to another factor. A third reason can be that, if the observed dimensions are produced by the same method, the set-up of the method induces an inherent bias in the obtained results that contributes to a higher correlation among measures that would otherwise be the case. And yet another reason may be that we are not able to observe the dimensions of a factor without (random) measurement errors. The difference between the measurement errors and the method bias is that, while the former are random, the method bias is of a systematic nature.

Theoretically, we can decompose the information comprised in an observed indicator into three distinct components: a systematic part related to the underlying theoretical concept (*true score common variance*), a systematic component that is not related to theoretical concept at hand, but to other factors and/or method bias (*true score unique variance*), and a third part that represents purely random measurement errors (*error variance*).

Existing methods of building latent variables differ in their potential to distinguish and capture the three components in observed measures. A main distinction is to be made between the method of principal component analysis and the methods of factor analysis.

Principal component analysis is designed to group a complex set of observed variables into factors based on the correlations among the variables. There are as many principal components that can be extracted as the number of variables in the set, although researchers often limit their search to a more reduced number of factors. Principal components are successively generated by the method according to the degree to which they capture the variance in the correlation matrix of observed variable. The first principal component explains this variance to the highest extent, the second principal component is the second highest in terms of the variance explained and so on.

The main disadvantages of the method are the following: the objective of the method is to explain as much variance as possible in the observed correlation matrix, with no regard for the error structure in the observed measures; the design of the method is such that the principal components generated are orthogonal, and therefore no correlation between components is allowed.

Principal component analysis has a ‘data mining’ nature in that it extracts the variance in a correlation matrix of observed variables with no regard for the fact that such correlations may actually be due to method biases, or partial correlations attributable to other factors that are not identified by the method. It is therefore solely data driven and it often poses problems in the interpretation of the resulting principal components as we don’t really have a direct control on the structure of variance in the observed measures.

The methods of factor analysis are designed to overcome the disadvantages of principal component analysis. We can distinguish between the methods of Exploratory Factor Analysis (EFA) and the Confirmatory Factor Analysis (CFA). Exploratory Factor Analysis is similar in nature to the principal components method, in that it first establishes the number of factors that can be constructed based on a given set of observed variables, but it has the advantage that it does not aim at explaining all the variance in the correlation matrix. Exploratory factor analysis offers the possibility to account for the fact that part of the correlations among observed measures may be due to other factors, not identified by the method. Confirmatory Factor Analysis takes a different view. Having collected a set of observed indicators, the question we ask is whether they combine into a *single factor* in a coherent manner. We therefore test the hypothesis that the set of observed dimensions can be assigned, and therefore combined, into a latent (aggregate) construct. Measurement models of Confirmatory Factor Analysis can be constructed to include several latent factors, but that does not change the nature of the question. What we test for is whether a given set of observed dimensions can be assigned to a unique latent factor. There are two main differences between Exploratory Factor Analysis and Confirmatory Factor Analysis. With EFA we first explore how many factors we can extract based on a given set of observed variables. This means that we do not know the number of latent factors to operate with in advance, and we therefore do not operate with a specific model that can be tested.

Furthermore, in an exploratory empirical exercise, all the observed measures relate to all factors and the measurement errors in observed indicators are not allowed to correlate. In an analogy with CFA models, under-identification of parameters in EFA is usually the rule.

In confirmatory factor analysis we first design a model that specifies the structural relationships between the observed dimensions and the latent factors. The latent factors are conceptually established by the researcher prior to the empirical analysis. The objective of confirmatory factor analysis is to extract the true score common variance in the measures assigned to a latent factor. Given that the 'residual' information left in the observed measures, after extracting the true score common components, needs not be purely random (to the extent it contains true score unique variance), the CFA model allow for possible correlations between the error terms. The model is then tested in order to evaluate the degree to which it is supported by the available data. This is the method of factor analysis I operate with in this study.

In order to grasp the intuition of confirmatory factor analysis better consider the following example. Assume we want to construct a latent factor that characterizes corruption in a country, and the available observed dimensions we have are the following: an index of legislative corruption (x_1), describing corruption in the lawmaking process; an index of executive corruption (x_2), indicating the extent of graft among the members of the executive, a measure of judicial corruption (x_3), capturing the extent of corruption in courts, and a measure of bureaucratic corruption (x_4). Confirmatory factor analysis can help us understand whether the four observed dimensions combine in a general factor of corruption in a coherent manner. If corruption in general is of a pervasive nature at all levels of the society, then it is possible to characterize a country as having high levels of corruption along all of the four dimensions and therefore aggregate them into one general measure of corruption. However, there may be a possibility that a country registers high levels of corruption along only two of the four dimensions (say x_1 and x_2), while another country will display high degrees of corruption along the other two dimensions of corruption (x_3 and x_4). In such a situation, the four dimensions of corruption would not combine in a systematic manner in a general factor of corruption across countries, and therefore we would need to be more specific in terms of the type of corruption we analyze when referring to a particular country.

For simplicity, assume that the four measures of corruption are constructed by different methods (sources) such that the possibility of method bias in the observed measures is reduced.

The measurement model for our example of the latent factor of corruption writes as following:

$$(1) \qquad \begin{cases} x_1 = \lambda_{11} \cdot \xi_1 + \delta_1 \\ x_2 = \lambda_{21} \cdot \xi_1 + \delta_2 \\ x_3 = \lambda_{31} \cdot \xi_1 + \delta_3 \\ x_4 = \lambda_{41} \cdot \xi_1 + \delta_4 \end{cases}$$

where:

$x_i =$ one of the observed measures of corruption ($i = 1,2,3,4$)

$\lambda_{i1} =$ factor loadings

$\xi_1 =$ the latent (unobserved) factor of corruption

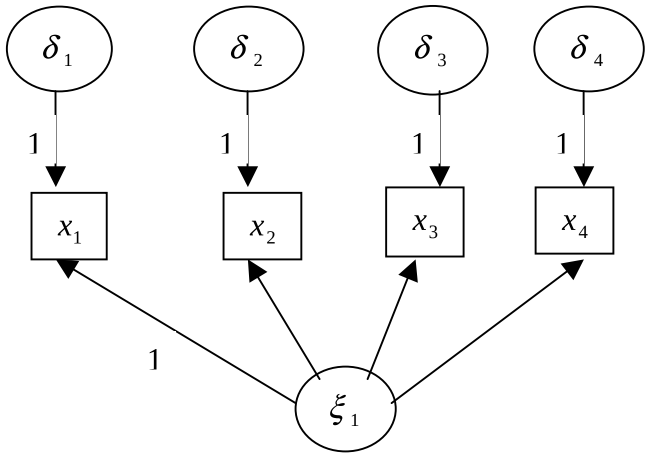
$\delta_i =$ error terms (measurement error)

Note that model (1) interprets the latent factor of corruption ξ_1 as 'causing' the observed dimensions of corruption. This is to say that if corruption is pervasive in a country then it will be reflected at all levels in the society. The presence of the error terms is meant to indicate that we believe we cannot observe the extent of corruption at the four levels without measurement error. The model in (1) can be represented in a diagram as illustrated in Figure 1.1.

The specification of the model in matrix form writes as following:

$$(2) \qquad \begin{bmatrix} x_1 \\ x_2 \\ x_3 \\ x_4 \end{bmatrix} = \begin{bmatrix} \lambda_{11} \\ \lambda_{21} \\ \lambda_{31} \\ \lambda_{41} \end{bmatrix} \cdot [\xi_1] + \begin{bmatrix} \delta_1 \\ \delta_2 \\ \delta_3 \\ \delta_4 \end{bmatrix}$$

Figure 1.1



The diagram of a measurement model illustrates the assumptions of the model. In the diagram above it is assumed that the factor is reflected in the observed measures with an error δ_i, and the parameter attached to the error term is constrained to the value of 1, which is the usual assumption made for identification purposes in any classical regression analysis. The model also imposes the constraints that covariances between the error terms are zero. As mentioned, this assumption can be relaxed if there are theoretical justifications for non-zero correlations between the error terms. A possible instance when the error terms may be correlated is the situation when we obtain the observed measures based on the same method, or from the same source. Another possible reason relates to the possibility that some of the observed measures relate to other common latent factor not considered in the model at hand. In our example of corruption it is more difficult to conceive such a situation, although not impossible.

A specific constraint necessary in any measurement model addresses the issue of choosing a scale for the latent factor. As factors represent theoretical constructs, it is seldom the case we have a clear definition for the measurement scale of the concept. For our example, we do not know in advance what type of a scale to choose a priori for the general factor of corruption. Moreover, the observed measures we employ for constructing the factor often come with different measurement scales. In order to make estimation possible, a factor scale needs to be assigned based on the scales of the employed measures. This amounts to constraining one of the factor loadings to a fixed value. The convention is that the fixed value is set to 1, although there is no particular reason why other fixed values cannot be used. As illustrated in Maruyama(1998), the empirical choice of the factor loading set to a fixed value for measurement scale purposes does not have any effect on the estimation results in terms of absolute magnitudes, model fit or statistical significance of parameter estimates[10].

Measurement models range from simple (i.e. including one factor only and the measures associated to it) to complex (when several factors are estimated together in a common model). The number of measures associated to a factor depends on both the definition of the theoretical concept underlying the factor and the availability of suitable measures. The general specification of a measurement model written in matrix form is the following[11]:

$$x = \Lambda_x \cdot \xi + \delta \qquad (3)$$

where:

$x =$ (qx1) vector of observed variables

$\xi =$ (px1) vector of latent (unobserved) factors

$\Lambda_x =$ (qxp) matrix of parameters associated to factors (factor loadings)

$\delta =$ (qx1) error term including the two components: true score unique variance and error variance.

The assumptions on the error term are similar to the ones in the multiple regression analysis. Disturbances in δ are assumed to be uncorrelated with the factors ξ, that is $E(\xi\delta) = 0$. It is also assumed that $E(\delta) = 0$. Correlations among the error terms across equations are allowed, provided they are theoretically justifiable. For estimation purposes (and more specifically hypothesis testing) normality is desirable, but there are possibilities to construct reliable test statistics that take into account the degree of non-normality in the data.

Elements in the parameter matrix Λ_x, denoted λ_{ij} and referred to as 'factor loadings', indicate the extent to which the factor is reflected by (that is, it 'loads into') each of the observed variables. If a measure is linked to only one factor in the model,

---

[10] A more careful consideration of the choice for the factor scale is required only when some of the observed measures are negatively correlated.

[11] The observed variables x are expressed in deviations from the mean. For a general specification with intercepts included see Bollen (1989).

then the factor loading is simply the correlation between the factor and the observed indicator. Each column in matrix Λ_x corresponds to one latent variable, and each row to one observed indicator.

The objective of the analysis is to best estimate parameters in the matrix Λ_x, together with all the other unknown parameters in the system, based on the information provided by the sample data, in such a manner that the solution obtained is admissible and it helps replicating the original sample information very closely. At it shall be described, once we estimated the factor loadings, then it is possible to construct the scores for the latent factor(s) ξ.

In the general model (3) above consider post-multiplying the matrix equation by the transpose of vector *x*, and then taking expectations:

$$(4) \qquad E\left(xx^T\right) = E\left[\left(\Lambda_x \cdot \xi + \delta\right)\left(\Lambda_x \cdot \xi + \delta\right)^T\right] = \Lambda_x \Phi \Lambda_x^T + \Theta_\delta$$

The term $E\left(xx^T\right)$ gives us the population variance-covariance matrix of the observed variables *x*. The matrix Φ is the variance – covariance matrix of the latent variables. The matrix Θ_δ is the variance-covariance matrix of the error terms.

For our example in (1), the three matrices have the following analytic form.

- The population variance-covariance matrix of the observed variables:

$$E\left(xx^T\right) = \begin{bmatrix} VAR(X_1) & & & \\ COV(X_2, X_1) & VAR(X_2) & & \\ COV(X_3, X_1) & COV(X_3, X_2) & VAR(X_3) & \\ COV(X_4, X_1) & COV(X_4; X_2) & COV(X_4, X_3) & VAR(X_4) \end{bmatrix}$$

- The variance – covariance matrix of the latent factors includes only one element as there is only one latent factor in the model:

$$\Phi = [\phi_{11}], \text{ with } \phi_{11} = VAR(\xi_1)$$

- The variance-covariance matrix of the error terms:

$$\begin{bmatrix} VAR(\delta_1) & & & \\ 0 & VAR(\delta_2) & & \\ 0 & 0 & VAR(\delta_3) & \\ 0 & 0 & 0 & VAR(\delta_4) \end{bmatrix}$$

Therefore, equation (4) indicates that the variance – covariance in the *x*'s can be decomposed into two terms:

- the first term is a function of the variance –covariance of the latent variables
- the second terms is the variance – covariance matrix of the error terms.

The information we have available includes the following two elements:

- the structure of the model (in terms of the assumptions we make in building the model)
- the sample variance-covariance matrix (*S*) of the observed variables.

The information we need to extract from the estimation of the model is included in the set of unknown parameters (denoted θ):

- the factor loadings: $\lambda_{21}, \lambda_{31}, \lambda_{41}$ (recall that λ_{11} is set to 1).
- the variance – covariance matrix of the error terms Θ_δ
- the variance of the latent factor: ϕ_{11}

The null hypothesis is that, given the specification of a true model, the population variance – covariance matrix of the x variables (denoted Σ) can be written in terms of the parameters in the model as following:

$$H_0 : \quad \Sigma = \Sigma(\theta)$$

The matrix $\Sigma(\theta)$ is called the *implied variance-covariance matrix* of the model, as it relates the population moments to the structure of the model.

Theoretically, for any particular model that we specify, the first step in the analysis is to formulate the implied covariance matrix of the model, $\Sigma(\theta)$, in terms of the unconstrained parameters. This is done by the construction of the system of equations (4).

The next step is then to equate the elements of the implied covariance matrix with the corresponding elements in the population covariance matrix of the observed variables and identify the free parameters in the model. This basically gives us a system of equations in the unknown parameters. Three situations are then possible[12]:

- *Under – identified models.* There is not enough information to uniquely determine each parameter, in which case some parameters can only be written as (non-)linear combinations of the remaining ones. In this situation indeterminate solution is obtain, in that an infinite number of alternatives is possible.
- *Just – identified models.* There is just enough information to uniquely determine each unknown in the system, in which case we obtain a unique solution. A necessary, but not sufficient, condition is that the number of (non-redundant) equations equals the number of the unknown parameters. Sufficiency varies for specific models. Once a just-identified model is obtained and estimation is rendered unfeasible.
- *Over – identified models.* There is more than just - enough information for determining the unknown parameters. This is the case when we have more equations than the free parameters in the system. In the estimation stage, the over-identified models offer the possibility of relaxing alternative constraints on the parameters and comparing various specifications of the model in terms of their ability to fit the observed data.

For our model of the latent factor of corruption above, the null hypothesis translates into the following matrix equation:

[12] For issues of model identification see Bollen(1989)

$$
\begin{bmatrix}
Var(X_1) & & & \\
COV(X_2, X_1) & VAR(X_2) & & \\
COV(X_3, X_1) & COV(X_3, X_2) & VAR(X_3) & \\
COV(X_4, X_1) & COV(X_4; X_2) & COV(X_4, X_3) & VAR(X_4)
\end{bmatrix} =
$$

(5)

$$
\begin{bmatrix}
\phi_{11} + VAR(\delta_1) & & & \\
\lambda_{21}\phi_{11} & \lambda_{21}^2\phi_{11} + VAR(\delta_2) & & \\
\lambda_{31}\phi_{11} & \lambda_{31}\lambda_{21}\phi_{11} & \lambda_{31}^2\phi_{11} + VAR(\delta_3) & \\
\lambda_{41}\phi_{11} & \lambda_{41}\lambda_{21}\phi_{11} & \lambda_{41}\lambda_{31}\phi_{11} & \lambda_{41}^2\phi_{11} + VAR(\delta_4)
\end{bmatrix}
$$

where the matrix in the hand-right side of the equation illustrates the analytic form of the implied covariance matrix of the model. For this model we have 8 parameters to estimate, and 10 equations available, which makes the model over-identified with 2 degrees of freedom.

Although it is desirable and recommended that we know whether the model is identified prior to estimation, the issue of model identification becomes a non-trivial problem in cases of complex models where an analytical proof is difficult, next to impossible, to obtain. In practice what happens is that we often cannot say that the model is identified and, instead of directly checking for the existence of an analytical solution for identification, we rely on empirical criteria employed to find some evidence that the model is identified[13]. The 'first test' of identifiability of a model is the possibility of inverting the information matrix and obtaining standard errors associated with parameter estimates. Occasionally, computer programs erroneously produce solutions with standard errors even for models that are under-identified[14], which is why it is necessary to further check for identification. An empirical procedure that can be used to check for model identification includes the following two steps:

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[13] Sometimes one could obtain the result of an unidentified model even though the model is analytically identified. This problem is called 'empirical under-identification' and it is generated by improper solutions. See the discussion on improper solutions later in the section.

[14] See Bollen(1989) for reasons why this could occur in practice. However, what we learn from the manuals accompanying SEM-dedicated computer programs, such AMOS4 and EQS6, is that they are rather accurate in the identification of models. See Arbuckle and Wothke(1999) and Bentler(1995).

- STEP 1: estimate the model based on the sample covariance matrix of the observed variables (S) and obtain the estimated implied covariance matrix ($\hat{\Sigma}$);
- STEP 2: re-estimate the model using the estimated implied covariance matrix (also called the *predicted variance covariance matrix* of observed variables) as input data and check the new parameter estimates. If the parameter estimates obtained in the two estimations are almost identical, then that is strong evidence that the model is at least locally identified[15].

Estimation of the model consists in finding admissible parameter estimates based on the sample data. As in any other econometric analysis, we do not have the covariance matrix of the entire population, such that the best we can is to approximate it with the covariance matrix for the sample (*S*) that we observe. The extent to which S differs from Σ depends on the quality of the sample data employed.

If the model is saturated then there is a unique solution to the matrix equation in the null hypothesis, meaning we obtain a unique possible set of parameter estimates. This has the disadvantage there is little scope to compare the current model with alternative models, and there is little possibility to judge its quality. For an over-identified model, there is theoretically an infinity of possible solutions available and a corresponding infinity of sample predicted covariance matrices. The estimation procedure compares the predicted covariance matrices with the sample covariance matrix, and chooses the solution that produces the estimated implied covariance matrix closest to the sample data.

The most common procedures employed for the estimation of such models are maximum likelihood (ML) estimation, general least square (GLS) estimation and un-weighted least square (ULS) estimation. In what follows I focus on the ML estimation procedure, as it is the method that is most widely used and it also proves applicable for the analysis included in Part II of this study.

With MLE, the fitting function (also called the discrepancy function) that is *minimized* has the following form:

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[15] The distinction between local and global identification of a model is discussed in Bollen(1989).

(6) $$F_{ML} = \log|\Sigma(\theta)| + tr\left(S\Sigma^{-1}(\theta)\right) - \log|S| - (p+q)$$

where:

p = number of factors

q = number of observed variables

It is assumed that both $\Sigma(\theta)$ and S are positive definite, and more specifically nonsingular. It is easy to see that if the sample predicted covariance matrix $\hat{\Sigma}$ (which substitutes Σ in calculations) is identical to the sample covariance matrix, *S*, then F_{ML} becomes zero and the model has a perfect fit. The larger the difference between the two covariance matrices, the larger the value for the discrepancy function and the worse the fit of the model.

The estimation process in practice challenges the theoretical setup whenever specific empirical difficulties occur. One of the main problems that I have with the analysis in this study consists of moderate and sometimes large amounts of missing data points. This requires complementing the estimation procedure with approaches that handle the missing data problem. The main techniques used in analyses with missing data can be grouped into three categories[16]: data deletion (listwise deletion, pairwise deletion), data imputation (mean imputation, or similar pattern imputation) and ML-based methods[17] (expectation maximization (EM) algorithm, the multiple group-approach, and full information maximum likelihood (FIML)[18]).

The approach of *listwise deletion* excludes all observations with missing values on any of the variables in the model. *Pairwise deletion* entails calculating sample covariances between each two variables based on pairwise complete data, excluding cases with missing values on one or both variables. Monte Carlo simulation studies (Brown(1994), Marsh(1998)) that analyze the performance of the two data deletion approaches conclude that deleting data results in biased and/or inefficient estimates as well as increased potential for obtaining indefinite sample covariance matrices.

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[16] See Schafer(1997) and Duncan, Duncan et al(1998)

[17] See Enders(2001).

[18] Note that the maximum likelihood method applied on complete data sets in SEM already corresponds to full-information likelihood in regression analysis of systems of equations. In SEM, the term FIML is used to refer to the full information maximum likelihood estimation procedure designed for analyses with missing data.

Data imputation (whether mean imputation, or regression-based imputation) also proves to have its shortcomings, as discussed in (Bollen(1989)), and a lower performance when compared to the ML-based procedures (Enders and Bandalos(2001)).

The intuition behind the ML – algorithms is that the observed data contain information that can be efficiently used to infer probable values for the missing data.

The EM method combines data imputation with ML estimation. The algorithm involves a two step procedure: missing data are first replaced by the predicted scores obtained from a series of regressions of variables with missing data on the remaining variables in the set. The second step implies applying the ML estimation on the complete data set obtained in the first step.

The multiple –group approach of missing data and FIML are more direct in that they do not require a preliminary imputation of data. The multiple – group method divides the sample data into groups, according to similar missing data patterns (that is, observations in a group have the same set of variables missing and present) and then calculates a likelihood function for each group. The group likelihood functions are then aggregated across the entire sample and maximized. The shortcoming of the method is that although it uses the information in the sample to a larger extent than the methods based on data deletion, it is still not most efficient as information in one group contributes to the parameters that involve present data points in that group, but it does not contribute to parameters that involve missing data in the group.

Most efficient use of information in studies with missing data is achieved with the SEM variant of full information maximum likelihood (FIML) procedure. Monte Carlo simulation studies, such as Enders and Bandalos(2001), suggest that FIML proves a superior performance, compared to the other approaches for missing data, even in cases with a large amount of missing data.

Given the, sometimes severe, problems I have with missing data points in the current analysis, I employ FIML as the estimation procedure in the analysis in Part II of this study[19]. The objective of the FIML approach is to fully use all the information included in the sample for parameter estimation. The algorithm entails calculating a likelihood function for each case in the sample in the form:

[19] The same estimation method is also employed in the second study in the thesis.

$$(7) \qquad \log L_i = K_i - \tfrac{1}{2}\log|\Sigma_i| - \tfrac{1}{2}(x_i - \mu_i)^T \Sigma_i^{-1}(x_i - \mu_i)$$

where:

$K_i =$ constant that depends on the number of existing data points across the observed variables for case i;

$x_i =$ the vector of observed data for case i across variables;

$\mu_i =$ the vector of parameter estimates of the means corresponding to variables with complete data for case i;

$\Sigma_i =$ the covariance matrix corresponding to the variables with no missing points for case i;

The case-wise likelihood functions are then aggregated across the entire sample:

$$(8) \qquad \log L(\Sigma, \mu) = \sum_{i=1}^{N} \log L_i$$

The 'aggregated' likelihood for all cases is maximized by minimizing the function:

$$(9) \qquad F_{FIML} = \sum_{i=1}^{N} \log|\Sigma_i| + \sum_{i=1}^{N} (x_i - \mu_i)^T \Sigma_i^{-1}(x_i - \mu_i)$$

If data is missing completely at random, then the partially observed cases considered in the analysis tend to increase the efficiency of the ML estimates relative to the other methods that either discard this information completely, or do not use it fully. If data incompleteness is not totally random, but it can be ignored[20], then the partially observed cases provide information on the underlying marginal distribution of the incomplete variables and contribute to a lower bias than would result from complete deletion of the observation with missing data.

[20] That is the probability that data is missing for variable X may depend on another observed variable in the set, but not on the values of X itself. See more on mechanisms that generate missing data in Schafer(1997).

After the estimation of the unconstrained model parameters is completed, there are two main levels at which the quality of results is evaluated:

- the quality of parameter estimates
- the overall fit of the model

Parameter Estimates

The parameter estimates that we obtain by estimating a measurement model include factor loadings, variances and covariances and the associated standard errors. Factor loadings indicate the changes induced in the observed indicators by changes in the latent factors. For the model we have as an example above, the estimated loading λ_{21}, for example, provides the expected change in x_2 for a one-unit change in ξ_1. Therefore, factor loadings have a similar interpretation as the estimates obtained in multivariate regressions; the only main difference is that the independent variables are unobserved.

The disadvantage in interpreting the estimated factor loadings comes from the fact that the scale of the latent factor relies on one of the measures. For a specific factor, the loadings to the measures are interpretable relative to the measurement scale of the indicator for which the loading had been constrained to 1 (or a fixed value). As observed indicators are measured in different units, this makes it difficult to interpret the magnitude of the factor loadings. One possibility to deal with this problem is to calculate standardized factor loadings in a similar way we calculate standardized regression coefficients:

$$(10) \qquad \lambda_{ij}^{s} = \lambda_{ij}\left(\frac{\phi_{jj}}{VAR(x_i)}\right)^{1/2}$$

The standardized coefficient λ_{ij}^{S} is calculated by multiplying the estimated factor loading λ_{ij} by the ratio of the standard deviations of the latent factor (ξ_j) and the standard deviation of the observed measure x_i. The standardized loading coefficient gives the 'expected' change in terms of standard deviation units induced in x_i by a change of one standard deviation in the latent factor. Given they operate with the same measurement units, the standardized coefficients provide a better picture on the relative contributions of factors to their associated measures. Empirically, standardized loadings of 0.70 or higher are considered high enough to suggest confidence in the quality of the model. Low loadings are to be found under the threshold of 0.50. The absolute magnitude of factor loadings is also interpreted as an empirical measure of the validity of the measure[21]. It is important to recognize, however, that these cutoff values are based on accumulated research experience only, and do not have a strict statistical justification.

Higher loadings in a model are not only desirable, but they also prove necessary. Ding, Velicer et al(1995) find that improper solutions occur more frequently during estimation when low factor loadings are estimated. Improper solutions in estimation are defined as situations when one or more of the following instances occur: negative variance estimates (known as Heywood cases), convergence failure for the algorithm, parameters that are outside reasonable limits, large standard errors for the parameter estimates etc. Rindskopf(1984) illustrates how a factor loading close to zero generates empirical under-identification of the model, in that some parameter estimates obtain very large standard errors and Heywood cases are likely to occur. Improper solutions are also generated by other potential problems such as violation of distributional assumptions, violation of assumptions on linearity and additivity underlying the equations in the model, large factor inter-correlations, model misspecification in terms of omitted variables or factors, omitted paths, correlated errors and many others[22].

Additional criteria to follow in evaluating the parameter estimates parallel the evaluation of results in regression analysis. Apart from statistical properties (also including statistical significance based on t-ratios), the magnitude and sign of the estimates are indicative of a good estimation. Initial correlations between the observed indicators and also the prior expectations on how the measures should reflect the concept help evaluating the quality of the estimates.

[21] Validity of an observed indicator is defined as the extent to which the indicator measures what it is supposed to.
[22] For possible remedies of improper results see Rindskopf(1984) and the references therein.

The next step in the evaluation of results focuses on the equations specified in the model. For each equation (corresponding to each observed indicator x_i), a coefficient $R^2_{x_i}$ of Squared Multiple Correlation (SMC) is calculated, very much in the same manner the R-square is determined for the regression analysis. In measurement models, the interpretation of SMC is straightforward in that it represents the amount of variance in the observed measure that is explained in the model. For simple models with one factor, SMC gives the variance in the measure explained by the latent factor. SMC ranges between 0 and 1, and the closer its value is to 1, the better the model explains the variance in the observed indicators. SMC is also interpreted as a measure of the validity of indicators in models with only one factor linked to an observed measure, and it is also used to evaluate the reliability of the measures[23] in more complex models with the same measures assigned to more than one factor (see Bollen(1989) for an extensive discussion).

Assume for a moment that we are satisfied with the quality of the parameter estimates obtained, and that the model fit indices indicate a good model. Then we can estimate the scores for the latent factor based on the information we obtain from the estimation procedure. The latent factor is derived as a weighted function of its observed dimensions. As mentioned in Bollen(1989), there are various methods available for the estimation of the latent factors, but the most popular method employed relies on the regression method of factor score estimation as following:

$$(11) \qquad \hat{\xi} = \hat{\Phi}\hat{\Lambda}_x^T\hat{\Sigma}^{-1}x$$

where $\hat{\xi}$ gives us the estimate(s) of the latent factor(s) ξ. The matrix $\hat{\Phi}\hat{\Lambda}_x^T\hat{\Sigma}^{-1}$ gives us the estimated weights used to linearly combine the observed measures into the latent factors. The matrix rows correspond to each latent factor in the model, and the columns correspond to the observed variables in the model.

[23] Reliability of measures refers to the consistency of the measurement process. Reliability is possible to evaluate in more complex models when alternative factors compete for the information captured in the observed measures.

Model Fit

The general performance at the model level[24] is evaluated based on overall fit indices. Overall fit indices are possible to calculate only in over-identified models. SEM literature includes a large number of fit indices that have been introduced through time. There is a pattern in that first some indices are introduced, and then revised versions that correct for various problems (degrees of freedom, violations of the normality assumption etc) are proposed. The presentation of fit indices in this section focuses on a subset of indices that are considered to be appropriate for evaluating the performance of the models in the next section, given the empirical problems I encounter. For more extensive discussions on fit indices see Bollen(1989), Hu and Bentler1995) and the various articles collected in Bollen and Long(1993).

One of the first fit indices proposed in the SEM literature is the χ^2 - test statistic, and its associated p-value. The value obtained for the index is traditionally reported in SEM analysis, although it doesn't prove robust to adverse empirical conditions. As specified earlier, the estimation procedure searches for those parameter estimates that generate minimum values for the elements in the residual variance – covariance matrix $\left(S-\hat{\Sigma}\right)$. This translates into finding a minimum for the discrepancy function F_{ML}. It is proved that, under certain regularity assumptions[25] and given that the model specification is correct, the constructed estimator $(N-1)F_{ML}$ has an asymptotic χ^2-distribution with $\frac{1}{2}(q+p)(q+p+1)-t$ degrees of freedom, where t is the number of unconstrained parameters in the model. Theoretically, the χ^2-test is used for testing the model $(H_0: \quad \Sigma=\Sigma(\theta))$ against the alternative that the covariance matrix of the observed variables is unconstrained. If the null hypothesis *cannot* be rejected (when the χ^2-value obtained for the model is very small and proves statistically insignificant (a large associated p-value)) then the results are interpreted as strong evidence that the model is valid. Rejection of H_0 suggests that at least one of the restrictions in the model is not valid, and then the implied covariance matrix differs significantly from the population covariance matrix. In practice, the χ^2 -indicator is regarded more as a

[24] As a result of the simultaneous estimation of the equations in the model.
[25] See Bollen(1989) for an extensive presentation of those assumptions.

measure of fit rather than a test statistic (Jöreskog(1993)). This is because, even under ideal conditions when all the assumptions of the test are satisfied, it is not realistic to assume that the model holds exactly in the population. A more realistic assumption would be that a good model resembles closely a hypothetical true model for the entire population. From this perspective, the lower the $\chi 2$-value obtained the better chances we have to operate with a good approximation of the true model. The implication of this view is that it is expected that the model would be rejected in very large samples, when the power of the test increases and it penalizes even a good approximation more severely. Note that the higher the sample size, the larger the value of the χ^2 – statistic, by definition. Another problem with this statistic is that it always decreases in less parsimonious models when more parameters are added to the model. In order to correct for this problem an alternative empirical measure is provided in the form of the ratio between the optimized χ^2 value and the number of degrees of freedom in the model (χ^2 / df). If all the assumptions underlying the χ^2 statistics are met, a corresponding χ^2 / df ratio between 2 and 3 is considered to be acceptable, and the smaller the ratio the better the fit.

Measures designed to be less dependent on the sample size are indices of goodness-of-fit GFI and AGFI. They measure how well an a priori model reproduces the data in the sample. These indices are analogous to R^2 in regression analysis[26] (they compare the goodness-of- fit to a component that is similar to the total sum of squares), but they report the total variance explained by the model, and not at the equation level. The index of goodness-of-fit (GFI), introduced by Jöreskog and Sörbom(1984), assesses how well the covariances predicted from the parameter estimates reproduce the sample covariances, and it is calculated according to the formula:

$$GFI_{ML} = 1 - \left[tr\left(\hat{\Sigma}^{-1} S - I\right)^2 / tr\left(\hat{\Sigma}^{-1} S\right)^2 \right]$$

[26] Note that with SEM analysis there are two categories of 'R^2' that are computed: the Squared Multiple Correlation (SMC) for each individual equation, and the goodness-of-fit indices for the overall model.

GFI basically gives a measure of the total amount of sample variance and covariance explained in the model. Based on the ratio of the sum of squared discrepancies to the observed variances, this index ranges between 0 and 1. Values exceeding the empirical threshold of 0.90 are considered to indicate a good fit of the data. A problem with this index is that it does not address the possibility that a high fit could be obtained whenever a large number of parameters relative to the degrees of freedom are estimated. With no degrees of freedom (in saturated models), this index indicates a perfect fit even though the structural processes specified in the model may be false. In order to correct for this problem, an alternative measure of goodness-of-fit has been proposed, the adjusted goodness – of – fit (AGFI) index that takes into account the parsimony of the model:

$$AGFI_{ML} = 1 - \left[t(t+1)/2df\right](1 - GFI_{ML})$$

The larger the number of parameters to estimate relative to the number of degrees of freedom, the lower the value of the index. $AGFI_{ML}$ ranges between 0 and 1 and, when $S = \hat{\Sigma}$, then GFI_{ML} equals $AGFI_{ML}$ at their maximum value of 1. A threshold value of 0.90 for $AGFI_{ML}$ indicates a good model fit. For both indices their theoretical values are positive, but in practice it is possible for them to also take negative values.

Alternative indices that indicate that, even with rejection based on χ^2 –test in large samples, the models can still hold approximately in the population are constructed based on the values of the sample residual covariances. These are the Root-Mean Square Residual (RMR), calculated as the square root of the mean of the squared discrepancies between the sample and implied covariances, and the Root Mean Squared Error of Approximation (RMSEA).

RMR gives the average residual value obtained in the residual covariance matrix. In order to identify the main sources of large residuals, its use can be coupled with a screening of individual residuals generated by the estimation of the model.. A positive residual means that the model under-predicts the covariance between the two variables. RMR ranges between 0 and 1, and the closer it is to 0 the better the approximation in the model. The index has the disadvantage of being sensitive to the measurement scale of the observed variables.

The index of RMSEA is currently being recognized as one of the most informative fit indices in covariance structure models (Browne and Cudeck(1993)). It takes into account the error of approximation in the population, and it is meant to measure how well the model, with unknown but optimally chosen parameters, would fit the population covariance matrix if it were available. This discrepancy is expressed per degrees of freedom, such that it makes the index less sensitive to the number of parameters estimated in the model. Values less that 0.05 indicate an excellent fit, and values between 0.05 and 0.08 suggest an good fit. For RMSEA a corresponding p-value is calculated, representing a test of the null hypothesis that RMSEA is less than or equal to the cutoff value of 0.05. The recommendation in the related literature is to base the evaluation of the model fit both on the magnitude of RMSEA and its associated p-value (MacCallum, Browne at al(1996)). In practice, a small RMSEA would be of little use if it comes with a wide confidence interval associated to it. A narrow confidence interval (and a consequently higher probability of close fit) generate more confidence that the RMSEA estimate obtained reflects the model fit with a good precision. Ideally, with an excellent fit, the p-value obtained should be higher than 0.50 (Byrne(2001)).

An alternative approach in evaluating the model fit is provided by incremental fit indices that measure the proportionate improvement in the overall fit obtained with a target model, when compared with a more restricted (nested) baseline model. The most typical baseline model employed for the comparison is the null model, in which all the observed variables are uncorrelated[27]. Incremental fit indices are further categorized according to the information they use and the distributional assumptions employed (Gerbing and Anderson(1993), Hu and Bentler(1995)). Such indices are usually based on the optimized statistic χ^2 estimated for the baseline and the target models.

An index that does not rely on a particular distribution of the χ^2- statistic in the two models, but it does assume the same fit function, is Bentler and Bonett's (1980) normed fit index (NFI):

$$NFI = \left(\chi_B^2 - \chi_T^2\right) / \chi_B^2$$

where:

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[27] Sobel and Bohrnstedt(1985) discuss alternative baseline models that can be considered.

χ^2_B = the optimized χ^2 statistic used in fitting the baseline model

χ^2_T = the optimized χ^2 statistic used in fitting the target (maintained) model

NFI represents the proportion of total covariance among observed variables explained by the target model relative to the corresponding covariance explained by the baseline (null) model. NFI ranges between 0 and 1. Given that the null model is most restricted possible (in that all correlations among observed variables are set to zero), the value of χ^2_B is at least as large as χ^2_T for optimized indexes, such that the larger the difference between the two, the closer NFI is to 1 and the better the fit of the target model.

A derived (type 2) fit index (TLI or NNFI) also uses the information on optimized χ^2 statistics, but it relies on assumptions of a central χ^2 distribution. TLI is designed to quantify the degree of fit improvement in the target model relative to the base model; it has been originally introduced by Tucker and Lewis(1973):

$$TLI = \left[\left(\chi^2_B / df_B\right) - \left(\chi^2_T / df_T\right)\right] / \left[\left(\chi^2_B / df_B\right) - 1\right]$$

The index TLI is not normed, meaning it is not confined to the range [0,1].

Non-central χ^2 distributions are addressed by incremental indices of type-3, of which I only introduce the index CFI (the comparative fit index)[28]:

$$CFI = 1 - \max\left[\left(\chi^2_T - df_T\right), 0\right] / \max\left[\left(\chi^2_T - df_T\right), \left(\chi^2_B - df_B\right), 0\right]$$

where the difference between the optimized χ^2 statistics and the corresponding degrees of freedom is employed to estimate the non-centrality parameter associated with the model. CFI ranges in [0,1], such that the closer it is to 1, the better the fit of the model. Values of at least 0.90, and preferably 0.95 or higher, are considered evidence of an acceptable model fit.

The incremental fit indexes of type-2 and type-3 are considered to perform better than indices in the category of NFI (with no distributional assumptions) when the

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[28] See Goffin (1993) for details.

assumed distributions are correct. Otherwise, their inappropriate use may affect the results to a large extent (Hu and Bentler (1995)).

Robustness Results

Although there are many alternative possibilities suggested for evaluation of the estimation results and the general performance of a model both in absolute and relative terms (i.e. comparisons with other models) under ideal conditions, simulation studies often find varying degrees of robustness of these indexes to empirical problems. I group the main empirical problems likely to affect the results as following[29]:

- violations of multivariate normality assumptions
- sample size
- factor loadings and improper solutions
- model specification (number of indicators per factor (the p/r ratio) and number of factors in the model)

i) Deviations from multivariate normality

The methods affected by departures from the assumptions of multivariate normality in the sample data are obviously the ones that rely on this assumption, namely MLE and GLS. Theoretically it is expected that, if multivariate normality is violated, the parameter estimates will remain unbiased and consistent (for large sample size), but they will no longer be efficient (West, Finch et al(1995)). Statistical tests of all parameters are expected to be biased, yielding too many significant results. However, robustness studies (Hoogland and Boomsma(1998))[30] suggest that the combined effect of smaller sample sizes and departures from multivariate normality do induce empirical biases in the parameter estimates also. For maximum likelihood estimation, the bias in the ML parameter estimates increases with univariate skewness and kurtosis, and the

[29] This presentation mainly focuses on the results delivered by maximum likelihood estimation. For Monte Carlo simulation results on the relative performance of estimation methods under adverse conditions of misspecification and non-normality in data see Olsson, Foss et al(2000). The references included in the text also present results produced for other estimation methods, such as GLS and ADF.

[30] The performance of fit indexes is evaluated only for correctly specified models.

problems become particularly acute in cases of excessive positive kurtosis in the data. The bias is usually negative, but it sometimes varies in sign. The standard error estimates produced by MLE under non-normality are usually incorrect. The degree of skewness in the data is found to have a relatively lower effect on the bias of standard errors, while increasing kurtosis in absolute value is positively correlated with increases in the bias. When variables have positive kurtosis, the standard errors are found to be underestimated, while with negative kurtosis the standard errors are overestimated, regardless the sample size. For example, for highly non-normal variables (skewness =3 and kurtosis=21) the standard errors of the parameter estimates were underestimated by about 25%.

For model fit indices there is a wide spectrum of results on their robustness to non-normality in the data. Theoretically, Hu, Bentler et al(1992) find that the normality-based methods such as MLE and GLS can still correctly describe and evaluate a model with non-normally distributed variables, if and only if certain regularity conditions on mutual independence of factors, or free estimation of their variance-covariance parameters in cases when factor are correlated are met. Those results are confirmed empirically only for large sample sizes (of at least 2500 observations). For smaller sample sizes, the ML method tends to reject the model too frequently. When the regularity assumptions are violated, the MLE is found completely unreliable, as it always rejects true models. The estimators for χ^2 produced by MLE tend to become very large as data are increasingly non-normal (West, Finch et al(1995)). Results obtained for a model with three factors and nine indicators, and a degree of non-normality with skewness=3, and kurtosis=21 for each variable, indicate that the mean of χ^2 in 200 simulations was overestimated by 50%, with a sample size of 1000 for each simulation. In this experiment, 48% of the true models were rejected, compared with the expected Type I error of 5%. The rejection rate and the mean statistic in MLE become worse when the underlying distribution has a large kurtosis. Alternative fit indexes such as NFI, TLI and CFI are found to be less sensitive to large degrees of non-normality. For MLE with a sample size of 100 and the same deviations from normality as above, CFI and TLI are found to be only modestly underestimated (by 3%) compared to their expected value of 1.

Remedies to non-normality suggested in the literature include increasing the sample size, appropriate transformation of variable to reduce the degree of univariate non-normality, use of test statistics corrected for non-normality and bootstrapping procedures applies to obtain the specific sampling distribution of the estimates.

With all its advantages, increasing sample size is relatively difficult in many situations due to scarcity of data. This is more so to the extent that larger deviations from normality require significant additional data. For example, Hoogland and Boomsma(1998) mention that for an average positive kurtosis of 5 for the observed variables, the sample size may have to increase up to 10 times the size of the model (that is the number of the unconstrained parameters in the model), which is less feasible for complex models.

Transformation of data such that the univariate normality of data is improved is also a possibility (West, Finch et al(1995)), although it does not come without problems. For the non-linear transformations of data, although they may induce improvements in terms of univariate normality of the series, they carry the risk of altering the relationships among the observed variables. To the extent that the objective of the analysis is to identify those relationship, data transformation could actually prove more harmful than beneficial.

More feasible alternative strategies to avoid the empirical consequences of employing highly non-normal data come with the construction of test statistics that prove robust to non-normality. For SEM analyses in particular, calculation of robust standard errors and test statistics introduced in Satorra and Bentler (1988) have become more of a norm than an exception in analyses that employ non-normally distributed data. The robust ML estimator of standard errors calculated when observed variables have excess kurtosis are found to be empirically superior when compared to the usual ML estimates (Satorra and Bentler(1994)). The corresponding SCALED ML χ^2 statistic is also to be preferred to the usual non-scaled test statistic, regardless of the independence condition between factors, although it proves less robust in small samples.

Bootstrapping consists of taking a large number of repeated samples of the same size from the original sample (with replacement after each case is drawn), and then calculating the parameter estimates for each sample. This results in an empirical sampling distribution (Diaconis and Effron(1983)). In situations when the assumption of theoretical distribution for the test statistics is severely violated, the empirical sampling distribution is thought of to be more accurate. Bootstrapping is recommended when deviations for the usual distributional assumptions are significant, but it proves less useful under multvariate normality when MLE is superior (Nevitt and Hancock(2001)). Another practical disadvantage of bootstrapping is that, based on the existing software packages, to my knowledge it is not currently feasible for analyses with missing data.

ii) Sample size effects

For sample size effects, the results of simulation studies are more numerous. As an empirical rule, a consensus seems to exist that a sample of 200 cases is at the limit between what can be considered small and moderate samples. However, standard error estimates produced by MLE are found to be less reliable for sample sizes less than 500, even when the multivariate normality assumption is met. For smaller sample sizes, the bias is either negative or varying in sign.

For fit indexes it is found that the sample size effects differ, depending on whether latent variables in the model are independent or not. In order for the fit indices to behave adequately, a substantially larger sample size is required under the dependence conditions than for independent factors. For the χ^2 statistic there is an observable direct effect of sample size, given that N enters directly the formula of the test statistic. With very large samples (large N), any trivial difference (a small F_{ML}) can lead to model rejection. It is thus to be expected to obtain larger values for this fit index, for the same model, as the sample size increases. In the same time, the statistical theory for χ^2 holds asymptotically, that is as sample size gets arbitrarily large. Consequently, in small samples there may not be enough statistical power for the test to detect the differences between competing models. From this perspective, the test statistic should be more reliable in meeting the distributional assumptions in larger samples.

The means of sampling distribution of absolute fit indexes (GFI and AGFI) are also reported to be positively associated with sample size. In general, GFI is found to outperform any other absolute fit index (such as AGFI and RMR) and it also proved better than NFI. Under independence conditions, GFI did not reject any of the true models in samples with 250 cases or more. Under dependence conditions, GFI produced by MLE rejects the true models too frequently in samples less than 250 models, if rejection is based on the 0.90 cutoff value. For the related index, AGFI, similar results are found. The only significant difference is that under dependence conditions, AGFI requires a larger sample size (of 500 or more) for a consistent behavior across methods. Using the cutoff value of 0.90 proves too restrictive in estimations based on small samples and dependent latent variables.

The Normed Fit Index (NFI) is found to be highly sensitive to sample size. The mean of the sampling distribution of NFI is positively associated with sample size, and NFI substantially underestimate its expected value of 1 at small sample sizes (see Hu and Bentler(1995) and references therein). For a simple model with two factors and large sample size, NFI was found to be 0.99 or above. For a more complex model with four factors, the mean of NFI varied from 0.80 (for a sample size of 25) to 0.95 (for a sample with 100 cases), suggesting that the empirical indicator of prefect fit for NFI is substantially less than its theoretical correspondent of 1 in smaller samples.

Tucker and Lewis index of fit (TLI) is found to be less sensitive to sample size if the estimation method used is MLE and there is independence among latent variables. Under dependence condition, the index TLI produced by MLE is found to reject 30% of the true models at a sample size of 150. For the Comparative Fit Index (CFI), comparable results suggest that mean values of CFI based on MLE are not associated with sample size under independence condition and for samples larger than 250. With factor that are not independently distributed, the mean value of CFI is best produced by MLE when compared to other methods, but it behaves inconsistently in samples smaller than 500.

Sample size effects are found to also affect the RMSEA index of fit and its associated p-value. When sample size is small, RMSEA tends to over-reject true population models if the usual cutoff values are considered. Also, in small sample and if the number of estimated parameters is large, the confidence intervals for RMSEA tend to be wider. With a small number of unconstrained parameters, the probability of obtaining narrow confidence intervals is higher, even in moderate samples (MacCallum, Roznowski et al(1994)).

iii) Factor loadings and improper solution

Ding, Velicer et al(1995) perform a Monte Carlo simulation study, under independence condition for the factors, in order to analyze the sensitivity of estimation results to various factors such as the magnitude of loadings found in the model, the presence of improper solutions, the number of indicators per latent factor (the p/r ratio), sample size and the choice of the estimation method

This study confirms to a large extent results found in previous studies (see references therein) and it also produces new results on the robustness of fit indices. In general it is found that the sample size effect becomes more severe when combined with low loadings and more indicators per factor. Based on these results, the recommended minimum sample size to be employed in SEM analyses settles at 100 to 150 cases. Low loadings proved negligible effects on some of the fit indices such as GFI, AGFI, RMR and TLI, but were found to be positively associated with the estimates of NFI and CFI: the higher the loadings, the better the estimates for these indexes. However, the magnitude of the bias is found to be modest even in samples as small as 50. When combined with small sample size low loadings are very often associated with the presence of improper solutions in the model. Nonconvergence was found to be less likely in samples larger than 200, and with loadings of 0.70 or higher. While improper solutions do constitute a problem, remedies employed to eliminate them (such as constraining parameters within acceptable bounds) were not found to have significant effects on the fit indices.

iv) Model specification

Effects of model specification on estimation results are analyzed in terms of the number of observed measures that are assigned to a factor (the p/r ratio), and the number of factors included in a model. The effect of the p/r ratio is of a particular interest for our analysis, in that it is closely related to the measurement models. The conceivable effects of the p/r ratio on the estimated of fit indices could act in opposite directions. There is a possible negative effect due to parsimony consideration: the more measures employed, the less parsimonious the model (Gerbing and Anderson(1993)), and a positive effect in that more indicators help estimate the identified latent factor better, which in turn should be reflected in better estimates for the fit indices. Results in (Ding, Velicer et al(1995)) show that the p/r ratio has a large net negative effect of NFI, and smaller effects on CFI. A small number of measures per factor is also found to be associated with the presence of improper solutions when estimation is based on samples of 100 or smaller. Consequently, also for identification purposes in models with one latent factor only, a recommended number of measures per factor is at least 3.

Over-factoring (Rindskopf(1984)), that is a large number of irrelevant factors included in the model, is also likely to generate improper solutions in terms of very large standard errors and non-convergence. Symptoms of irrelevant factors in the model usually come in the form of low loadings for (most of) the measures assigned to the factor.

Final Comments on Empirical Issues

In general, when interpreting the estimates obtained in an empirical analysis, it is essential to realize that the guidance provided by the results of robustness studies includes only conservative criteria, in that they represent the 'least' problems that should be expected to obtain in a specific analysis. This is because the robustness studies results are often produced based on relatively simpler models than it is expected to have in an actual analysis.

For the analysis in this study in particular, the models that I employ have specifications similar to the ones reported in simulation studies. However. the conservative approach to empirical guidance offered by those studies still applies to the extent that the existing robustness results are only based on the use of maximum likelihood estimation performed on data sets with no missing data. To date, there is no simulation study that employs FIML and data sets with missing data points for robustness analyses. I have no particular reason to believe that FIML on missing data would perform better than maximum likelihood applied in less adverse conditions data-wise.

Discussions on robustness are relevant for the analysis in this paper as I encounter most of the empirical problems described, at least in initial stages of data preparation and factor definition. As mentioned, the issue of missing data is addressed by employing the SEM variant of the FIML method for the estimation of the models. This also addresses problems with sample size, which would be acute if I decided to eliminate observations with missing data points from the data set. Deviations from multivariate normality are addressed by ‘mild’ transformations of the data (mainly linear transformations, and natural logarithm), while the remaining moderate data ‘non-normality’ is tackled by relying on the statistical inference on robust standard errors and robust test statistics. As suggested by measures of multivariate normality reported for each of the estimated models, this problem does exist but it is not severe. Consequently, it is not expected to affect the estimation results in a significant manner.

Given that I operate with measurement models only, estimation problems generated by model complexity occurred only sporadically. This is also explained by the fact that I tried to ensure a minimum of three observed indicators for each latent factor that I estimate, such that the models are at least just identified without imposing constraints on the factor loadings.

The set of model fit indices that are reported for each model parallels the presentation in this section. As mentioned, they have been selected from a large pool of alternative indices, based on their robustness properties. The combined ‘preventive’ efforts made in terms of model specification, data transformation and the choice of the estimation method seem to result in reliable estimates for at least some of the models that I specify.

PART II: Latent Dimensions of Transition in the Post-Communist Countries in Central and Eastern Europe, and Eurasia

The main objective in this study is to construct a set of summarizing indicators that reflect the process of reform and institution building in the post- communist countries in the aftermath of the communist breakdown.

As it shall be illustrated throughout this section, there is a wealth of indicators that measure specific aspects of the reform process and institutions in the transition economies. EBRD[1], for example, provides us with a set of 11 indices that characterize the progress with liberalization of relative prices, reforms in the enterprise sector, infrastructure reforms, financial system reforms and reforms in the legal system. In an empirical analysis that aims at characterizing the impact of the reform process on, say, the economic development during transition the use of such a large number of indicators (plus some other control variables) is likely to encounter empirical difficulties in terms of a reduced number of degrees of freedom and multicollinearity. Similar problems are likely to be met in the analysis of institutional developments, given the various dimensions that can be conceived for the process of institution building.

In the analysis in this section I employ the method of confirmatory factor analysis in order to summarize information on the various dimensions of the transition process. As illustrated in Table II.1, there are three main categories of dimensions I consider: initial conditions, reforms and institutions (state governance and political environment). Within each category, I further group the dimensions of transition, according to their informational content, in factors that are to be estimated in associated CFA models. The category of initial conditions includes two factors: time-invariant initial conditions and initial structural imbalances. In the category of reforms, I summarize the observed information in three main factors: liberalization of relative prices, reforms in the financial sector and reforms in the enterprise sector. Finally, the category of institutions includes summarizing indicators for laws and regulations, graft and bureaucratic corruption, and the political environment.

[1] European Bank of Reconstruction and Development

Table II.1: Categories, factors and indicators of transition

- *Category: Initial Conditions*
    - Latent Factor: **Time- Invariant Initial Conditions (IC I)**
        - Geographical location
        - Number of years of communism
        - Dominant religion
    - Latent Factor: **Initial Structural Imbalances (IC II)**
        - Share of CMEA in GDP (1990)
        - Share of services (1990)
        - Share of agriculture (1990)
        - Initial Liberalization (1990)

- *Category: Reforms*
    - Latent Factor: **Liberalization of Relative Prices (RELPRICES)**
        - Price liberalization
        - Foreign exchange and international trade liberalization
        - Wage liberalization
    - Latent Factor: **Reforms in the Financial Sector (NFINANCE)**
        - Liberalization of interest rates and reforms in the banking sector
        - Competition in banking
        - Openness of the banking system to entry of foreign banks
        - Government interference in the banking sector
        - Reforms of securities markets and non-bank financial institutions
    - Latent Factor: **Enterprise Sector Transformation (NENTREF)**
        - Small-scale privatization
        - Large-scale Privatization
        - Imposition of hard budget constraints
        - Competition policy

- *Category: State governance and political environment*
    - Latent Factor: **Laws and Regulations (NLAWREG)**
        - Government regulation of businesses
        - Protection of property rights
        - Law and order
    - Latent Factor: **Interference of Politics in Business (NIPB)**
        - Perception of administrative corruption
        - Corruption in politics
        - Politicized Bureaucracy
    - Latent Factor: **Political Environment (NPOLITIC)**
        - Institutionalized democracy
        - Absence of autocracy traits
        - Political rights
        - Civil Liberties

There are two main criteria I followed in the initial design of the latent factors, prior to the empirical analysis. First, the factors estimated in this study are meant to serve the purpose of building a simultaneous equation model in the next study in the thesis. The objective in the next study is to analyze the role of initial conditions, reforms and institutions for growth in transition economies. For that purpose I need indicators that are summarizing enough in order to circumvent the problem of empirical multicollinearity, and yet specific enough to maintain the informational content embedded in the original measures. Therefore, a first step in allocating dimensions across categories is the analysis of the informational content of the observed measures. For the factors of reforms, for example, I separate the reforms that relate to the enterprise sector from the reforms that targeted the financial sector. The grouping of observed measures across factors is then validated empirically by means of CFA models. Second, the empirical models should help us understand whether there is complementarity of policy measures that belong to a certain category of reforms. If, for example, the government in a country pursued a coherent strategy in transforming the enterprise sector, the strategy will be reflected in all of the specific dimensions related to reforms with enterprises (such as privatization, hard budget constraints, competition policy). If the corresponding model is supported by the data, the extent to which the observed measures combine in a common latent factor therefore reflects the implemented strategies better than the component indicators, in that it also takes into account the complementarity among specific reform measures.

The use of the latent variable concept is not novel to this study in that similar efforts have been made in other existing empirical studies on transition economies. The specific methods, and their shortcomings, employed in alternative studies are mentioned as the specific latent factors are introduced.

The structure of this part is the following: in Section II.1 I introduce some brief general comments on the data. Further details on the definitions and sources of the indicators employed are provided when the measures are introduced in the analysis. Section II.2 focuses on the estimation of latent factors for initial conditions. In Section II.3, I concentrate on latent factors of reforms, and in Section II.4 the possibilities to estimate latent factors of institutions are considered. Section II.5 summarizes the results and concludes.

II.1 Brief Comments on Data

Although there is a multitude of observed indicators that measure various economic, institutional and political dimensions of transition in the post-communist countries, I only employ the ones that have a broader coverage in time and across transition economies. The pool of countries considered in the analysis includes 25 transition economies in Central and Eastern Europe and Eurasia. Data stretches from the first year of transition (which differs across countries) until year 2001. The maximum possible number of observations in the sample is 269. This could be considered as a moderate to large sample size for CFA models from the perspective of empirical problems that are expected to occur due to sample size effects. However, in some subsets of variables the sample size I operate with is smaller due to simultaneously missing data for all variables in the subset. The degree of missing data for each measurement model is indicated when the respective model is introduced. Details on countries considered, their corresponding first year of transition and data definitions and sources are included in Appendix I.

Each of the following sections includes details on the data transformation performed on the originally collected series. As a general principle, the data transformations that I apply address two main aspects:

- Measurement units: whenever possible, I normalize the indicators in the range in [0,1], such that consistent comparisons of scores across countries and indicators are made possible. Similar measurements units are also expected to be beneficial for the quality of the un-standardized parameter estimates obtained.
- Univariate normality: following the distributional concerns discussed in Section I.2, efforts to control for the degree of non-normality in the data set are made. However, I do consider the tradeoff between the gain in terms of normality obtained by transforming the data, and the distortions induced in the informational relevance of the data through these transformations and therefore limit these efforts to ‘mild’ data transformations only (i.e. linear and natural logarithm). If, after data transformations, large deviations from the normal distribution are still present then I employ corresponding robust test statistics that control for the degree of non-normality in the data.

II.2 Latent Factors of Initial conditions

A first category of latent factors that I consider is the group of initial conditions that characterized the post-communist countries at the beginning of the transition process. Table 1 in Appendix II includes a summary of various measures of initial conditions, and the methodology employed for constructing them, as found in some of the existing empirical studies of the transition process. The classification of the observed measures in Table1 builds on the grouping used in Sachs, Zinnes et al(2000), as they employed the most comprehensive range of indicators relative to the other studies mentioned.

The study that pioneered the use of initial conditions indicators in the analysis of the transition process is De Melo, Denizer et al(2001). The authors employ a set of 11 observed measures of initial conditions and use the method of principal component analysis in order to construct summarizing indicators of initial conditions. They settle for the first two principal components that account for 67% of the total variance in the correlation matrix of the observed indicators. The first principal component assigns greater loadings to market memory (expressed in terms of the number of years the communist regime reigned in the country) and economic distortions (as indicated by dependence on CMEA trade, repressed inflation and black market premium). The first component is interpreted by the authors as reflecting the extent of initial macroeconomic distortions in transition economies, as well as their unfamiliarity with market processes. The second component assigns positive loadings to the levels of income per capita, the degree of urbanization and the index of over-industrialization, and it is interpreted as reflecting the initial overall level of development.

The same method of principal component analysis is also used in other studies, such as EBRD(1999), Raiser, Di Tommaso et al(2000) and Falcetti, Raiser et al(2002), for the construction of similar indices of initial conditions. One of the shortcomings of the method, namely the orthogonality of the principal components, is acknowledged in De Melo, Denizer et (2001). Given the design of the method, the two principal components of initial macroeconomic imbalances and initial structural imbalances, as extracted in their study, are constructed such that they do not correlate. And yet, it is to be expected that the initial macroeconomic imbalances are correlated with (if not a result of) the initial structural distortions. An additional shortcoming of the principal component analysis is that it has no regard for the fact that correlations among observed indicators may be partially due to systematic measurement errors or method biases, as discussed in Part I of this study.

An alternative method for the construction of indices of initial conditions is employed in Sachs, Zinnes et al (2000). As illustrated in Appendix II, the authors collect a large set of measures of various dimensions of initial conditions, grouped in 12 categories. The summarizing indicators are constructed based on a hierarchical procedure that first ensures the compatibility between the informational content of each observed variable and the category to which it is assigned. After standardization and appropriate scaling of the observed measures, each summarizing indicator is calculated as a weighted average of its component indicators. As the authors specify *'the weights are chosen by canvassing expert opinion (including our own) about the relative importance of the variables selected in capturing the underlying knowledge. In some cases, however, we made adjustments to reflect the knowledge of data quality and quantity'* (Sachs, Zinnes et al(2000)). The authors also mention that they occasionally employ the two indices of initial conditions derived in De Melo, Denizer et al(2001). The indicators of initial conditions obtained in this manner are then employed in a clustering procedure in order to identify clusters of transition countries in such a way that within – cluster differences are minimal, while inter-cluster differences are maximized. Based on the clustering method, the authors then identify patterns in terms of policy, institutional and economic developments recorded during transition.

The problem that I perceive with the method used to construct summarizing indicators in the study mentioned above is the lack of transparency, as it relies on the use of subjective weights employed for the construction of the summarizing indicators, with very limited possibilities of empirical replication.

Finally, there are empirical studies, such as Berg, Borenzstein et al(1999) and Fischer and Sahay(2000), that focus on direct observed indicators of initial conditions.

In the analysis in this section I rely on the research efforts mentioned above for the observed indicators collected. In early stages of my analysis I attempted to combined all, or most, of the indicators of initial conditions presented in De Melo, Denizer et al(2001) into one unique latent factor with no success. The informational content in the indicators proves heterogeneous enough such that they do not relate to a common factor in an empirically coherent manner. I then decided to split the set of indicators of initial conditions into two main types: time - invariant initial conditions and measures that characterize structural economic distortions. The fixed initial conditions distinguish countries according to their geographical location, market memory and cultural dimensions. Structural economic imbalances capture the relative proportion of the main economic sectors (industry, agriculture, services) and the shielding effects generated during the communism regime by an active trade involvement in CMEA.

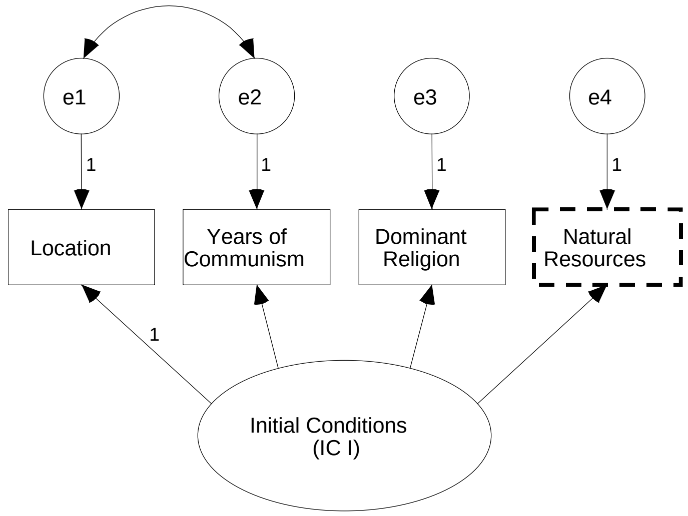
Factor of Time – Invariant Initial Condition (IC I)

The first composite indicator of initial conditions (**ICI**) is based on the observed measures of geographical location, number of years under central planning and cultural dimensions proxied by an index of dominant religion in the country. The analysis of this factor is based on the comparison between two candidate measurement models[1]: *Model 1*, including the measures of geographical location, years of communism, dominant religion and natural resource endowments, and *Model 2*, which is more restricted in that it includes only the first three measures (see Figure II.1).

Geographical location is measured in terms of the proximity of a specific transition country to the developed countries in Western Europe. Expressed in number of km. between the capital of the transition country and Duesseldorf (LOCAT), this variable is meant to capture the 'demonstration effects' induced by political and economic co-operation with Western partners (Fischer and Sahay(2000)). Proximity to Western Europe can also be interpreted as a proxy for similarities in mentalities as well as better ability to co-operate with Western partners. It is thus expected that a smaller distance to a developed market economy (in Western Europe in this case) would reflect more favorable initial conditions at the onset of transition from central planning to market economy.

Figure II.1 Measurement Model for Initial conditions (IC1)

[1] An attempt to include the dummy variable of State Independence prior to 1989 defined in De Melo, Denizer et al(2001) proved unsuccessful. This was, however, to be expected as dummy variables are known to perform badly in latent variable models.



Model I includes all of the four measures
Model 2 does not include natural resources

The second indicator included in the set of time-invariant initial conditions is a proxy of the communist legacy and time spent under central planning. Referred to as 'market memory' (De Melo, Denizer et al(2001)), and expressed in the number of years spent under the communist rule (YCOMM), the variable is meant to capture people's mentalities and their ability to adapt (less) quickly to the challenging living and working conditions during the transition process. While countries in CEE and SEE experienced the communist 'boot' for 40-45 years, in the former USSR Republics there is no generation left to recollect the era before communism came to power. Three quarters of a century spent under the communist leadership is expected to affect people's minds and attitudes in a persistent manner and then the transitional confusion would be more accentuated. YCOMM is also used as a proxy for social and cultural dimensions that are difficult to capture otherwise and it is expected to contribute to increasingly adverse initial conditions. More significant communist legacies are to be expected in countries Central Asia and Caucasus, and Russia, as they had a communist leadership for more than 70 years. The rest of the transition countries in the pool experienced an average of 44 years of communist rule.

Specific cultural aspects are also proxied by an indicator of the dominant religion constructed for each country. I constructed DOMREG as a categorical variable that takes the value of 1 if the dominant religion in the country is Roman Catholic, the value of 2 for a dominantly Protestant population, a value of 3 for Christian Orthodox dominant religion and the value 4 for a dominantly Muslim country (see Appendix II). DOMREG is a crude measure of the dominant religion in that it does not distinguish between various types of Christian Orthodox faiths, and it also does not reflect the existence of other religious minorities When constructing the variable DOMREG I considered more the religious heritage of the country, rather than official religious status. For Albania, for example, formally there is no official religion declared, but we learn that historically the main religion in the country was Islam. Religion is expected to be relevant in the analyses of initial conditions as it penetrates and shapes various cultural strata in the society. Not surprisingly, there is a regional pattern revealed by the scores on dominant religion, in that Catholic and Protestant countries are closer to Western Europe, while further in the East the dominant religion is Muslim. In South-Eastern Europe, the predominant faith is Christian Orthodox, although countries differ in the type of their dominant Orthodox religion.

An attempt to include a measure of natural resources that each country enjoys is also made. Natural resource endowment is measured by a categorical variable (NATRES) introduced in De Melo, Denizer et al(2001). The variable NATRES is a crude measure of oil and energy resources in that it only makes the distinction in terms of existence of natural resources. Countries are classified as resource - poor (value 0), moderately rich (value 1) and resource – rich (value 2). Endowments with natural resources could be a blessing for a developing country to the extent they attract foreign investment and contribute to favorable terms of trade, but they could also impose difficult political constraints on transition. Political conflicts over the control of natural resources could induce a ‘war of attrition’ (Alesina and Drazen(1991)) that delays effective implementation of reforms. Resource – rich countries are Azerbaijan, Kazakhstan, Russia and Turkmenistan. There is no particular regional pattern for countries poorer in natural resources.

The bivariate correlations, as given by Spearman’s rank coefficient, between each pair of the four variables are included in Appendix II. The variables LOCAT, YCOMM and DOMREG are highly and positively correlated with each other, while the correlations between each of these variables and NATRES are much lower, although still statistically significant. Both univariate and multivariate normality properties of the data series are included in Appendix II. As the original series of LOCAT and YCOMM have a relatively higher negative kurtosis, a transformation of natural logarithm is applied in order to reduce the degree of kurtosis present in the data. This helps reducing the multivariate kurtosis for the data set employed[2] to –1.47. Given that the estimate of multivariate kurtosis indicates a moderate level of negative kurtosis, it is unlikely that the estimation results are affected by deviations from multivariate normality to a significant extent. The estimation results for MODEL1 and MODEL2 are included in Table II.2.

Table II.2 Full Information Maximum Likelihood Estimation of IC1

	MODEL 1		MODEL 2	
	Factor Loadings[3] (standardized)	Squared Multiple Correlations	Factor Loadings (standardized)	Squared Multiple Correlations
Geographical Location (LOCAT)	*0.936***	0.867	*0.939***	0.882
Communist Legacy (YCOMM)	0.821** (0.014)	0.673	0.818** (0.018)	0.669
Dominant Religion (DOMREG)	0.861** (0.083)	0.741	0.859** (0.099)	0.738
Natural Resource Endowments (NATRES)	0.624** (0.188)	0.389		
Model 1: Overall Fit Indices Scaled χ^2 (1df) = 0.0959 (*p-value*=0.757), Std. RMR= 0.00[4], RMSEA = 0.00 (*p-value=0.787*), NFI=1.000, TLI=1.002, CFI=1.000, GFI=1.000, AGFI=0.997 Model 2: *just-identified* Sample Size (N): 25				

*** Robust test statistics significant at the 5% level*

Note: LOCAT and YCOMM are in natural logarithms of the original series

The indices reported for the overall fit of the model are introduced and discussed in Part I of this study. The estimated Squared Multiple Correlation coefficient indicates

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[2] Multivariate kurtosis is reported only for the final model MODEL2.
[3] Standardized parameter estimates in *italic* font correspond to the measures that provide the scale for the latent factor. See Section I.2 for the discussion on choosing the factor scale and its implications.
[4] Standardized RMR

the proportion of variance in the observed measure that is explained by the latent factor to which it is assigned.

Both models produce similar results for the first three variables, while for NATRES the Squared Multiple Correlation index of 38% suggests a lower validity for the measure relative to its companion measures in Model 1. The overall fit of MODEL 1 does reach a good level and it could hardly be improved. The adjusted goodness-of-fit (AGFI) index indicates that the model explains 99% of the variance in the sample data. For the RMSEA index a very low level is estimated, with the associated p-value (that tests for RMSEA<0.05) is very high, therefore indicating an excellent fit. MODEL 2 has the disadvantage of being saturated, such that no model fit could be calculated, but the fact that we obtain very close estimates for LOCAT, YCOMM and DOMREG suggests they are highly robust across the two model specifications. Given high standard error obtained for the parameter estimate corresponding to NATRES in Model 1, and also its lower validity as expressed by its estimated SMC, I consider the more parsimonious model MODEL 2 as providing a more reliable and precise representation of the factor IC1. By not taking into account NATRES, we obtain a more conservative estimate of IC1, in that it is based on only highly valid measures.

Given the positive factor loadings estimated for LOCAT and YCOMM, I interpret the construct variable (IC1) as reflecting *unfavorable fixed initial conditions* in terms of distance from Western Europe and the Communist Legacy. *That is the higher the scores estimated for the index, the more unfavorable the fixed initial conditions*. While interpreting the loading for the dominant religion would constitute a value judgment difficult to justify, note that Orthodox and Muslim religions tend to be associated with a higher distance from Western Europe and a more persistent communist legacy. Figure 1 in Appendix II illustrates scores on IC1 estimated for each country (the estimated data points are included in Table 1 in Appendix V). A regional pattern can be identified, in that most unfavorable fixed initial conditions are estimated for countries in Central Asia and Caucasus. Better initial conditions (that is, lowest scores on IC1) are estimated for countries in CEE, such as Czech Republic, Hungary, Poland, Slovak Republic and Slovenia.

Factor of initial structural economic imbalances (IC II)

The second factor of initial conditions focuses on structural imbalances (**ICII**) in the post-communist countries at the beginning of the transition process, and it is based on observed indicators reported in De Melo, Denizer et al(2001). In initial stages of the analysis of the measurement model of ICII I attempted to introduces several other indicators, apart from the ones reported in this section. Measures of repressed inflation, black market premium, initial private sector share and initial levels of GDP per capita could not be fit into a measurement model at all. The observed measures that proved relatively more robust in various specifications of the model are trade dependence on CMEA[5], initial share of services in GDP, reliance on agriculture and an index of initial liberalization.

Initial trade dependence on CMEA (CMEA) is derived based on the share of trade with CMEA in GDP in year 1990. In order to make the normalization of the estimated factor ICII possible, I employ a corresponding measure of non-dependence on CMEA, calculated simply as one minus the initial share of CMEA. *The indicator CMEA ranges in [0,1], with higher values representing less dependence on the trade within the COMECOM block.* The variable CMEA is introduced as a proxy for business practices the managerial communist elite was being used to. Losing their traditional business partners affected many of the managers in transition economies, and in particular those relying on supplies of energy, oil and raw materials coming in through CMEA (Fischer and Sahay(2000)). If not able to adapt to new market requirements, managers and employees in SOEs previously 'insured' through CMEA contracts would then resist change, opposing restructuring and/or privatization. According to this indicator, relatively more active in CMEA were Azerbaijan, Belarus, Latvia, Lithuania and countries in Central Asia. Low shares of CMEA are registered for Albania, Croatia, Macedonia, Romania and Slovenia.

The share of services in GDP was usually very low in transition economies compared to the developed countries. The communist leadership had a particular

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[55] CMEA stands for Council of Mutual Assistance (also called COMECOM). The members were Bulgaria, Cuba, former Czechoslovakia, former German Democratic Republic, Hungary, Mongolia, Poland, Romania, former USSR and Vietnam. The formal dissolution of CMEA took place in early 1990.

preference for large industries, while neglecting the service sector. Over-industrialization made it difficult to restructure and privatize the huge and rigid SOEs during transition for both economic and social reasons. Share of services in GDP (SRVSH) is introduced as a proxy of the structure and flexibility of the economy at the onset of transition. Higher proportion of the service sector in the total economic activity indicates an economic structure less biased towards heavy industries and more able to adapt to the market economy faster, at least in an initial stage of transition. The variable SRVSH ranges in [0,1]. High shares of services in GDP were registered in countries of former Yugoslavia (Croatia, Macedonia and Slovenia) and Hungary. At the other extreme of the scale we find Bulgaria, Belarus, Kyrgyz Republic, Lithuania and Romania.

Economic structure is also captured by an indicator of the reliance of agriculture (AGRIC), calculated as one minus the share of agriculture in GDP (also reported in De Melo, Denizer et al(2001)). The interpretation of AGRIC is similar to CMEA, in that higher scores indicate a lower share of agriculture in GDP in year 1990.The indicator AGRIC ranges in [0,1]. Lowest relative reliance on agriculture is estimated for Slovenia (in 1990, the share of agriculture in GDP was 5%), countries of former Czechoslovakia (7%) and Croatia (10%). Highest share of agriculture in GDP was estimated for Kyrgyz Republic (33%), followed by Moldova (32%), Uzbekistan (31%), Turkmenistan and Kazakhstan (each with 29%) and Albania (26%).

The index of initial liberalization (INLIB), as constructed in De Melo, Denizer et al(1996) is meant to reflect the reforms adopted by the communist leadership during the pre-transition period. Some of the countries, such as Hungary, Poland and countries in former Yugoslavia, started the transition with previous exposure to reforms and modern legal systems, which is expected to have helped the launch of reforms earlier in the transition process. The measure of initial liberalization is dated in 1989 and it ranges between 0 and 1, such that the higher the value of the indicator, the more experience with reforms during the communist rule the country had. Highest scores were estimated for Croatia, Hungary, Poland and Slovenia. The former USSR countries also obtain non-zero scores as a reflection of the reforms that were initiated during 1980s, while the remaining transition countries register a value of 0 for the index (that is, no reforms relevant from a market economy perspective were attempted during the communist rule).

Figure II.2 Measurement Model for Initial Structural Imbalances (ICII)

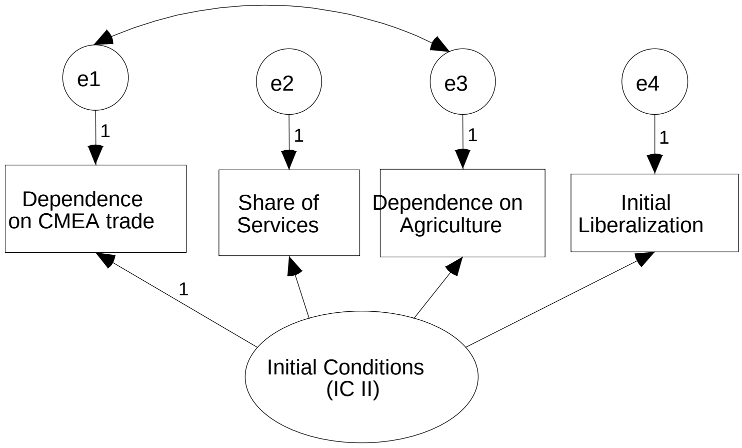


Figure II.2 above illustrates the diagram of the measurement model estimated for the second factor of initial conditions IC2. Bivariate correlations between pairs of variables reveal a mixed picture. Highest and statistically significant correlation is found between the indicators on CMEA and agriculture (0.580). Countries less dependent on trade with the CMEA partners also had a lower share of agriculture in total economic activity. Lower correlation (0.447), but still statistically significant at the 0.05 level, is observed between the index of initial liberalization and the share of services in GDP. Data distributional properties are presented in Appendix II. Highest univariate kurtosis level in absolute terms is estimated for the measure of reliance on agriculture. This contributes to a level of multivariate kurtosis of –3.438.

The estimated parameters produced by the model are included in Table II.3.

Table II.3 Full Information Maximum Likelihood Estimation of ICII

	Factor Loadings (standardized)	Squared Multiple Correlations
Trade Dependence on CMEA (1990)	0.525** (0.076)	0.275
Share of Services in GDP (1990)	*0.883***	0.781
Reliance on Agriculture (1990)	0.522** (0.057)	0.273
Initial Liberalization (1989)	0.927** (0.140)	0.860
Model Fit Indices: Scaled χ^2 (1df) = 5.8797 (*p-value=0.01532*), Std. RMR= 0.015[6], RMSEA = 0.153 (*p-value*=0.037), NFI=0.986, TLI=0.925, CFI=0.988, GFI=0.987, AGFI=0.866 Sample size (N): 25		

*** Robust test statistics significant at the 5% level*

The estimation results for this model are rather modest. High factor loadings obtained for initial liberalization and the share of services are associated with lower loadings for the other two variables. The model fit indices also indicate a rather weak fit, especially according to the estimated level for RMSEA and its associated p-value. Although all the estimates are statistically significant and come with the expected sign, the limited validity obtained for the indicators on agriculture and CMEA suggests there is scope for improvement of the model by (possibly) considering alternative indicators. However, attempts to include measures of over-industrialization, repressed inflation, and black market exchange rate premiums did not prove successful either[7], in that they generated improper solutions for the model. I interpret these results as evidence that the initial measures of structural imbalances are not homogenous enough to warrant data aggregation. Aggregating such diverse measures carries the risk of providing a distorted picture in that countries that appear to be similar actually differed significantly in their specific conditions. For illustration purposes I estimate the factor scores for each country. As the estimated weights are considerably higher for initial liberalization and the share of services in GDP (based on the high validity of these measures), the estimated factor IC II emphasizes more the structural dimensions related to

6 Standardized RMR
7 Results are not reported in this study.

liberalization and services. The higher the scores of IC II, the less initial structural imbalances especially in terms of liberalization and the share of services in economic activity. *The index thus suggests initial favorable structural conditions*. As all of the component measures range in [0,1] and all the estimated weights are positive, it is possible to normalize the factor scores in [0,1]. A value close to 0 for IC II represents a country with little or no initial liberalization, a tiny service sector and, to a lesser extent, higher reliance on agriculture and CMEA trade. Values close to 1 are obtained for countries with potentially more flexible economic structures in that they had experienced some previous reforms and also had a more developed service sector (data series is included in Table 1, Appendix V). Figure 2 in Appendix II illustrates most favorable initial economic structure for countries of former Yugoslavia (Croatia, Macedonia and Slovenia with an average of 0.32), Hungary 0.30 and Poland (0.23). Lowest scores of IC II are estimated for Belarus, Kyrgyz Republic and Lithuania (all of them with a score of 0.14) and Moldova (0.15). Most of the other transition economies register values in the range [0.17, 0.18].

When comparing the two estimated factors of initial conditions ICI and ICII I find a low, negative correlation between them (-0.245). The two indicators of initial conditions combined do not reveal a very clear regional clustering of countries. Countries with favorable fixed initial conditions (that is low scores for IC I) did not always have more favorable structural economic conditions (higher scores for IC II). Most favorable initial conditions from both perspectives are estimated for countries of former Yugoslavia and Hungary, which benefited from a closer location to Western Europe, a lower number of years of communism, and also had pervious exposure to economic reforms and a higher share of services in economic activity. Poland also scores well in terms of fixed initial conditions, but had a relatively lower exposure to economic reforms and a lower share of services compared to the countries mentioned above. Czech Republic and Slovak Republic, although with good location and a limited central planning history, obtain low scores for IC II due to no exposure to economic liberalization during central planning and an average (across transition economies) share of services to start with. Least favorable initial conditions along both dimensions are estimated for countries in Caucasus and Central Asia regions.

II.3 Latent Factors of Reforms

In constructing latent factors that reflect the process of economic reforms implemented during transition, the overriding objective of my analysis has been to obtain summarizing indicators that are still specific enough to provide an accurate picture on the state of specific types of reforms. From this perspective I assign the observed measures that I collect from various sources to three main groups: reforms related to liberalization of relative prices (including liberalization of prices and wages), reforms related to the transformation of the (state – owned) enterprise sector (in terms of privatization, restructuring and competition policy), and reforms implemented in the financial sector (reflecting measures with supervision and statutory regulations in banking, the existence and regulations of other non-bank financial institutions, liberalization of interest rates, entry condition for foreign competition in the banking sector etc.).

The selection of the relevant observed measures to be included in each of the three groups proved challenging. I Table I, Appendix III, I introduce the reader to the various possible sources where we can find indicators on various aspects of the reform process in transition economies. Notes on the informational content of each of the indicators reported are also included in the appendix.

Depending on the coverage across countries and time of the reported indicators, there are two main sources of data I consider for the current analysis: EBRD and Heritage Foundation. The indicators of reforms published on an annual basis by EBRD (EBRD(1994)-EBRD(2001)) constitute the main 'workhorse' in the empirical analyses of economic reforms at macroeconomic level. Data on the annual progress with reforms, as reported by EBRD, range from year 1991 until year 2001. There are 9 indicators reflecting the state of reforms with prices, international trade and currency convertibility, privatization, hardening of budget constraints of the SOEs[1], competition policy, infrastructure and the financial system. Alternative indicators on economic reforms implemented in transition economies are also found with Heritage Foundation, although for a more limited period of time and for all transition economies. There are also three other sources of data I mention for reader's further reference: Freedom

[1] State-owned enterprises.

House, Fraser Institute and the data set constructed by Kaufmann, Kraay et al(1999a, 1999b, 2002) at the World Bank. Although potentially revealing in their informational content, I do not include the indicators reported by these sources in the current analysis due to their limited coverage across time.

The main summarizing indicator, that reflects the progress with economic reforms in transition economies, currently employed in empirical studies[2] on macroeconomic developments during transition is the index of economic liberalization constructed in De Melo, Denizer et al(1996), based on EBRD data, for the period 1989-1994[3]. The authors constructed an aggregated index of economic liberalization as a weighted average of three types of reforms: liberalization of internal markets, liberalization of external trade, and reforms that facilitate private sector entry. The weights used to linearly combine the three categories of reforms were obtained '*through consultations with experts and other senior executives*' (De Melo, Denizer et al(1996)) and they are meant to represent the estimated impact of the reforms. The three component indicators that feed into the weighted average are constructed as following. The measure of liberalization of internal markets is based on the EBRD index of price liberalization, which the authors further adjusted in order to also reflect the abolition of the state trade monopolies. The indicator of external trade corresponds to the EBRD index on trade and foreign exchange liberalization. The indicator of private sector entry is calculated as a sum of the scores on the EBRD indices for large-scale privatization, small-scale privatization and reforms in the banking sector. Based on the general index of economic liberalization (LI), that results form calculating the weighted average of the three main components, the authors also calculate a Cumulative Index of Liberalization (CLI) by summing up the scores of LI starting from year 1989 and until the current year. The cumulative measure CLI would later be employed by many of the empirical analysis on economic growth in transition countries. The conceptual problems of the cumulative index CLI are discussed in Study 2, Section III, in this thesis. For the time being it suffices to say that there are three main empirical shortcomings I perceive with the index of Economic Liberalization. First, the use of subjective weight leaves little

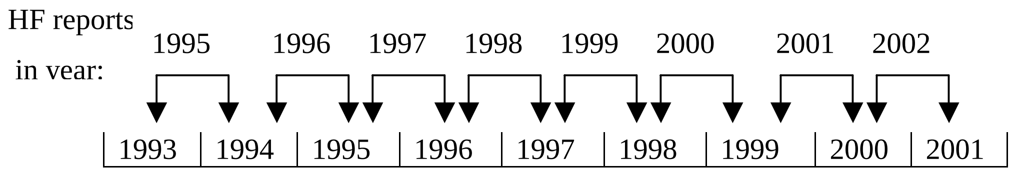
[2] See the next study in this thesis.
[3] Scores on the index of Economic Liberalization are updated for the period 1995-1998 in Havrylyshyn, Wolf et al(1999).

scope for cross-validation and replication of the construction of the index. Given the period of time when the index has been constructed (year 1996), perceptions on the impact of reforms may have changed with new developments in transition. In many transition economies reforms in the enterprise sector and in the financial sector were in progress in year 1996 and the effects of such reforms usually take time to materialize. As discussed in the next study in this thesis, there is little we know empirically about the impact of reforms and the interdependencies between specific types of reforms. Furthermore, the exact meaning of the 'impact of reforms' is not clearly defined in the above study. Second, the third component of private sector entry included in the weighted average of the index of Economic Liberalization is calculated as a sum of scores of three other indicators. In terms of the method employed by the authors, this amounts to saying that the three indices that combine into the measure of private sector entry had the same impact on private sector entry (given they have equal weights), with little conceptual or empirical justification. Third, the index of Economic Liberalization condenses information on substantially different types of reforms. This measure does not allow for the analysis of the differential impact of specific reforms, and yet it is conceivable that there are interdependencies among, say, reforms in the enterprise sector and reforms in the financial sector that are not accurately captured by a simple sum of the scores of the corresponding indicators.

An alternative method used by Fraser Institute in constructing indices of specific economic reforms is the principal component analysis. The shortcomings of this method are discussed in Section I.2 as well as in the previous section.

As mentioned above, in the current analysis I rely on two main sources for indicators of economic reforms: EBRD and Heritage Foundation. For the indicators collected from Heritage Foundation I employ a specific transformation of the date as following. From the explanatory notes that accompany the Heritage Foundation data series, I learn that the values reported in a specific year actually measure the progress with reforms registered one and a half year in advance. For example, the score reported in 2002 for a specific indicator is obtained based on information referring to developments during the last half of year 2000 and the first half of year 2001. Consequently, the data series reported for period 1995-2002 refers to the economic developments observed during the period starting with the second half of 1993 and until the first half of year 2001. Given that this period covers a significant part of the transition process in many of the countries that I consider, I ‘recover’ the information contained in the Heritage Foundation data according to the scheme in Figure II.3.

Figure II.3: Heritage Foundation data reconsidered



In order to recover the information related to year 1994, for example, I take an average of the score reported in year 1995 (that refer to the first half of year 1994) and the score reported in year 1996 (that includes information about reforms in the second half of 1994). For the initial year (1993) and the final year in the series (2001) the corresponding scores reported in 1995 and 2001 are considered as best available estimates, even if limited.

Liberalization of relative prices

The first latent factor of reforms that I analyze is meant to reflect the liberalization of relative prices in the domestic economy (**RELPRICES**). I consider the concept of liberalization of relative prices not only in terms of the removal of domestic price controls, but also the liberalization of foreign exchange market, liberalization of wages and the competitive pressure exerted on prices by imported foreign goods and prices. A competitive process of adjustment of prices and wages in the economy is thus viewed as combining concurrent efforts with liberalization measures in all these areas. The dimension of domestic price liberalization included in the factor RELPRICES is captured by the EBRD index of price liberalization, and the indicator of wages and prices constructed by Heritage Foundation. EBRD evaluates the extent to which price controls for several categories of goods and state – procurement at controlled prices have been removed. Prices of utilities are also considered in the EBRD evaluation. I employ a normalized variant (NPLI) of the EBRD index that takes a continuum of values between 0 and 1. Corresponding the its original definition[4], the measure of domestic price controls takes a value of 1 for comprehensive price liberalization and efficiency-enhancing regulation of prices for utilities. In countries with a minimum score of 0, most prices are still controlled by the state. An alternative measure employed in order to control for possible method biases is the index of wage and price liberalization of Heritage Foundation, that is based on information on government price controls, government subsidies to businesses that affect prices, and the existence of minimum wage laws. The corresponding normalized continuous variable (NHFWP) that I construct ranges from 0 to 1, with zero assigned to countries where prices and wages are almost completely controlled by the government, and the score of 1 for the most advanced reformers with wages and prices fully determined by the corresponding markets, and no minimum wage is imposed. The rankings across time and countries reflected by the two indicators appear to differ considerably, as suggested by the low correlation that I find between NPLI and NHFWP (0.296). Scores differ significantly, especially across countries, in that similar strategies with price liberalization indicated by the ERBD index appear to be very different according to the Heritage Foundation corresponding scores. Representative examples are the ratings for Czech Republic and Azerbaijan. With EBRD data, Czech Republic liberalized most of the prices in the first year of transition (1991), obtaining a score 0.61 that would then remain constant until year 2001. Azerbaijan reaches the same level of price liberalization as Czech Republic in the second year of reforms and it maintains this level until year 2001. Heritage Foundation scores Czech Republic at a comparatively high level of price liberalization, but Azerbaijan obtains a score of 0 until year 1999-2000, when the scores are slightly improved. In year 2000, price liberalization in countries such as Kazakhstan, Kyrgyz Republic, Romania, Russia, Tajikistan and Ukraine obtain the same EBRD scores as Czech Republic, Estonia, Latvia and Slovak Republic, while they do differ considerably according to the Heritage Foundation data. These differences in scores provided by the two sources are most likely due to the fact that the Heritage Foundation measure also includes information on wage regulations in transition economies. According to the EBRD data in 2001 the most advanced countries in terms of price liberalization (with a score of 0.70 out of a maximum of 1) were Hungary, Kazakhstan, Moldova, Poland and

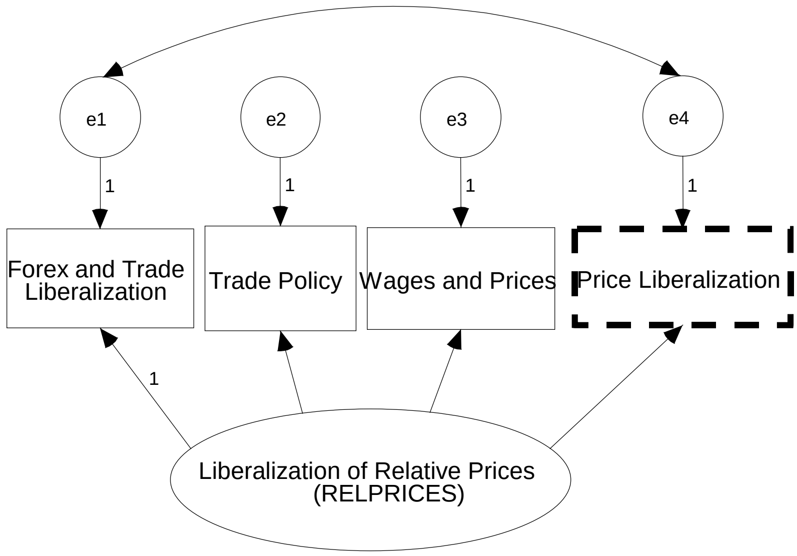
[4] For a detailed description of the scale of the indicators see EBRD(2000)

Slovenia. Most other countries obtain a score of 0.61, with the exceptions of Belarus, Turkmenistan and Uzbekistan. In year 2000, the scores constructed by Heritage Foundation indicate high levels of price and wage liberalization in Estonia (0.88), Armenia, Czech Republic, Hungary and Lithuania (0.75), followed by Bulgaria and Albania (0.63). For Kazakhstan a score of 0.38 in assigned in year 2001, while Moldova, Poland and Slovenia obtain a score of 0.50 in the same year.

The exposure of domestic markets (and producers) to foreign prices and competition is introduced in the analysis as represented by indices of foreign exchange and international trade liberalization. At least during the first year of transition, competition in the product markets is likely to have been hampered due to the oligopolistic structure of the industries, as inherited from the central planning period. Competition imported from abroad, in the form of foreign goods and prices, is likely to have forced the SOEs (or the newly privatized enterprises) to redesign their product lines and define new strategies for approaching the domestic markets, also putting pressure on their pricing system. A direct measure of liberalization of foreign exchange and trade is reported by EBRD on an annual basis. I use a normalized variant of this index (NFXTL) that ranges in [0,1]; NFXTL takes a value of 0 for countries with extensive import and/or export controls and restricted legitimate access to foreign exchange, and the maximum value of 1 corresponding to the removal of most tariff barriers, free legitimate access to foreign exchange and WTO membership. The EBRD measure is complemented with the index on trade policy (NHFT) constructed by Heritage Foundation. Variable NHFT is based on information on both tariff and non-tariff barriers to international trade, and also corruption in the custom service. It takes a value of 0 for countries with highly restrictive foreign policy trade and a value of 1 for liberal trade policies. The estimated rank correlation between the two indicators is 0.502, reflecting the differences in their definitions. Full foreign exchange and trade liberalization (with a maximum score of 1) is indicated by EBRD data for Albania, Bulgaria, Croatia, Czech Republic, Estonia, Georgia, Hungary, Latvia, Poland, Slovak Republic and Slovenia in year 2000. Heritage Foundation scores reflect a more conservative picture in year 2000: Albania and Bulgaria (0.25), Slovenia (0.38) and Georgia (0.63). The differences reflect the fact that the EBRD index focuses on regulations of the foreign exchange markets and the imposition of tariff barriers to trade, while Heritage Foundation data is based on information reflecting non-tariff barriers to trade and corruption in the custom service. From the perspective of the current analysis, there is a value in considering the two indicators as complementary to each other in that they reflect various relevant dimensions related to policies of international trade.

The measurement models specified for the latent factor of relative price liberalization (RELPRICES) are illustrated in the diagram in Figure II.4.

Figure II.4 Measurement models for the latent factor RELPRICES



Model 1 includes all of the four indicators
Model 2 does not include Price Liberalization

Distributional properties of data, proportion of missing data and the bivariate correlations between each pair of the four observed indicators are included in Appendix III. Problems with missing data already become apparent in that the maximum number of observations available for Heritage Foundation indicators is 195, much lower than the sample size obtained from EBRD (264). Given that I use the SEM variant of the FIML estimation method, none of the present data points is ignored and information is used efficiently (as described in Section I.2). The estimated multivariate kurtosis for the set of four indicators suggests a moderate level (1.7569), mainly due to the higher positive kurtosis in the series of price liberalization.

I start the estimation of the latent factor RELPRICES by specifying a model that includes all of the four observed indicators (Model 1). Estimation results are included in Table II.4.

Table II.4 Full Information Maximum Likelihood Estimation of RELPRICES

Measures / Models	Model 1		Model 2	
	Factor Loadings[5] (std. Errors)	Squared Multiple Correlations	Factor Loadings (std. Errors)	Squared Multiple Correlations
Forex and Trade Liberalization	*0.764*	0.584	*0.764*	0.584
Trade Policy	0.775** (0.127)	0.601	0.776** (0.126)	0.602
Wages and Prices	0.769** (0.077)	0.591	0.768** (0.078)	0.590
Price Liberalization	0.530** (0.041)	0.281		

Overall Fit Indices for Model 1:
Scaled χ^2 (1df) = 0.565 (0.452), Std. RMR= 0.005, RMSEA = 0.000 (0.626), CFI=1.000, GFI=1.000, AGFI=0.996

Model 2: *just – identified model*

Maximum Sample Size (NxT): 264

*** Robust Standard Errors Significant at 0.95 level*

The estimates of factor loadings obtained for the indicators on currency convertibility and price liberalization, trade policy and wages and prices are high and statistically significant. They also have the expected sign, in that progress with liberalization in the three areas reflects overall progress with liberalization of relative prices. The loading attached to the EBRD measure of price liberalization is lower, with its corresponding squared multiple correlation suggesting a low validity for this measure (SMC=0.281). The estimated overall fit indices indicate an excellent fit for Model 1, in that the model does produce a predicted covariance matrix very close to the sample

[5] Parameter estimates written in italic font correspond to the measures that provide the scale of the latent factor. See Section I.2 for the discussion on choosing the factor scale and its implications.

covariance matrix. A low level and a high associated p-value is estimated for the index RMSEA.

Given the limited performance of the measure of price liberalization in Model 1, I re-estimate the model after eliminating this indicator. The assumption I rely on is that doing so does not entail too much of a loss of relevant information as the proportion of liberalized prices is already captured in the Heritage Foundation data series of wages and prices. For the remaining variables in Model 2, the corresponding estimates obtained are almost identical to the ones produced in Model 1, thus confirming that, given its low validity, the presence of price liberalization does not have a significant contribution in terms of the estimation of the latent factor of relative prices. As Model 2 is also more parsimonious, I base the estimation of the factor scores on this model.

Estimated factor scores for the latent factor of liberalization of relative prices are included in Table 2, Appendix V. Most of the estimated data points that I obtain start in year 1993 (due to the shorter data series corresponding to Heritage Foundation indicators). Forceful starts with relative price liberalization, as reflected by scores in 1993, are estimated for Czech Republic, Estonia, Romania and Slovak Republic. In year 2000, the most advanced in terms of combined liberalization of prices, wages, foreign exchange and trade are Estonia (with almost full liberalization reached in the 10th year of transition, 2000), Lithuania (0.87 in 2001), followed by Czech Republic, Hungary and Latvia (0.81 in the 11th year of transition). Figure 1 in Appendix III illustrates the scores of countries in the 10th year of transition. Lowest levels of relative price liberalization are estimated for Turkmenistan (0.11), Uzbekistan (0.21) and Belarus (0.23). Turkmenistan is one of the few countries in our pool that maintains price controls in most areas, and the access to foreign exchange is limited and driven by the government discretionary policies. Before 2001, Uzbekistan imposed trade restrictions in the form of non-tariff barriers, effective state control of imports, state monopoly of exports and selective access to foreign exchange for importers. The multiple exchange rate system introduced is coupled with mandatory surrender of exports receipts. Uzbekistan registers an improvement in its score in year 2001, as a reflection of the liberalization measures in the foreign exchange markets and state monopoly trading initiated at the beginning of the year.

Policy reversals are observed for Belarus, Kazakhstan, and Russia, partly as a consequence of the Russian crisis in mid 1998. Belarus reintroduced price controls already in 1996, imposing limits on the maximum allowed monthly price increases, and further foreign exchange and trade restrictions in 1998, requiring mandatory surrender of 40% of export receipts at a highly over-valued exchange rate. Exporters are also restricted in accepting payments in local currency on certain categories of goods. Kazakhstan imposes similar restrictions in the form of a 50% mandatory surrender of export receipts, and further tariff and non-tariff barriers on imports from the neighboring countries, Russia, Kyrgyz Republic and Ukraine. Following the crisis in August 1998, Russia imposed temporary price and foreign exchange controls and export tariffs on oil, gas and certain categories of goods. Price interventions are also reflected by special agreements between government and large producers on the maximum allowed price increases.

The validity of the estimated latent factor that I obtain could be further analyzed based on comparisons with alternative comparable indicators, if they were available. For the factor of liberalization of relative prices I did not find any alternative measure with a similar definition to compare it with. The closest we can get is the indicator on foreign exchange reported by Fraser Institute. Fraser Institute reports scores on the access and use of foreign currencies in some transition economies for years 1990, 1995 and 1999. The estimated correlation between the latent factor RELPRICES and the Fraser Institute indicator is 0.428 and statistically significant at the 0.05 level. This comparison can be considered only illustrative at best, as the FI measure only monitors developments in the foreign exchange market and the coverage in time is limited.

Transformation of the Enterprise Sector

The second latent factor of reforms that I consider relate to the extent to which governments in transition economies implemented a coherent strategy in terms of privatization and restructuring of the state – owned enterprises, and improvements in the competitive environment in the domestic economy. The latent factor of enterprise sector transformation (**NENTREF**) considers the complementarity of reform measures implemented with the objective of creating a competitive private sector.

The observed indicators of privatization that I use are constructed based on the EBRD indices of small – scale privatization and large – scale privatization. Small – scale privatization is introduced in the form of a normalized variable (NSSPRIV), ranging in [0,1], with the same interpretation of the original EBRD indicator: a maximum value of 1 is assigned to countries where there is no state – ownership of small enterprises anymore. Large – scale privatization (NLSPRIV) is constructed in a similar manner, based on the EBRD data series, with a maximum score of 1 assigned to countries where more than 75 percent of assets in medium and large enterprises are in private hands. A qualification is necessary in that both these indicators do not reflect the qualitative dimensions of the privatization process. Based on ex post experiences for large – scale privatization in particular, it is believed that a more meaningful representation of the privatization process should take into consideration the method of privatization rather than the mere number of privatized enterprises. Closely related to the issue of specific methods of privatization employed is the remaining 'disguised' *de facto* state control maintained for some of the newly privatized enterprises. When based on methods of mass-privatization, the change of ownership of large-scale enterprises often implied more of a change in title, rather than genuine privatization, as it did not entail significant infusions of capital and it resulted in diluted ownership. If the private ownership is diluted among a large number of small private investors, and if the government still retains part of the ownership, the effective control on the unit would most likely stay with the government; the newly privatized unit would continue to benefit from state support and remain sheltered from market competition.

The two indicators on privatization reflect slightly different strategies adopted by some countries through time, with respect to the size of the units that were to be privatized. It is generally agreed that small – scale privatized was socially and politically easier to implement, and it has therefore proceeded at a faster pace. Czech Republic and Slovakia had already almost completed privatization of small enterprises by the second year of transition (with a score of 0.91 out of a maximum value of 1). Similar levels with NSSPRIV were attained by Poland, and Kyrgyz Republic in their third year of transition, and by Croatia, Estonia, Latvia, Lithuania and Slovenia by their fourth year of transition. Hungary implemented a more gradual policy of small – scale privatization, reaching a level of 0.82 in the fifth year of transition (1994), and 0.91 in the seventh year of transition (1996). Russia started the process of privatization in 1992, and reached a level of 0.91 in 1995 that would remain constant for all the following years until 2001. Slow progress with small – scale privatization is observed in Azerbaijan that started the process in the 5th year of transition (1996) and reached the level of 0.70 in year 2001. Belarus scores 0.30 already in the second year of transition (1993), but no subsequent progress is made thereafter, such that the same level is observed in 2001. Bulgaria registers slow progress until the 5th year of transition, when a more forceful process of small-scale privatization leads to a score of 0.82 in year 2001. A similar strategy is observed with Romania.

Large –scale privatization proved to be more difficult for both political and social reasons in most of the transition economies. Significant early progress with the privatization of large units is observed for Czech Republic, reaching a score of 0.61 in their 3rd year of transition, and 0.91 in the following year (1994). Similar achievements are observed in Estonia and Hungary, with a level of 0.61 in their 4th year of transition (1994) and 0.91 in the following year for Estonia, and two years later for Hungary. Slovak Republic reaches the same level in the 3rd year of transition (1993) as Czech Republic (0.61), but the second wave of privatization would come later, in 1997 (0.91). Examples of a relatively early start but subsequent stagnation with large scale-privatization are Kyrgyz Republic, with an observed score of 0.61 in the third year of transition but no progress thereafter, and Lithuania, with a level of 0.61 in the 3rd year of transition and little progress during the following years. The more gradual strategy of Poland is reflected in the score of 0.61 reached in their 5th year of transition (1994), and the level of 0.70 in year 2001. Russia already reaches the level of 0.61 in the 3rd year of transition (1993), but the process slows down considerably afterwards, reaching a similar level to Poland (0.70) in year 2001. Very little progress with large – scale privatization is observed in Turkmenistan that attains a score of 0.30 in the 5th year of transition, just to be followed by policy reversals thereafter.

However, despite the differences revealed by the two data series on privatization, I find there is a strong positive and statistically significant correlation between the two indices (0.808), indicating that governments that adopted small scale privatization were more likely to pursue a similar strategy in relation to the medium and large enterprises also.

Another dimension of the enterprise sector transformation is reflected by the extent to which government policies induce the restructuring of the state – owned enterprise either before or after privatization. The literature on transition economies established the result that restructuring has been driven mainly by the hard budget constraints imposed on enterprises[6]. It is believed that subsidy cuts and the elimination of directed credits provided strong incentives to incumbent managers to file for restructuring. As a comprehensive data set of enterprise restructuring across time and countries is not available, I employ the EBRD index of enterprise reforms that capture the incentives for restructuring. The normalized variant of the EBRD index (NHBC) that I construct ranges in [0,1], with the value of 0 assigned to countries where the government maintains soft budget constraints (directed credits, subsidies, tax arrears etc) to enterprises, and the maximum of 1 for countries with *'effective mechanisms of corporate controls exercised through financial institutions'* (EBRD(2000)). According to this index, early emphasis on enterprise restructuring is observed in Czech Republic that reaches a level 0f 0.30 in their 1st year of transition (1991), followed by Estonia, Hungary, Latvia, Poland and Slovak Republic, all of them reaching the same level (0.30) in their second years of transition. All the other transition countries in the pool would reach a comparative level in their fourth year of transition at earliest. Little progress and reversals of policies are observed for Belarus, that obtains the score of 0.21 in 1995 and reverses the policy two years later (a score of 0 in 1997), when it imposes the 'golden share' of government in the management of all enterprises.

A distinct role in the transformation of the structure of economies in transition is attributed to the emergence of *de novo* private firms (Havrylyshyn and McGettigan(1999)). As conditions that foster competition are considered as providing critical incentives for the emergence of new private companies (EBRD(1997)), I also add the dimension of competition policy to the latent factor of enterprise sector transformation. The variable NCOMPOL is based on the EBRD index of competition policy that captures the quality of the institutional framework that regulates competition in the markets. NCOMPOL ranges in [0,1], taking a value of 0 for countries with no

[6] See the discussions and additional references included in Djankov and Murrell(2002), Roland(2000). Frydman, Gray et al(2000) provides empirical evidence on Czech Republic, Hungary and Poland, and Coricelli and Djankov(2001) analyze enterprise restructuring in Romania.

institutions or laws that regulate competition in the markets, and the maximum of 1 for cases with effective enforcement of competition policy and unrestricted entry in most markets. Earlier and significant progress with competition policies is observed in Estonia, Hungary, Poland and Slovak Republic, all reaching a level of 0.61 in their 3rd or 4th year of transition. Estonia, Lithuania and Slovenia reach a level of 0.52 in year 2000, but they had implemented the policies more gradually through time. Most of the other countries register scores between 0.30 and 0.39 in year 2000, with the exceptions of Albania and Tajikistan (0.21), and Armenia and Turkmenistan with no progress at all in year 2000.

An aggregate picture on how the four dimensions (small- and large – scale privatization, restructuring, and competition policy) compare to each other is reflected by the bivariate rank correlations included in Appendix III. Highly positive and statistically significant correlations are estimated between the indicators of privatization, and the measure of restructuring. Competition policy correlates highest with the indicator of restructuring (0.733). The estimation of the latent factor of enterprise sector transformation is performed with FIML method theoretically described in Section II.2. Based on considerations of sample size and distributional properties of the data no specific estimation problems occurred. Estimated multivariate kurtosis indicates a low level of negative kurtosis (-0.968).

The diagram of the measurement model specified for the estimation of the latent factor of enterprise sector transformation (NENTREF) is illustrated Figure II.5.

Estimation results, included in Table II.5 indicate very high factor loadings for all of the four the indicators of privatization, restructuring and competition policy. They are also estimated with the expected sign in that progress with the four types of reforms loads positively into a general latent factor of enterprise sector transformations. The squared multiple correlation coefficients indicate that the factor explains around 80% of the variance in the measures of privatization and hard budget constraints, but only 50% in the measure of implemented competition regulations.

Figure II.5 Measurement model for the latent factor NENTREF

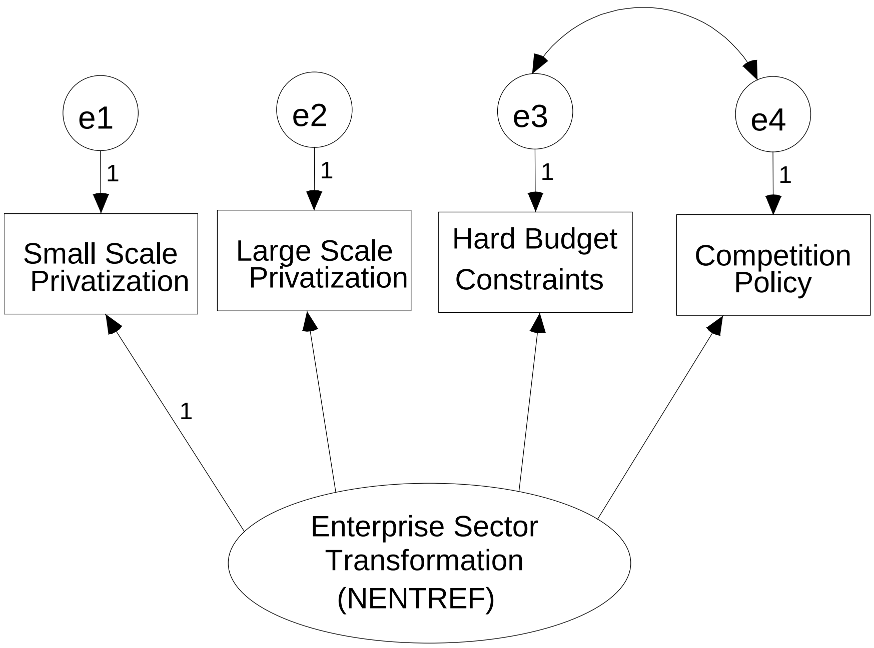


Table II.5 FIML estimation results for the latent factor NENTREF

	Factor Loadings (std. Errors) [7]	Squared Multiple Correlation
Small Scale Privatization	*0.868*	0.753
Large Scale Privatization	0.915** (0.048)	0.837
Hard Budget Constraints	0.887** (0.037)	0.786
Competition Policy	0.706** (0.038)	0.499
Overall Model Fit Indices: χ^2 (1df) = 6.573 (0.010), Std.RMR=0.014, RMSEA = 0.144 (0.041), CFI=0.997, GFI=0.988, AGFI=0. 878 Sample size (NxT): 264		

*** Robust Standard Errors Significant at 0.05 level*

[7] Parameter estimates written in italic font correspond to the measures that provide the scale of the latent factor. See Section I.2 for the discussion on choosing the factor scale and its implications.

The model fit indices reflect a satisfactory fit, although not a very good one. The model accounts for approximately 90% of the variances of and the covariances in the sample data, as indicated by the adjusted index of goodness – of – fit AGFI.

A possible concern with the estimated factor of enterprise sector transformation relates to the possibility that the factor also captures a method bias to some degree, given the fact that all of the observed measured employed are collected from the same source (EBRD2000). In a companion analysis performed in view of the analysis in this study[8], I tested for the existence of possible method bias in the EBRD indicators and did not find systematic evidence that supports the hypothesis. I therefore concluded there is limited chance for the indicators of reforms to be affected by a possible method bias. This issue would be fully settled if we could find alternative, similar, measures that reflect reforms with privatization and hard budget constraint. The only similar measure I found is the index on privatization reported by Freedom House. However, the indicator could not be included in the analysis due to its limited coverage in time (when compared to the EBRD indices), as it is only reported for the period 1997-2001.

Based on the estimated results, I calculate and report the associated scores for the latent factor of enterprise sector transformation in Table 3 in Appendix V. Factor scores are normalized in [0,1], such that a maximum value of 1 would correspond to a completed process of reforms in the four areas considered. In terms of coverage across time, complete data series are obtained for all countries during the period under consideration, except for the year 1990. Data point estimates for the factor NENTEPR indicate that most comprehensive strategies for enterprise sector transformation along the dimensions included in the model have been implemented early in transition (the 2nd year) by Czech Republic (0.39 out of a maximum of 1), Poland (0.39) and Slovak Republic (0.39). Similar levels or higher were reached by Estonia (0.39), Hungary (0.40), Kyrgyz Republic (0.46), Lithuania (0.45) and Russia (0.40) in their third year of transition. All those countries, with the exceptions of Kyrgyz Republic and Russia, are among the most advanced reformers in terms of the level enterprise sector transformation in year 2000, according to the estimated scores for NENTREF. Low progress with enterprise sector transformation, even after 10 years of transition, is observed for Belarus (0.13) and Turkmenistan (0.14). The remaining countries display a

[8] Results are not reported.

more gradual progress, reaching levels between 0.44 (for Tajikistan and Uzbekistan), and approximately 0.68 (for Croatia) in year 2001.

Further validation of the estimated scores for the latent factor NENTREF is possible by comparing it with the index of Privatization reported by Freedom House for the transition economies during 1997-2001. Freedom House evaluates the legal framework of the privatization process in transition economies, as well as the current progress recorded. *Higher values for the Freedom House indicator on Privatization reflect less progress with privatization.* The correlation that I estimate between the latent factor NENTREF and the Freedom House indicator confirms prior expectations in that it is strongly negative (-0.896) and statistically significant at the 0.01 level. The rank correlation coefficient is based on 123 common observations between the two data series (see the results reported in Appendix III). A general tendency of enterprise sector transformation to be associated with lower intervention of the government in the economy is reflected by the correlation between the factor NENTREF and an indicator of the extent of government intervention in the economy reported by Heritage Foundation. The Heritage Foundation index of Government Intervention combines information on government ownership of industry, the share of government revenues from state enterprises, the economic output generated by governmental units and government consumption. The higher the value of the index, the more pervasive is the government intervention in domestic economic sectors. The estimated correlation between the latent factor NENTREF and the Heritage Foundation index is –0.629 and statistically significant at 0.01 (based on 195 common observations).

Reforms in the Financial Sector

The main dimensions that I consider in constructing the latent factor of reforms in the financial sector (**NFINANCE**) are liberalization of interest rates, government ownership of banks, competitive conditions and restriction imposed to foreign entry in the banking sector, the extent of directed credits, diversity of financial services provided by banks, regulations and prudential supervision instituted in the banking sector, as well as the reforms of securities markets and non-bank financial institutions. This information is captured by annual indicators on reforms in banking and non-bank financial institutions reported by EBRD, a measure of the presence of foreign banks that I calculate based on the number of foreign banks present relative to the number of domestic banks, interest rate spreads and an indicator of progress in banking and finance areas based on data reported by Heritage Foundation.

The indicator of banking reforms (NBNKREF) is based on the corresponding EBRD index that combines information on liberalization of interest rates and credit allocation, the establishment of prudential supervision and banking regulation framework, banking laws and regulations in accordance to internationally accepted (BIS) standards on capital ratios and competition in the financial sector. The variable NBNKREF takes values between 0 and 1, with zero representing little progress with reforms in the banking sector, and a value of 1 for full convergence to BIS standards and provision of competitive banking services. According to EBRD data, rapid progress with reforms in banking is observed early in transition in Czech Republic, Estonia, Hungary, Latvia, Poland, Slovak Republic and Slovenia, all of them reaching a level of 0.30 (out of a maximum of 1) during their first two years of transition. All of these countries, even if to a lesser extent in Slovenia, would reach the level 0.61 during the following one or two years after initial reforms. A comparable initial level of reforms (of 0.30) is reached in the most of the CIS countries in their 4th year of reforms, with the exceptions of Kyrgyz Republic and Moldova were reforming the banking system started earlier in the process. In South Eastern Europe, an early reformer is Bulgaria, reaching the level of 0.21 in 1992, and 0.30 in its 3rd year of transition. No significant progress with reforms in their banking systems is observed for Belarus, Tajikistan and Turkmenistan all along during the transition process. Scores reported for year 2001 distinguish Hungary as the most advanced reformer in the banking area (0.91), followed by Czech Republic and Estonia (0.82), and Croatia, Lithuania, Poland, Slovak Republic and Slovenia (0.70). Modest performances are displayed in Russia and Uzbekistan (0.21), Ukraine (0.30), and Albania, Armenia, Azerbaijan, Georgia, Kyrgyz Republic and Moldova (0.39). The low level of reforms in Russia and Kyrgyz Republic in year 2001 is partly explained by policy reversals observed in the aftermath of the Russian crisis in 1998. Romania and Kazakhstan (0.52) score lower than the intermediate reformers Bulgaria, Lithuania and Macedonia (with a score of 0.61) in year 2001.

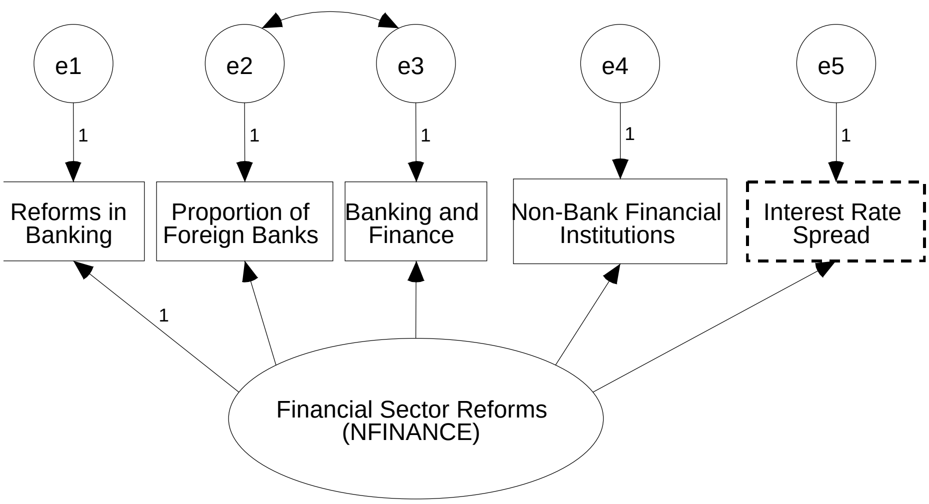
A complementary measure of the quality of banking in transition economies is reported by Heritage Foundation, as a component of their general index of economic freedom. The indicator of Banking and Finance is meant to assess government interference and restrictions imposed on the financial sector, and it combines information on the government ownership of banks, openness of the banking system to foreign entry, the amount of directed credits and the diversity of financial services provided by banks. I normalize and inverse the scale of the original Heritage data series and obtain the indicator NHFBF that ranges in [0,1], with higher values assigned to countries with less restrictions and government interference in the financial sector. A maximum score of 1, reflecting total freedom in the financial sector, is reported for Czech Republic even in very early stages of transition (1993), followed by Estonia with a score of 0.75 in the same year. In year 1993, when the data series reported by Heritage Foundation starts, countries such as Albania, Belarus, Bulgaria, Romania and Russia obtain the same scores as Hungary, Poland and Slovak Republic. Later developments, however, indicate a sustained policy of financial liberalization in the latter countries, while for Belarus a downward adjustment to 0.25 is observed in 2001, Bulgaria is still at the level of 0.50 in the same year, Romania registers a worsening of scores starting with 1999 and the scores for Russia are also changed downwards after the crisis in mid 1998. Signs of significant constraints and government interference in the financial sector are indicated by scores of 0 for Turkmenistan and Uzbekistan all during the transition process. In year 2001, most free financial sectors are indicated for Czech Republic and Estonia (with a maximum score of 1), followed by Armenia, Hungary, Latvia, Macedonia, Poland and Slovak Republic, all of them with scores of 0.75. Modest progress according to this indicator is observed in Azerbaijan, Georgia, Kazakhstan, Tajikistan and Ukraine (0.25) in year 2001.

I also mean to capture the degree of competition, both domestic and competition induced by foreign banks, in the banking sector by employing a measure of interest rate spreads, and an indicator of the proportion of foreign banks in the total number of banks. Interest rate spreads are calculated as differences between the average annual lending rates and the average annual deposit rates, as reported by EBRD. Higher interest rate spreads are usually symptoms of restricted competition in the banking sector. The companion indicator of openness and attractiveness to foreign entry (FGBNK) that I calculate is a crude measure of the sort, in that it is based on the number of foreign banks relative to the total number of banks in the domestic sector. A better picture for the competitive pressure exerted by foreign banks would have been captured by considering the proportion of assets of foreign banks in total domestic banking assets, if it were available. In year 1993, when the number of missing data points starts being negligible, a higher presence of foreign banks in the domestic banking sector is observed for Czech Republic (23% out of 52 banks in total) and Hungary (34% out of 40 banks in total). For Hungary in particular, the score in year 1990 indicates the same degree of openness to the foreign entry in their banking sector as in year 1993. Poland had 87 banks registered in year 1993, out of which 10 banks had foreign ownership. For Russia, the proportion of foreign banks appear very low due to the large number of registered banks in the system. In 1995 Russia had 2297 banks registered, out of which only 21 had foreign ownership. Weak presence of foreign banks is observed during the period 1994-1995 in most of the CIS countries and Bulgaria. In Albania 3 banks, out of a total of 6, had foreign ownership in 1994, and similar numbers are observed for Macedonia. In year 2000 Albania has a total number of 22 banks, with 7 banks with foreign ownership. Higher presence of foreign banks (relative to the size of their own banking system and also in the other transition countries) is observed in Bulgaria, with 25 foreign banks out of a total of 35, Hungary (30 banks are foreign in a total of 38) and to a lesser extent in Poland and Romania, were 64% of banks have foreign ownership.

The indicators of developments in the banking sector are complemented with information on the progress in the securities markets, as reflected by the EBRD indicator of reforms with non-bank financial institutions. The EBRD annually assesses the progress in transition economies with the development of securities markets, and other non-bank financial institutions such as investment funds, pension funds and private insurance both in terms of regulations instituted by the government as well as the level of activity in these areas. I construct a normalized variant of the EBRD index (NNBFI) that follows the original EBRD definition: a value of 0 reflects non-existing or little progress with the development of securities markets and rudimentary corresponding regulations, and a maximum value of 1 is assigned to countries with fully developed financial intermediation outside banks and corresponding laws and regulations comparable with the norms in advance market economies. The EBRD data reflects an early emphasis on non-bank financial intermediation in Hungary, Poland and Slovenia (all with a score of 0.30 as early as 1991, which is their 2nd year of transition). Czech Republic, Estonia, Kazakhstan, Lithuania, Russia, and Slovak Republic reached comparable levels, although slightly lower in some cases, in their 3rd year of transition. Reforms with securities markets are observed in Belarus (0.30) and Ukraine (0.21) as early as 1992. Despite their early start, however, both countries did not make subsequent significant progress during the following years, such that in year 2001 their score is still at the modest level of 0.30. No reforms in the non-bank financial sector are reported for Turkmenistan and Tajikistan. In year 2001, most developed non-bank segments of the financial sector are observed in Hungary and Poland (0.82), followed by Czech Republic, Estonia and Lithuania (0.61) and Slovenia (0.52). The other transition economies register modest levels of development of non-bank financial intermediation even after 10 or 11 years of transition, their highest scores being in the range 0.30-0.39.

In the initial stage of the estimation of the latent factor of reforms in the financial sector (NFINANCE) I construct and test a measurement model that includes all the measures described above (Figure II.6 below).

Figure II.6 Measurement Models for the Latent Factor NFINANCE



Model 1 includes all five observed indicators
Model 2 does not include Interest Rate Spreads

Table II.6 FIML estimation of the latent factor of reforms in the financial sector (NFINANCE)

Measures / Models	Model 1		Model 2	
	Factor Loadings[9] (std. Errors)	Squared Multiple Correlations	Factor Loadings (std. Errors)	Squared Multiple Correlations
Reforms in Banking	*0.925*	0.856	*0.920*	0.846
Banking and Finance	0.0.760** (0.080)	0.587	0.763** (0.079)	0.582
Proportion of Foreign Banks	0.611** (0.072)	0.374	0.605** (0.073)	0.366
Non-Bank Financial Institutions	0.797** (0.049)	0.635	0.802** (0.050)	0.642
Interest Rate Spreads	-0.360** (0.221)	0.130		

Overall Fit Indices for Model 1:
Scaled χ^2 (4df) = 8.402 (0.0779), Std. RMR= 0.019, RMSEA = 0.051 (0.414), CFI=1.000, GFI=0.995, AGFI=0.980

Overall Fit Indices for Model 2:
Scaled χ^2 (4df) = 1.945 (0.16317), Std. RMR= 0.010, RMSEA = 0.058 (0.300), CFI=0.999, GFI=0.997, AGFI=0.974

Max. Sample Size (NxT): 264

** *Robust Standard Errors Significant at 0.05 level*

Bivariate rank correlations estimated for each pair of the five observed indicators reflect a highly positive association between the indicators on reforms and developments in banking and the measure of developments in the non-bank segment of the financial sector. Interest rate spreads are negatively correlated with all the other indicators, with a maximum correlation of –0.540 with the EBRD measure of reforms in the banking sector. For the proportion of foreign banks in the total number of banks the highest correlation is obtained with the EBRD indicator of reforms in banking (0.580) and it is statistically significant at the 0.01 level. Missing data becomes more a problem in Model 1 due to the randomly missing data points in the series of interest rate spreads

[9] Parameter estimates written in italic font correspond to the measures that provide the scale of the latent factor. See Section I.2 for the discussion on choosing the factor scale and its implications.

and the measure of the presence of foreign banks. The total number of complete (listwise) observations is 143, out of a maximum sample size of 264. The estimation procedure, however, takes into consideration all the present data points in the set. For Model 1 a severe deviation from the distributional assumptions of multivariate normality is also obtained. Due to the very high positive kurtosis (41.944) in the series of interest rate spreads, the level of multivariate kurtosis is estimated at 25.20. This is expected to induce significant lack of precision in the parameter estimate associated with the indicator of interest rate spreads and possibly propagate into the system. Estimation results are reported in Table II.6.

Estimation results for Model 1 indicate large, positive and statistically significant loadings for all the observed indicators, with the exception of interest rate spreads. The latter indicator, although statistically significant according to the robust test statistic and with the expected sign, obtains a low loading in absolute value (-0.360) and a very low estimated coefficient of squared multiple correlations(SMC=0.130). These results suggest that the indicator of interest rate spread creates more problems than benefits in the estimation of the latent factor of financial sector. Given its very low validity, I re-estimate the model after eliminating the variable of interest rate spreads from the analysis (Model 2). In Model 2 the estimates obtained for the unconstrained parameters are very similar to the corresponding ones obtained in Model 1. With the exception of RMSEA that stays at a similar level, the model fit indices are also slightly improved. The estimates of the overall fit of the model generally indicates a very good fit, with the model explaining around 97% of the total variance and covariance in the sample. The RMSEA estimate of 0.058 and its associated p-value of 0.300 also indicate a very good fit of the model.

Given the poor performance of the indicator of interest rate spreads and the slightly better fit estimated for the more parsimonious Model 2, I estimate the scores for the latent factor of reforms in the financial sector based on this model. The estimated scores are reported in Table IV, Appendix V. For most of the countries factor estimates are obtained starting with their third year of transition, due to the missing data for the initial years in the series of component indicators. In the 3rd year of transition, significant overall progress with reforms in the financial sector is estimated for Czech Republic (0.56). Scores for the 4th year of transition indicate Czech Republic as the most advanced reformer (0.61), followed by Hungary, Estonia and Poland with similar scores (0.48-0.49). Albania, Belarus, Moldova and Romania obtain scores of 0.30-0.32 in their 4th year of transition, comparable with levels of financial reforms in Bulgaria, Kyrgyz Republic, Russia and Ukraine as observed in their 5th year of transition. Estonia, Latvia, Slovak Republic and Slovenia display similar levels of financial reforms as Hungary and Poland (with an average of 0.50 across countries) in the 5th year of transition. After a decade of transition, highest overall progress in the financial sector is estimated for Hungary (0.81), Estonia (0.75), Czech Republic (0.70) and Poland (0.64). Latvia, Lithuania, Slovak Republic and Slovenia obtain an average score of 0.57 in their 10th year of transition. Almost no progress with reforming their financial system is estimated for Tajikistan and Turkmenistan, and weak reforms in Belarus and Uzbekistan.

The validity of the estimated latent factor of reforms in the financial sector (NFINANCE) is further analyzed by comparing it with a similar indicator reported by Fraser Institute for a subset of transition economies, for year 1990, 1995 and 1999 (see Table I in Appendix III). Fraser Institute constructs a measure of ‘freedom of exchange in capital and financial markets’, based on information related to the deposits held in banks with private ownership, credit extended to the private sector, interest rate controls and regulations that induce negative interest rates, and restrictions on capital transactions with foreigners. The rank correlation coefficient between the two indicators is highly positive (0.802) and statistically significant at the 0.01 level, but it is estimated based on only 28 common data points in the two series (see results reported in Appendix III). A similar comparison between the estimated latent factor NFINANCE and the amount of credit extended by banks to the private sector, as reported in EBRD(2001), reveals a positive and statistically significant correlation estimate of 0.683, calculated based on 129 observations available for both series. Given the estimation results described earlier, as well as the high validity of the factor when compared with alternative or related observed indicators, I conclude that the estimated latent factor of overall progress in the financial sector provides a valid aggregate picture on the respective developments across time and countries.

II.4 Latent Factors of State Governance and Political Environment

Characteristics of state governance and the extent of democratization of the political environment in transition economies have been subject to an increasing interest during the last decade. This is reflected in the numerous efforts invested in the assessment of the quality of government and political institutions in transition economies, as illustrated in Table 1 in Appendix IV. The list of sources is by no means exhaustive in that it mainly focuses on data readily available either on the Internet, or from easily available published materials[1]. Details on other sources of information are to be found at the Internet addresses I report in the appendix.

The main pillars of the state governance concept are represented by measures of the rule of law (ICRG[2], Freedom House, Fraser Institute, Kaufmann, Kraay et al(1999)), protection of property rights (Heritage Foundation, Fraser Institute, World Bank), excessive regulations of businesses (Heritage Foundation, Kaufmann, Kraay et al(1999) and surveys of World Bank and EBRD), and corruption and quality of bureaucracy (ICRG, Transparency International, Freedom House, Kaufmann, Kraay et al(1999), World Bank and EBRD surveys). Measures of the political process in transition reflect both institutions and regulations that guide the political activity (Polity IV; Freedom House) as well as the interference of politics in business (BEEPS[3] survey of World Bank and EBRD). As it is apparent in Table 1 in the appendix, data on governance and political dimensions in the post-communist countries differ greatly in terms of definition and coverage (across time and countries). In the current analysis I use data from sources that provide broadest coverage in time and across countries. I consider the construction of CFA models corresponding to three latent factors:

- Legal and regulatory framework (NLAWREG)
- Interference of Politics in Business (NIPB)
- Political environment (NPOLITIC)

[1] With the exception of ICRG data that are available to subscribers only.
[2] International Country Risk Guide
[3] Business Environment and Enterprise Performance Survey

The first two factors relate to state governance, while the third latent factor focuses on the features of the political process in transition economies.

A similar approach of latent variables employed in order to obtain summarizing indicators of state governance is to be found in Kaufmann, Kraay et all (1999a, 1999b, 2002). The authors collect a very large set of observed indicators from various sources and attempt to combine them in 7 summarizing indicators in order to reflect various aspects of governance and the political process. From the description of the method the authors provide I find it difficult to infer the exact structure of the models of latent variables they employ in the analysis, and therefore there is a very limited scope to compare the models and the results introduced in this section with the associated constructs reported in the studies mentioned above. In terms of the reported estimated results, the authors do not report any statistical measure that conveys the quality (in terms of overall fit of the models, or associated indices) of their models. However, what we do learn is that the empirical exercise results in highly imprecise parameter estimates, and therefore a low reliability of the resulting factors. From the details reported for the data series employed I learn there is a high degree of missing data, which can partly be considered as a reason for obtaining very high standard errors of the parameter estimates. Reporting the model fit indices would have proved highly informative in terms of further understanding the reasons behind the weak results of their empirical endeavors.

Another study that makes an attempt to use latent variables and confirmatory factor analysis for the analysis of institutions in transition is Raiser, Di Tommaso et al(2000). Institutional change is interpreted by the authors in terms of the EBRD indicators for enterprise reforms, competition policy, reforms in the banking sector and non-bank financial institutions, and two additional indices reported by EBRD in connection to the extensiveness and effectiveness of company laws. The authors employ a MIMIC model that relates the latent factor of institutional change, based on the dimensions specified above, to other (manifest) variables of initial conditions, political environment, price liberalization, small scale privatization and a measure of number of year with inflation levels lower than 30%, and budget deficits lower than 5%. The reading of the estimated results of the MIMIC model indicates very low factor loadings in the measurement model (much lower than the empirical cutoff value of 0.70), and an associated weak overall fit of the model. I interpret the analysis in the study as an example of what is known as 'nominal fallacy' in the SEM literature. The 'nominal fallacy' concept refers to situations when the name chosen for the latent factor does not prove compatible with the observed measures employed for the estimation of the factor. The analysis in the study mentioned above is an example of the perils associated with the application of the methods of latent variables without a solid concern for the theoretical compatibility between the latent factor and the measures employed as reflecting its dimensions.

Latent Factor of Laws and Regulations

The indicators I use to estimate the latent factor of legal and regulatory framework **(NLAWREG)** come from Heritage Foundation (government regulation of businesses and protection of property rights) and ICRG (rule of law index). The HF[4] Government Regulation of Businesses Index measures the extent to which government regulations hinder business activities. I normalize the original HF index and inverse its scale in order to obtain a normalized variable (THFR) in the range [0,1]. A value of 0 is assigned to countries where government seriously impedes business activities and the creation of new startups. Corruption in such cases is deemed to be widespread, with regulations applying randomly in most situations. The maximum score (one) is obtained whenever straightforward regulations apply equally to all active legal businesses in the country. Bureaucracy is corruption-free and economic agents do not perceive government regulations as impeding their activity. The interesting aspect revealed by the Heritage Foundation data is that in many of the transition economies scores on the quality of regulations worsened as transition proceeded. Czech Republic started with a maximum score of 1.00 in year 1993, and reached the level of 0.50 by year 2001. Similar developments are observed with Hungary and Slovak Republic. Russia displays a dramatic deterioration in the quality of regulations in time, as indicated by the initial score of 0.75 in year 1993 and the value of 0.25 registered in 2001. For Estonia and Poland the Heritage Foundation assessment indicates the same (stable) levels of the quality of government regulations during the period 1993-2001 (0.75 for Estonia, and

[4] Heritage Foundation

0.50 for Poland). Improvements in the quality of laws and regulations in time are observed for Slovenia, especially during the most recent three years of transition (reaching a score of 0.75 in 2001). As a general trend, the scores for the CIS countries indicate a significantly lower level of quality regulations (0.25), when compared with countries in CEE, and no progress through time. Uzbekistan and Belarus are positioned at the lowest end of the scale, with a score of 0 in year 2001. Countries in SSE region are assigned the same low score (0.25) in year 2001, although their developments through time differed. Romania stagnated at the level of 0.25 during the period 1993-2001, while Albania and Moldova display a deterioration of scores during 2000 and 2001, compared to their previous level of 0.50.

The second measure included in the latent factor of laws and regulations focuses on the extent to which government guarantees and protects private property in transition economies. The HF index on Property Rights Protection combines information on government intervention and corruption into the judicial system, delays in receiving judicial decisions, the existence and use of a commercial code in defining contracts, government expropriation of private properties, and legal guarantees and protection for private property. The original HF index is normalized in the range [0,1] in order to obtain a variable (THFPR) that takes a minimum value of 0 for countries where almost all property belongs to the state and/or private property is outlawed, or it is not legally recorded due to corruption and chaos. The maximum score of 1 is assigned to countries where private property is guaranteed by the government, and an efficient judiciary enforces contracts. The risk of expropriation is believed to be minimal in those cases. Consistently high scores on the protection of property rights provided by the state are observed for Czech Republic, Estonia and Hungary during the period 1993-2001 (with a constant level of 0.75). Poland displays a lower score (0.50) in 1993, but it reaches the level 0.75 in 1995 and stays there at least until 2001. Deterioration of scores in time is observed in Albania, Belarus, Croatia, Russia and Slovak Republic. In year 2001, best protection of property rights is ensured in Czech Republic, Estonia, Hungary and Poland (all with a score of 0.75), followed by Armenia, Bulgaria, Latvia, Lithuania, Moldova, Slovak Republic and Slovenia (with scores of 0.50). All the other transition countries register a level of 0.25 in year 2001.

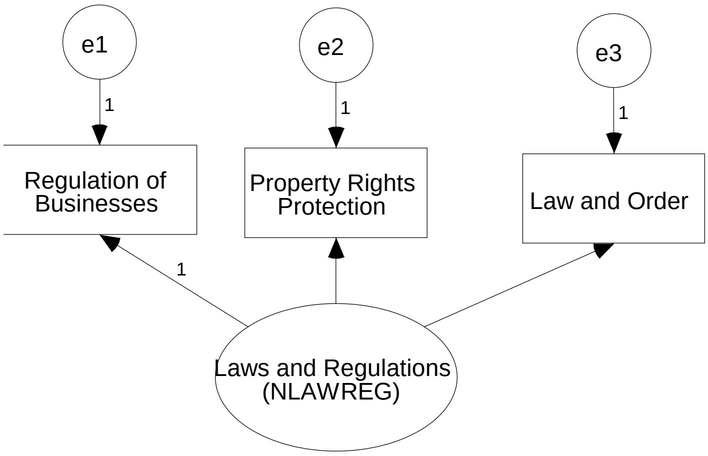
The quality of the judicial system is also captured by the ICRG index of Law and Order. The ICRG measure combines information on the strength and impartiality of the legal system (LAW) and the assessment of the popular observance of the law (ORDER). I normalized the data acquired from ICRG[5] in order to obtain a variable (LWOD) that takes a continuum of values in the range [0,1]. The higher the score obtained by a country for LWOD, the better the rule of law in the country. There is a high degree of missing data in ICRG series on Law and Order, especially for CIS countries, but also for Croatia, the Baltic states, Macedonia and Slovenia. From the data points that are present, I learnt that in 1992 ICRG scored all of the former USSR republics at the same level, with the exception of Russia, which obtains a lower score. In 1992 Poland displays the maximum score across countries, followed by Bulgaria, Czech Republic, Hungary and Slovak Republic. In year 2000 Poland, Hungary, Estonia and Slovak Republic lag behind Croatia, Czech Republic, Latvia, Moldova and Slovenia in terms of the perceived law enforcement and order, as assessed by ICRG.

The estimation of the latent factor of laws and regulations is based on all the three observed indicators described above (see diagram in Figure II.7 below). Descriptive statistics, bivariate correlations and the extent of missing data for each series are included in Appendix IV. Missing data constitutes an acute problem for the ICRG series of Law and Order, with 50% of the data points missing (there are 131 observations with data points present, out of the maximum possible of 264). For the Heritage Foundation data, the extent of missing data points amounts to 27%, as 195 observations are valid. Given that data is missing randomly across countries and time, the combined data set of the three indicators is left with only 89 observations valid listwise (that is a 66% of missing data). The implication is that, although the factor loading estimates are based on all of the data points present in the set, the number of data points that I can actually estimate for the latent factor is only 89 (corresponding to the number of observations that are complete listwise). Distributional properties do not constitute a major concern in this model, as the estimated level of multivariate kurtosis is at the modest level of –0.788. The highest bivariate rank correlation is estimated

[5] Data obtained directly from ICRG is combined with IRIS data for data points missing the ICRG data set. IRIS data series is constructed based on ICRG ratings collected from published materials. IRIS Center can be found at http://www.iris.umd.edu/

between the two indicators of Heritage Foundation (0.782), while correlations between them and the ICRG indicator on law and order are surprisingly low (with a maximum correlation of 0.476 between the HF property rights protection and the ICRG law and order).

Figure II.7 Measurement model for the factor of laws and regulations (NLAWREG)



Estimation results for this model are presented in Table II.7.

Table II.7 FIML Estimation of the latent factor NLAWREG

	Factor Loadings (std. Errors) [6]	Squared Multiple Correlation
Regulation of Businesses	*0.808*	0.654
Property Rights Protection	0.968** (0.118)	0.936
Law and Order	0.590** (0.144)	0.348
Overall Model Fit Indices: *just – identified model* Maximum Sample Size (NxT): 195		

*** Robust Standard Errors Significant at 0.05 level*

[6] Parameter estimates written in italic font correspond to the measures that provide the scale of the latent factor. See Section I.2 for the discussion on choosing the factor scale and its implications.

The consequences of the large amount of missing data are reflected in the relatively large standard errors obtained for the parameter estimates. This indicates lack of precision in estimating the factor loadings, especially for the indicator of law and order. All factor loadings are estimated with the expected sign, and they suggest a particularly high validity of the measures on property rights and the regulation of businesses. The LWOD indicator obtains a lower factor loading, and its SMC coefficient indicates that the latent factor explains only 35% of its variance. These results suggest that we could benefit from using an alternative measure instead of the ICRG one, if it were available. Given the large amount of missing data in this series, a more precise comparison of this measure with the other two that I consider, across all transition economies and time, is rendered difficult. However, as I did not find a more complete alternative measure, for illustration purposes only I base the estimation of the latent factor of laws and regulations on the model at hand.

As mentioned above, I obtain a number of 89 estimated data points for the factor NLAWREG, which limits the possibilities of extensive comparisons across all transition economies (see Table 5 in Appendix V). Most complete data series are obtained for Albania, Bulgaria, Czech Republic, Hungary, Poland, Romania, Russia and Slovak Republic for the period between their 3^{rd} year of transition and their 10^{th} corresponding year of transition. During the first half of the transition period, relatively better overall quality of laws and regulations is indicated for Czech Republic (0.78 in the 3^{rd} year), Hungary (0.75 in the 4^{th} year), and Slovak Republic (0.76 in the 3^{rd} year, but lower in the following year). Poland registers a score of 0.52 in the 4^{th} year of transition, at the same level with Russia and Albania in their 3^{rd} year of transition. Further developments, however, indicate an improvement of laws and regulations in Poland (reaching 0.72 in the 10^{th} year of transition), while scores of Albania and Russia worsen considerably through time. For the 10^{th} year of transition, significant progress with laws and regulations is estimated for Czech Republic, Estonia, Hungary, Poland and Slovenia (with scores between 0.72-0.75), followed by Slovak Republic, Latvia and Lithuania (with an average of 0.51) and Bulgaria (0.48) in the same year. Albania, Croatia, Romania and Russia lag even further behind.

The next step of the analysis is to compare the estimated scores obtained for the latent factor of law and regulations (NLAWREG) with alternative indicators constructed by other methods (see Appendix IV for a summary of results). I find related indicators with Freedom House, Fraser Institute, and the database described in Kaufmann, Kraay et al(1999a, 1999b, 2002). Freedom House provides a measure of Governance and Public Administration, comprising information on legislative bodies, local government institutions, and legislative and executive transparency for the period 1997-2001 (see Table 1 in Appendix IV). The higher the values of the FH index, the less freedom related to state governance and public administration. The rank correlation estimated between the latent factor NLAWREG and the FH index is –0.876 and highly statistically significant, indicating similar rankings of countries across the panel and cross. Similarly, high correlations are estimated between NLAWREG and two indicators included in KKLZ database: Regulatory Quality (0.834) and Rule of Law (0.810), but the comparison is at best preliminary as it is based on only 11 common observations available. A lower correlation (0.600) is estimated for the Fraser Institute measure of Laws and Property Rights, based on 21 common observations.

Latent Factor of Political Interference in Business

The second latent factor of state governance, called the interference of politics in business **(NIPB)**, summarizes information on the extent of corruption at the administrative and political levels, and on the quality of bureaucracy that is usually closely related to administrative corruption. The measure of Perception of Corruption comes from Transparency International[7]. TI scores reveal the perception of businesspeople, risk analysts and the general public on the extent of both administrative and political corruption in the country[8]. For the purpose of the current analysis I normalize and inverse the scale of the TI data, and obtain a continuous variable (TTICPI) in the range [0,1], taking the value of 0 for countries perceived as almost corruption – free, and the maximum of 1 for countries where corruption is considered to be endemic. According to Transparency International assessment, corruption has been on the rise in all transition economies during the period 1995-2001 when data is available. In year 1995, highest levels of corruption were observed in all CIS countries,

[7] Data series is updated in Abed and Davoodi (2000) based on additional sources.
[8] For details on the methodology and sources see Lambsdorff(2000)

with a minimum score of 0.65 for Moldova and a maximum score of 0.86 for Tajikistan. Least corruption is indicated in Slovenia (0.07), Hungary (0.12), Czech Republic and Poland (0.14) and Estonia (0.29) in the same year. Among the countries in the SEE region, a minimum score is indicated for Croatia (0.40) and a maximum level of corruption in Albania (0.67). In year 1999, when scores for all transition economies are reported, Estonia reached a level of 0.43, although this proves to be the minimum score across all transition countries in that year. For Hungary and Slovenia slightly higher levels of corruption are estimated (0.47 and 0.48) and Bulgaria, Croatia, Czech Republic and Poland are all at almost the same level (with an average of 0.50). Most pervasive corruption is signaled in Azerbaijan and Ukraine (0.85), Russia (0.79), Armenia, Moldova and Uzbekistan (with 0.75 on average) and Kazakhstan and Romania (0.70 on average).

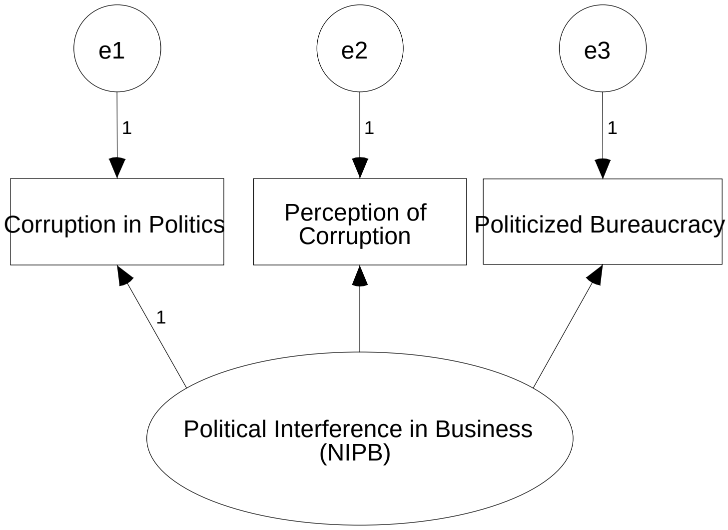
A second measure of corruption which complements the TI measure is taken from ICRG and it focuses mainly on corruption in the political arena. As defined by ICRG, this measure combines information on actual or potential corruption in the form of *'excessive patronage, nepotism, job reservations, favor-for-favors, secret party funding, and suspiciously close ties between politics and business'*. It is less concerned with petty corruption or corruption related to police protection or soft financing. I use a variant of the ICRG score in that I normalize and inverse the scale of the original ICRG data series. The resulting indicator (CORRY) takes a continuum of values in [0,1], with higher values corresponding to more corruption in the political system. As mentioned above, data reported by ICRG has a more limited coverage across countries, as data is missing for the CIS countries for almost all years until 1999, with the exception of the year 1992. In year 1992, least corruption at the political level is indicated for Bulgaria, Czech Republic, Hungary, Poland and Slovak Republic. Highest scores are obtained for Albania, Croatia, Macedonia and Moldova. In year 2000, Russia is considered as having by far the highest level of grand corruption, followed by Albania, Armenia, Azerbaijan, Kazakhstan and Ukraine, all with a comparable level of political corruption. Least corruption at the political level is indicated in Hungary and Estonia, with Czech Republic, Slovak Republic and Slovenia lagging behind them. For Poland, ICRG evaluates the same level of political corruption as in Belarus, Bulgaria, Croatia, Latvia, Lithuania and Romania in year 2000.

Measures on corruption used for the estimation of the NIPB latent factor are complemented with an indicator of the quality of bureaucracy constructed by ICRG. Although not a direct measure of corruption, this indicator reflects the extent to which bureaucracy is independent from political pressure and it is relatively strong in terms of regulations and provision of public services. A weak bureaucracy from this perspective constitutes a handicap in that changes in government affect day-to-day business activities to a larger extent via drastic changes induced in the bureaucratic structure. This indicator is used as a proxy for the 'bridge' between politics and bureaucracy. It is to be expected that a weaker and politically dependent bureaucracy would have less opportunities to establish a mechanism for recruitment and training based on meritocracy, and would thus be more prone to administrative corruption. I normalize and inverse the scale of the original ICRG data series, and obtain an indicator of the extent to which the bureaucracy is weak and politically dependent (IPBUR). The indicator ranges in [0,1], and the higher its value the weaker the bureaucracy in terms described above. In year 2000, weaker bureaucracies are signaled in most of the CIS countries, and Albania and Romania. Most politically independent bureaucracy is indicated in Hungary, followed by Croatia, Czech Republic, Estonia, Poland, Slovak Republic and Slovenia.

The diagram of the measurement model used to estimate the factor of political interference in business (NIPB) is illustrated in Figure II.8.

Bivariate correlations between indicators, data distributional properties and missing data problems are summarized in Appendix IV. I estimate a high correlation between the two indicators of corruption (0.828), statistically significant at the 0.01 level and based on 79 common cases. The rank correlations between corruption and the degree of politicization of bureaucracy are lower (a maximum of 0.638 with the Transparency International perception of corruption), although still at a significant level. Missing data constitute a problem in this case also, especially for the ICRG data series (there are only 132 data points in the series of Corruption in Politics, and 100 data points in Politicized bureaucracy, compared to a maximum possible sample size of 269).

Figure II.8 Measurement model of the latent factor NIPB



Transparency International data series includes 143 data points, which amounts to 47% of missing data. The total number of data point estimates (79) I finally obtain for the latent factor is even lower than in case of the previous latent factor. As I could not find alternative, similar and more complete, data series I estimate the factor based on the available data set and its associated model. Estimated coefficient of multivariate kurtosis indicates a moderate to low level of –1.521. Estimation results are presented in Table II.8.

The estimated results indicate there is a potential in obtaining a highly relevant latent factor, if it were not for the large amounts of missing data in the sample. The high factor loadings obtained signal a high validity of the observed measure used, although the associated standard errors are also high. I believe that the lack of precision is most likely due to the acute missing data problems. As in the case of the previous model, no overall fit indices are reported as the model is exactly identified.

More complete data series for the factor NIPB are estimated for Albania, Bulgaria, Czech Republic, Hungary, Poland, Romania, Russia and Slovak Republic for the period between their 4th and the 10th year of transition. Data points are obtained sporadically for the other transition countries in various years also (see Table 6 in Appendix V).

Table II.8 FIML estimation of the factor NIPB

	Factor Loadings (std. Errors) [9]	Squared Multiple Correlation
Corruption in Politics	*0.896*	0.803
TI Perception of Corruption	0.850** (0.135)	0.723
Politicized Bureaucracy	0.667** (0.145)	0.446
Overall Model Fit Indices: *just – identified model* Maximum Sample Size: 143		

*** Robust Standard Errors Significant at 0.05 level*

Across years, most complete series is obtained for the 9th year of transition, when I estimate higher interference of politics in business in Russia, Ukraine, Azerbaijan, Albania and Armenia, and lowest levels in Poland, Estonia and Hungary.

Related indicators on corruption and political interference are also reported by other sources (See Table 1 Appendix IV), such as Freedom House (for all transition economies, during the period 1999-2001), BEEPS Survey (year 1999) on private sector in transition economies, and the database in Kaufmann, Kraay et al(1999,2002) for years 1998 and 2001. The correlation of the latent factor NIPB is highest with Freedom House indicator of Corruption (0.875), and lower for the indicator on the Control of Corruption reported in KKLZ database (0.718). Both estimated correlations are statistically significant at least at the 0.05 level. The correlation with the indicator of 'Corruption as an Obstacle to Business' reported by the BEEPS survey is estimated at the lower level of 0.642, and statistically significant at 0.01 level. Given that the number of common data point is usually low (with a maximum of 37 for the Freedom House data), these comparisons should only be considered as illustrative and not necessarily a definite proof of the validity of the latent factor.

[9] Parameter estimates written in italic font correspond to the measures that provide the scale of the latent factor. See Section I.2 for the discussion on choosing the factor scale and its implications.

Latent Factor of Political Environment

The latent factor constructed to differentiate countries in terms of the political environment they constructed during the transition process, called simply political environment **(NPOLITIC)**, is based on data included in the Polity IV Project developed by Center of International Development and Conflict Management at University of Maryland, and on the indices of political rights and civil liberties provided by Freedom House. In constructing the factor NPOLITIC I start with the definition of political democracy provided by Bollen(1990)[10]. The author defines democracy in terms of political rights (including fairness of elections, the nature of the recruitment of the chief executive and the effectiveness and nature of the national legislatures) and political liberties (in terms of freedom of press, freedom of political parties to organize and oppose the government and the civil liberties of citizens). The Polity IV database[11] includes data on transition economies related to various facets of political institutions in those countries. Component variables are organized along three main concepts: the nature of the recruitment process of the chief executive, the constraints imposed on the executive and the nature of the political competition. Distinct dimensions of the three concepts are then used to construct composite indicators on institutionalized democracy, autocracy and a general indicator on polity (calculated as a sum of democracy and autocracy indices). Points are assigned to the index of Institutionalized Democracy whenever each of the following conditions apply[12]:

- Competitiveness of political participation: there are stable political groups that compete at the national level and there is a voluntary transfer of power from the ruling group to competing parties.
- Competitiveness of executive recruitment: chief executives are chosen through competitive elections with two or more participants (major parties or candidates).

[10] The paper discusses alternative measures of democracy used in empirical work and their shortcomings.
[11] A detailed presentation of the database is to be found in Marshall and Jaggers (2000).
[12] This description considers only the main elements used to construct the index. There are situations of transitional arrangements for each category that I do not present in this section but they are included in the final scores. For details see the reference on Marshall and Jaggers (2000)

- Openness of Executive Recruitment: recruitment is considered open if there is a regularized process that provides opportunities for the politically active populations to access the top of political arena. Points are assigned in cases where the chief executive is chosen by either elite designation or competitive elections, or by transitional arrangements between the two.
- Constraints on the chief executive: democracy is considered stronger if there are substantial constraints on the decisional discretion of the chief executive, such as in parliamentary political regimes. Higher scores are assigned in situations when the legislature or a ruling party, or other accountability groups, have a considerable greater power than the chief executive in many or most important areas. Lower scores are assigned when the chief executive has more effective authority than the accountability groups, but it is substantially restricted by them (those are situations when the legislature often modifies or rejects executive proposals for action, or when they make appointments to important administrative positions)

The Polity IV index of Institutionalized Democracy ranges on a scale from 0 (when none of the conditions above apply) to 10 (when maximum score is obtained for each category). I normalize the index in order to obtain a variable (NDEM) that ranges in [0,1], with a maximum of 1 obtained in full democracies, and a value of 0 at the other extreme, when none of the democratic dimensions are observed. According to this evaluation, in earlier stages of transition (year 1992), higher levels of institutionalized democracy were observed in Hungary, Lithuania and Slovenia (with a maximum score of 1), followed by Bulgaria, Czech Republic, Latvia, Poland and Slovak Republic (0.80). No signs of institutionalized democracy in 1992 are indicated for Tajikistan, Turkmenistan and Uzbekistan (with a score of 0), and incipient democracy is assessed in Croatia, Kazakhstan, and Azerbaijan (with a score of 0.10). In year 1999, the most democratic regimes are indicated in Hungary, Lithuania, Poland and Slovenia (all with a maximum score of 1), followed by Bulgaria, Czech Republic and Slovak Republic (0.90). Azerbaijan, Belarus, Turkmenistan and Uzbekistan show no signs of a democratic polity in 1999.

As mentioned in Marshall and Jaggers(2000), democratic elements can coexist with autocratic traits, especially in polities in transition from a fully autocratic regime towards democracy. Full autocracy is defined as a polity where competitive political participation is highly restricted or suppressed, and the executive leadership, chosen from within the political elite, is unchallenged by institutional constraints. The Index on Autocracy constructed in Polity IV is defined in terms of distinct political dimensions that include the following:

- Competitiveness of Recruitment: Autocracy traits are considered in the form of pure designative selection of the chief executive or hereditary succession (as in monarchies). Evidence comes in the form of unopposed elections, frequent replacement of presidents before their term ends, selection of civilian executives by the military, repeated election boycotts by the opposition parties etc.
- Openness of Executive Recruitment: Autocracy points are assigned in situations where there are very limited possibilities, if any, for the politically active population outside the incumbent political elite to have access to the top executive position. Chief executives are selected from within the political elite only.
- Constraints on the Executive: Absence of regular constraints on the executive actions is described as situations when the constitution is frequently revised at the executive's initiative, the legislature does not exist or has little authority, the executive has considerable discretion in appointing and dismissing members of accountability groups and executive decrees are frequently issued and applied. A lower score is assigned when there are some but weak constraints in the executive. In such cases there is an independent judiciary that initiates some categories of legislation and blocks the implementation of executive decrees, but the authority of the executive still prevails in most important areas.
- Regulation of Participation: Political participation without intense factionalism is allowed, but there are considerable restrictions on significant groups often excluded from the political process altogether. The incumbent political group favors group members and restricts the political activity of competing groups.
- Competitiveness of Participation: Autocracy scores are added for polities where no significant active political opposition is permitted outside the ranks of the incumbent party. Lower scores are also assigned when some organized political competition does occur outside the government, but without serious factionalism

and the regime systematically limits it. Examples of suppressed political participation are situations when some kind of political action (such as communist parties) is allowed to organize, but prohibited from competing in elections. Systematic harassment of political opposition (such as leaders killed, jailed or sent to exile, opposition media banned etc) is also considered evidence of Autocracy traits of the polity.

Note that, although both Institutionalized democracy and Autocracy are defined in terms of the same main concepts, the particular dimensions that are considered in constructing the indexes are not the same.

The index of Autocracy ranges on a scale from 0 to 10, with 0 representing complete absence of autocratic traits, and a maximum of 10 for strongly autocratic polities. I normalize and *inverse* the scale of the Polity IV index on Autocracy in order to obtain the variable (NATCY) ranging in [0,1] with the reverse interpretation: a maximum value of 1 represents no evidence of autocratic dimensions for the polity, and a value of 0 for strong autocratic elements. For year 1992, significant autocratic features are indicated for the political environment in Turkmenistan and Uzbekistan (0.18), followed by Tajikistan (0.42), and to a lesser extent in Croatia and Kazakhstan (0.64). In year 1999, more autocratic regimes are evaluated in Uzbekistan (still at the level of 0.18), Turkmenistan (0.27), Azerbaijan and Belarus (with a score of 0.38) and Kazakhstan (0.64). Almost all the countries in Central and Eastern Europe show little political autocracy traits, if any, in year 1999.

An alternative measure of political liberties is reported by Freedom House in the form of the index of Political Rights[13]. I include this indicator mainly with the objective of cross-validation of information included in the two Polity IV measures. The FH measure of political rights largely addresses the same dimensions of democracy as discussed in the preceding paragraphs, namely the nature of recruitment process of the executive, the existence of an independent legislature, freedom ad fairness of elections, the scope of political opportunities to access top positions in the political arena, possibilities to organize political opposition and the political status of ethnic, religious

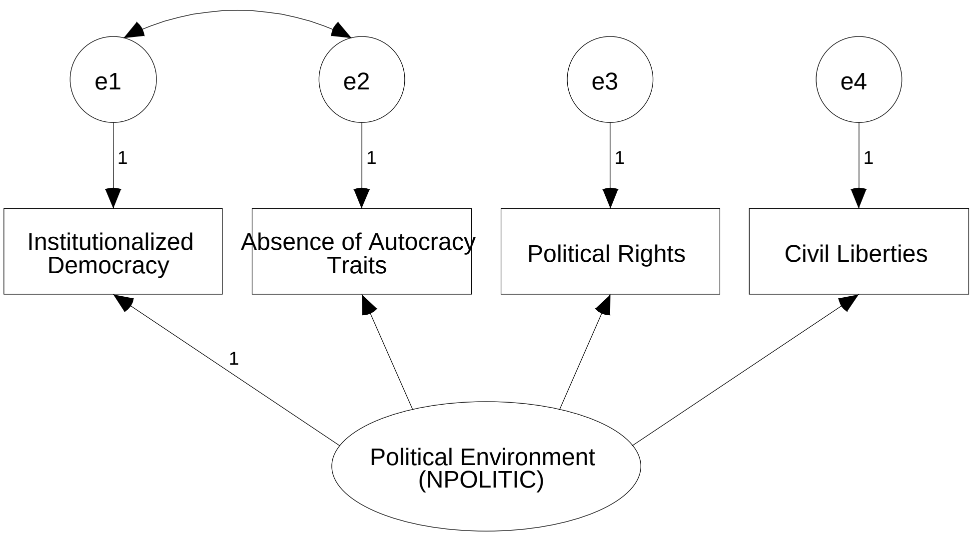
[13] For details on the methodology and the check lists based on which scores are assigned for Political Rights and Civil Liberties see: :www.freedomhouse.org/research/freeworld/2001/methodology.htm

and other minority groups. I normalize and inverse the scale of the original FH indicator and obtain a continuous variable (POLRGH) in [0,1], that takes increasing values for more extensive political liberties in the country.

The measures on political rights and liberties are then complemented with an indicator of civil liberties, as constructed by Freedom House. The index of Civil Liberties (CIVLIB) comprises information on freedom of expression and beliefs (including independence of media and other means of cultural expression), rights to assemble, demonstrate and organize open public discussions, the functioning of the judiciary in civil and criminal matters, protection from political terror and oppression, and personal autonomy and economic rights for the citizens of the country. The indicator used in this analysis (CIVLIB) is obtained by inversing the scale of and normalizing the original FH index. CIVLIB takes a continuum of values in [0,1], with the maximum of 1 corresponding to extensive civil liberties, and the minimum of 0 assigned to a polity that highly oppresses the civil society in the country.

The measurement model for the latent factor of political environment is illustrated in the diagram in Figure II.9 below.

Figure II.9 Measurement model of latent factor NPOLITIC



Bivariate rank correlations between the observed indicators and the distributional properties of the data are summarized in Appendix IV. All of the four observed indicators correlate highly with each other, and the estimated correlation coefficients are statistically significant at the 0.01 level. Missing data does not constitute a serious problem in this case, when compared to the previous models in this section. As the data in Polity IV database is available until year 1999 at the time of writing this study, the missing data in the two corresponding series amounts to 55 data points (out of a maximum possible of 269). The estimated coefficient of multivariate kurtosis in the data indicates a relatively low level of negative kurtosis of –1.051.Estimation results are reported in Table II.9.

Table II.9 FIML estimation of the latent factor of political environment

	Factor Loadings (std. Errors) [14]	Squared Multiple Correlation
Institutionalized Democracy	*0.900*	0.810
FH Political Rights	0.986** (0.033)	0.973
Absence of Autocracy Traits	0.822** (0.049)	0.675
FH Civil Liberties	0.937** (0.035)	0.878
Overall Model Fit Indices: Scaled χ^2 (1df) = 3.570 (0.05883), Std. RMR= 0.004, RMSEA = 0.09 (0.171), CFI=0.998, GFI=0.995, AGFI=0.950 Maximum Sample Size: 269		

*** Robust Standard Errors Significant at 0.05 level*

The estimates produced by the model suggest very good factor loadings, when compared to the empirical threshold of 0.70, and an excellent overall fit of the model. The latent factor NPOLITIC explains very high proportions of the variance in the indicators of democracy and civil rights, and to a lower extent the variance in the indicator of autocracy traits. The estimated value for the fit index AGFI indicates that

[14] Parameter estimates written in italic font correspond to the measures that provide the scale of the latent factor. See Section I.2 for the discussion on choosing the factor scale and its implications.

model captures 95% of the total variance and covariance in the sample. Therefore, the latent factor NPOLITIC provides a reliable measure of a democratic political environment, in that a higher level of institutionalized democracy, as observed by the two sources, is associated with more civil rights and weak signs of autocratic behavior of the political leadership.

The estimated scores for the factor NPOLITIC, included in Table 7 in Appendix V, indicate a highly democratic political environment in Bulgaria, Czech Republic, Hungary, Slovak Republic, and to a lower extent in Poland and Ukraine in the 1st year of transition. During the transition process, most of the countries in Central and Eastern Europe (CEE and SEE regions) further liberalized their political environment towards higher democracy, while in some of the CIS countries there has been no improvement (Turkmenistan) or even a deterioration of their incipient level of democracy (Belarus, Azerbaijan, Uzbekistan). In the 9th year of transition, most democratic regimes and strong civic rights are observed in Czech Republic (0.96), Estonia, Hungary, Bulgaria, Slovak Republic and Slovenia, Poland and to a lower extent in Romania (0.83). Significantly lower levels are indicated for Albania (0.48) and Croatia (0.46).

The expected high validity of the latent factor NPOLITIC is also illustrated by a high rank correlation (0.948) with the indicator of Voice and Accountability reported in the Kaufman, Kraay et all(1999a, 1999b, 2002) dataset (see Table 1 in Appendix IV for details), for the year 1998 when the latter indicator is available.

II.5 Summary of Results and Comparisons of the Latent Factors

There are three main stages in which the analysis of latent factors in the previous sections unfolds:

1) At the conceptual level, I analyze the definition of each of the component measure employed for a specific factor in order to ensure its compatibility with the broader definition of the factor, and limit the possibilities of capturing spurious correlations. This amounts to formulating an *a priori* hypothesis on the way in which the observed measures relate to a common latent factor.
2) Having selected the set of observed indicators for each latent factor, I then perform the econometric analysis of specified measurement models in order to test statistically whether there is enough evidence in the sample data that supports the a priori hypothesis formulated in stage 1) above. The validity of the observed measures is reflected both by the magnitude, sign and precision of the parameter estimates, and by by the overall fit of the model. Whenever necessary, alternative specifications of a measurement model are considered.
3) After the econometric analysis of a measurement model is performed, and the scores of the latent factors are estimated, I further compare the estimated latent factors with alternative indicators available from other sources. These comparisons are considered as illustrative only, and not as a proof for the validity of the estimated factors, given the fact that the alternative indicators that I find available do not necessarily follow the same definitions as the latent factors. Furthermore, they usually cover very short periods of time, and/or only a subset of transition countries.

The same empirical strategy is applied in the analysis of four categories of latent factors: initial conditions, economic reforms, state governance and political environment.

For initial conditions two latent factors are analyzed. *The first concept* is a latent factor of time-invariant initial conditions (IC I), comprising information on geographical location of transition countries, the duration of the communist regime they experienced before transition started, and the dominant religion in each country.

Estimation results show a high degree of compatibility between the observed indicators, providing confidence in the resulting latent factor ***ICI***. The interpretation of the estimated factor is that of an index of unfavorable time-invariant initial conditions. The higher the scores obtained for ICI, the less favorable the initial conditions along the specified dimensions.

The second factor of initial conditions is meant to capture the extent of structural economic imbalances (***ICII***) in transition economies at the start of transition (mostly as measured in year 1990). I report results for a measurement model including information on countries' dependence on CMEA trade, the share of services, the share of agricultures, as well as previous exposure to economic reforms relevant from a market economy perspective. The estimation results indicate that the informational content in these observed indicators in not homogenous enough to warrant aggregation. As country rankings differ considerably across indicators, a process of linear aggregation carries the risk of diluting their original information content. In earlier stages of the analysis I also tried to follow the example provided in previous empirical studies and include measures of past economic performance, over-industrialization, repressed inflation and black market exchange rate premiums, but all these attempts proved unsuccessful. For illustrative purposes only, I still estimate the factor of initial structural economic imbalances and compare it with the first factor of fixed initial conditions. I find a low correlation between the two factors, indicating that countries with more favorable fixed initial conditions did not necessarily have less structurally imbalanced economies at the start of transition. I interpret this result as preliminary support for the hypothesis that differentiating among types of initial conditions may prove more rewarding in the analysis of the impact of initial conditions on economic developments during transition.

For the category of economic reforms, I conceptualize and estimate three latent factors of reforms. *The first* latent factor focuses on the liberalization of relative prices (***RELPRICES***) in transition economies. The relevant dimensions included relate to liberalization of domestic prices, liberalization of foreign exchange markets and international trade, and liberalization of wages. Significant differences, in terms of rankings across countries and time, are found between the measure of price liberalization produced by EBRD, and the index of wages and prices produced by Heritage Foundation. I attribute these discrepancies to the different definitions of the two indices. Econometric analysis of the model reveals a low validity of the EBRD measure of price liberalization, relative to the other indicators included. The final scores of the latent factor are estimated based on a model that does not include the EBRD measure on price liberalization. Estimates in this latter model suggest a reliable estimation of the latent factor RELPRICES based on the remaining indicators.

The second factor of reforms, enterprise sector transformation (***NENTREF***), summarizes information on privatization, restructuring and competition policy. All the observed dimensions included in the model are highly correlated with each other, and the estimation results indicate their high validity for the latent factor of enterprise sector transformation. Analysis of this latent factor suggests that, despite some of the perceived differences among countries in terms of their specific policies of privatization, restructuring and competition policy, there appears to be a general strong tendency for some countries to act simultaneously on all dimensions when compared to other countries, and through time. The factor of NENTREF is found to highly correlate with a measure of privatization constructed by Freedom House for transition economies.

Similar reliable results are obtained for the *third latent factor of reforms*, liberalization in the financial sector (***NFINANCE***). The factor combines information on interest rate liberalization, introduction of appropriate regulations and prudential supervision of banks, government interference in the banking sector, openness of the domestic banking sector to foreign entry, and reforms with securities markets and other non-bank financial institutions. All these dimensions (that I consider as reflections of progress with reforms in the financial sector) combine in a robust and reliable manner into the latent factor NFINANCE. The estimated latent factor NFINANCE also correlates highly with the measure of ‘freedom of exchange in capital and financial markets’ conceived by Fraser Institute for some of the transition economies, and with the amount of credit extended to the private sector by banks, as reported by EBRD.

Latent factors of state governance focus on the quality of laws and regulations (***NLAWREG***) and the extent of political interference in business (***NIPB***). The factor NLAWREG comprises information on regulation of businesses, protection of property rights, and the perceived functioning of laws. The latent factor NIPB includes dimensions of political and administrative corruption, and the extent to which bureaucracy is politically independent. The main problem that I have in estimating these two latent factors is the large amount of missing data in the data series I operate with. Although the estimated factor loadings are large in magnitude and with the expected signs, their associated standard errors are rather high, suggesting lack of precision. The net result of the estimation of the factors NLAWREG and NIPB is a low number of data points, given the randomly missing data in the original series on which estimation is based. I view these results more as indicative of a strong potential in estimating meaningful factors of the sort, if more complete observed data series were available.

The latent factor of political environment (***NPOLITIC***) summarizes information on the characteristics of political interactions between the existing power poles and their satellites in the polity. In the analysis of the factor I consider measures of institutionalized democracy, absence of autocracy traits and civil rights. Estimation of this factor reveals significant confidence in its reliability. It is also found to correlate highly with a similar indicator, Voice and Accountability, constructed in Kaufmann, Kraay et al (1999,2002).

From the perspective of potential future research, a comparison of the estimated latent factors with each other provides interesting preliminary evidence. In Appendix IV I report the rank correlation coefficients calculated for the estimated latent factors.

The factors of reforms are highly correlated with the index of fixed initial conditions, and a particularly high correlation is estimated between the liberalization of the financial sector and the factor of time-invariant initial conditions (-0.811). Correlations between economic reforms and initial structural imbalances are found to be much weaker, if at all statistically significant.

The institutional latent factors are also highly and negatively (rank)correlated with the index of time-invariant initial conditions, suggesting that countries closer to developed economies in Western Europe, with shorter history of communism and predominantly catholic or protestant religions appear to have more democratic political regimes, better laws and regulations and lower levels of corruption. On the other hand, the rank correlations between the institutional factors and initial structural imbalances are much weaker.

When comparing the factors of reforms among each other, I find that rank correlations are very high for each possible pair of the three latent factors. The highest correlation is estimated between the reforms in the enterprise sector and the reforms in the financial sector (0.834 and statistically significant at the 0.01 level).

The latent factor of political environment also displays strong positive correlations with economic reforms, especially with policies of liberalization of relative prices and reforms of the financial sector. Correlations of the other two latent factors of institutions with reforms are also found to be high in the case of the financial sector. The latent factor of financial sector transformation correlates positively to the latent factor of laws and regulation (0.748) and negatively to the factor of political interference in business (-0.620)

Comparisons of the latent factors of state governance and political environment with each other produce a negative correlation between the political environment and the factor of the political interference in business (-0.719), and a significant positive correlation between political environment and the factor of laws and regulations (0.774). The two factors of state governance are also highly correlated with each other (-0.750), indicating that laws and regulations are perceived as better in countries with less political and administrative corruption, and a less politicized bureaucracy.

There is no question that based on those correlations we can infer anything about the potential causality between the indicators involved, but I consider them as a useful preliminary guidance for potential links between the progress with reforms and the process of institution building during transition.

The latent factors that are found to be most reliable in the analysis in this study are carried over to the next study in the thesis, in order to be employed in an analysis of the relative roles of initial conditions, economic reforms and institutions in stimulating economic growth of the private and the state sectors of economies in transition.

APPENDIX I: Summary of variables, data definitions and sources

Table 1: Regional Groups of Transition Economies

Region	Country	Year when Transition Started
Central – Eastern Europe (CEE)	Croatia	1990
	Czech Republic	1991
	Hungary	1990
	Poland	1990
	Slovak Republic	1991
	Slovenia	1990
South – Eastern Europe (SEE)	Albania	1991
	Bulgaria	1991
	Moldova	1992
	Romania	1991
	Macedonia	1990
Baltic Countries	Estonia	1991
	Latvia	1991
	Lithuania	1991
Central CIS[1]	Belarus	1992
	Russia	1991
	Ukraine	1992
Caucasus	Armenia	1992
	Azerbaijan	1992
	Georgia	1992
Central Asia	Kazakhstan	1992
	Kyrgyz Republic	1992
	Tajikistan	1992
	Turkmenistan	1992
	Uzbekistan	1992

[1] Commonwealth Independent States. CIS includes all the former USSR republics, except the Baltic countries.

Table 2: Variables employed in the analysis: definitions and sources

Variable Name	Definition	Calculation Method/ Measurement Units	Scale Adjustment	Source/ Original Source of Raw Data
AGRIC	Reliance on Agriculture	100 - Share where: Share= proportion of agriculture in total GDP (1990)	Divided by 100	De Melo et al(2001)
CIVLIB	Civil Liberties	Calculated as a normalized index using the formula CIVLIB=(7-CLIB)/6 CLIB=civil liberties index reported by Freedom House		Freedom House
CMEA	Trade Dependence on CMEA (1990)	100 – CMEA Share where CMEA Share is calculated as percent of trade with CMEA partners in GDP (1990)	divided by 100	De Melo et al(2001)
CORRY	Corruption in Politics	Calculated as a normalized index using the formula: CORRY= (ICRG-6)/6 Where: ICRG=the original indicator		International Country Risk Guide online
DOMREG	Dominant Religion	Categorical variable 1 – Roman Catholic; 2 – Protestant; 3 – Christian Orthodox; 4 – Muslim		Calculated based on information in Microsoft Interactive World Atlas 2000
FGBNK	Presence of foreign banks in the domestic banking system	Calculated as: FGBNK= (No. of Foreign Banks/No. of Domestic Banks)		Calculated based on data in EBRD (1999-2001)
ICI	Time - invariant initial conditions	Latent Factor estimated in Section II.2		
ICII	Initial structural imbalances	Latent Factor estimated in Section II.2		
INLIB	Initial Liberalization (1989)	Normalized variant of the index reported by the source		De Melo et al(2001)
IPBUR	Quality of Bureaucracy	Calculated as a normalized index using the formula: IPBUR= (4-ICRG)/4 Where: ICRG=the original indicator		International Country Risk Guide online

LOCAT	Proximity to the West	kilometers between the capital and Duesseldorf	logarithmic transformation	Sahay and Fischer(2000)
LWOD	Law And Order	Calculated as a normalized index using the formula: LWOD= (6-ICRG)/6 Where: ICRG=the original indicator		International Country Risk Guide online
NATCY	Absence of Autocratic Traits	Calculated as a normalized index using the formula: NATCY=(POLIND-10)/10 Where POLID = the original POLITY IV indicator		Polity IV database
NATRES	Natural Resource Endowments	categorical variable; see Appendix II		De Melo et al(2001)
NBNKREF	Reforms in the Banking Sector	Calculated as a normalized index using the formula: NBNKREF=(BNKREF-1)/3.3 BNKREF = banking sector reform index reported by EBRD		EBRD(1999-2001)
NCOMPOL	Competition Policy	Calculated as a normalized index using the formula: NCOMPOL=(COMPOL-1)/3.3 COMPOL = competition policy index reported by EBRD		EBRD(1999-2001)
NDEM	Institutionalized Democracy	Calculated as a normalized index using the formula: NATCY=(10-POLIND)/10 Where POLIND = the original POLITY IV indicator		Polity IV database
NENTREF	Enterprise Sector Transformation	Latent Factor estimated in Section II.3		
NFINANCE	Reforms in the Financial Sector	Latent Factor estimated in Section II.3		

NFXTL	Foreign exchange and trade liberalization	Calculated as a normalized index using the formula: NFXTL=(FXTL-1)/3.3 FXTL = forex and trade index reported by EBRD		EBRD(1999-2001)
NHBC	Reforms in the Enterprise Sector	Calculated as a normalized index using the formula: NHBC=(ENREF-1)/3.3 ENREF = enterprise reform index reported by EBRD		EBRD(1999-2001)
NHFBF	Banking and Finance	Calculated as a normalized index using the formula: NHFBF=(5-HFBF)/4 HFBF = Banking and Finance Index reported by Heritage Foundation		Heritage Foundation website
NHFT	Trade Policy Index	Calculated as a normalized index using the formula: NHFT=(5-HFT)/4 HFT = Trade Policy Index provided by Heritage Foundation		Heritage Foundation website
NHFWP	Wage and Price Liberalization	Calculated as a normalized index using the formula: NHFWP=(5-HFWP)/4 HFWP = Wage and Price Index provided by Heritage Foundation		Heritage Foundation website
NIPB	Interference of Politics in Business	Latent Factor estimated in Section II.4		
NLAWREG	Legislative and Regulatory Framework	Latent Factor estimated in Section II.4		

NLSPRIV	Large Scale Privatization	Calculated as a normalized index using the formula: NLSPRIV=(LSPRIV-1)/3.3 LSPRIV = large scale privatization index provided by EBRD		EBRD(1999-2001)
NNBFI	Reforms with non-bank financial institutions	Calculated as a normalized index using the formula: NNBFI=(NBFI-1)/3.3 NBFI = non-bank financial institutions index reported by EBRD		EBRD(1999-2001)
NPLI	Price Liberalization	Calculated as a normalized index using the formula: NPLI=(PLI-1)/3.3 PLI = price liberalization index reported by EBRD		EBRD(1999-2001)
NPOLITIC	Political Environment	Latent Factor estimated in Section II.4		
NSSPRIV	Small Scale Privatization	Calculated as a normalized index using the formula: NSSPRIV=(SSPRIV-1)/3.3 SSPRIV = small scale privatization index reported by EBRD		EBRD(1999-2001)
POLRGH	Political Rights	Calculated as a normalized index using the formula: POLRGH=(7-PRGH)/6 PRGH=political rights index of Freedom House		Freedom House
RELPRICES	Liberalization of Relative Prices	Latent Factor estimated in Section II.3		
SRVSH	Share of Services in GDP (1990)	Percent	/100	De Melo et al(2001)

THFPR	Property Rights Protection	Calculated as a normalized index using the formula: THFPR=(5-HFPR)/4 HFPR = Property Rights Protection Index provided by Heritage Foundation		Heritage Foundation website
THFR	Government Regulation of Businesses	Calculated as a normalized index using the formula: THFR=(5-HFR)/4 HFR = Government Regulation Index provided by Heritage Foundation		Heritage Foundation website
TTICPI	Corruption Perception	Calculated as a normalized index using the formula: TTICPI=(10-TICPI)/10 TICPI = Corruption Perception Index constructed by Transparency International		Transparency International; updated based on Abed and Davoodi(2000)
YCOMM	Number of years with communist leadership	years	logarithmic transformation	De Melo et al(2001)

APPENDIX II: Factors of Initial Conditions (IC1 and IC2)

Table 1 Studies and indicators of initial conditions in transition economies

	De Melo et al (2001)	EBRD (1999)	Raiser et al (2000)	Sachs et al(2001)
Physical Geography				
Distance to the EU	*	*	*	
Distance to major port				F1
Landlocked population				F1
Natural Resource Endowment	*	*	*	F1
Energy Imports				F1
Resource Balance (1989)				F1
Macroeconomic Variables				
Inflation (1990)				F2
Repressed Inflation (1989)	*	*		F2
Total consumption (%GDP, 1990)				F2
Average past growth	*	*		F2
Domestic absorption(%GDP 989)				F2
Gross domestic savings (%GDP 1989)				
Government Expenditure(%GDP)				F2
Black Market Premium (%1990)	*	*		F2
Services (%GDP 1990)				F2
Government Consumption(%GDP)				F2
Government Revenues(%GDP1989)				F2
Initial private sector share in GDP		*		
GDP per capita (1990)		*	*	
Fiscal Imbalances (1989)				
Demographics and Health				
Fertility Rate (1989)				F3
Life Expectancy at birth (1989)				F3
Urban Population (%total 1989)	*	*	*	F3
Urban population growth (%1989)		*		F3
Infant Mortality Rate (per 1000, 1989)				F3
Labour Force (%total 1989)				F3
Distortions in the allocation of employment		*		
Employment in agriculture		*		
Working Age Population (%total 1990)				F3
Old Population (%total 1990)				F3
Population Growth (1989)				F3
Public Health Expenditure (%GDP)				F3
Trade				
Trade (%GDP 1989)				F4
Exports to CMEA(%GDP 1990)	*	*		F4
Infrastructure				
Electricity Consumption (per 1000 1990)				F5
Hospital beds(per1000 1990)				F5

Paved Roads (% 1990)				F5
Telephone lines (per 1000 1989)				F5
Industrialization				
Industry (%GDP 1990)				F6
Over-industrialization (1990)	*	*		F6
Commercial energy used				F6
Agriculture (%GDP 1990)				F6
Wealth				
Income per capita (1989)	*			F7
GNP per capita (PPP 1989)				F7
Vehicles (per1000 1990)				F7
Television Sets (per1000 1990)				F7
Private consumption (%GDP 1990)				F7
Human Capital				
School enrollment ration (1995)				F8
Education index (1998)				F8
Human development index (1995)				F8
Physicians (per1000 1989)				F8
Secondary School Enrollment				
Market Memory				
Years under central planning	*	*	*	F9
Economic Freedom Index(1989)				F9
Democratic Rights Index(1989)				F9
State Independence prior to 1989	*	*	*	
Physical Capital				
Gross Domestic Investment(%GDP)				F10
Gross Domestic Fixed Investment(%GDP)				F10
Culture				
Muslims (%population)				F11
Christians(%population)				F11
Orthodox(%population)				F11
Western Christians (dummy variable)			*	
Eastern or Orthodox Christians (dummy variable)			*	
Ethnic Heterogeneity (dummy variable)			*	
Initial Liberalization(1989)	*			
Method	Principal Component Analysis	Principal Component Analysis	Principal Component Analysis	Weighted average

A. Factor IC1 of Initial conditions

Dimensions of IC1

Country	Location (km.)	Years of Communism	Natural Resouces	Dominant Religion
_ALB	1494	45	0	4
_ARM	3143	74	0	3
_AZE	3270	75	2	4
_BEL	1435	75	0	3
_BUL	1574	43	0	3
_CRO	913	44	0	1
_CZE	559	43	0	1
_EST	1449	51	0	2
_GEO	3069	70	1	3
_HUN	1002	41	0	1
_KAZ	5180	75	2	4
_KYR	1293	75	0	4
_LAT	1293	51	0	2
_LIT	1299	51	0	1
_MAC	1522	44	0	3
_MOL	1673	52	0	3
_POL	995	42	1	1
_ROM	1637	43	1	3
_RUS	2088	74	2	3
_SLK	824	43	0	1
_SLN	815	44	0	1
_TAJ	4938	75	0	4
_TUR	4254	75	2	4
_UKR	1664	75	1	3
_UZB	4788	75	1	4

Correlations

			Location	Market Memory	Dominant Religion	Natural Resources
Spearman's rho	Location	Correlation Coefficient	1.000	.694**	.806**	.583**
		Sig. (2-tailed)	.	.000	.000	.002
		N	25	25	25	25
	Market Memory	Correlation Coefficient	.694**	1.000	.745**	.396
		Sig. (2-tailed)	.000	.	.000	.050
		N	25	25	25	25
	Dominant Religion	Correlation Coefficient	.806**	.745**	1.000	.427*
		Sig. (2-tailed)	.000	.000	.	.033
		N	25	25	25	25
	Natural Resources	Correlation Coefficient	.583**	.396	.427*	1.000
		Sig. (2-tailed)	.002	.050	.033	.
		N	25	25	25	25

**. Correlation is significant at the .01 level (2-tailed).

*. Correlation is significant at the .05 level (2-tailed).

Descriptive Statistics

	Maximum	Mean	Std. Deviation	Skewness	Kurtosis
Location	8.55256	7.423735	0.600763	0.429627	-0.65694
Years of communism	4.317488	4.015191	0.254007	0.21353	-1.81114
Dominant religion	4	2.583333	1.179201	-0.27076	-1.43767
Natural resources	2	0.5	0.74317	1.110187	-0.29527
Multivariate kurtosis (model2)					-1.4727

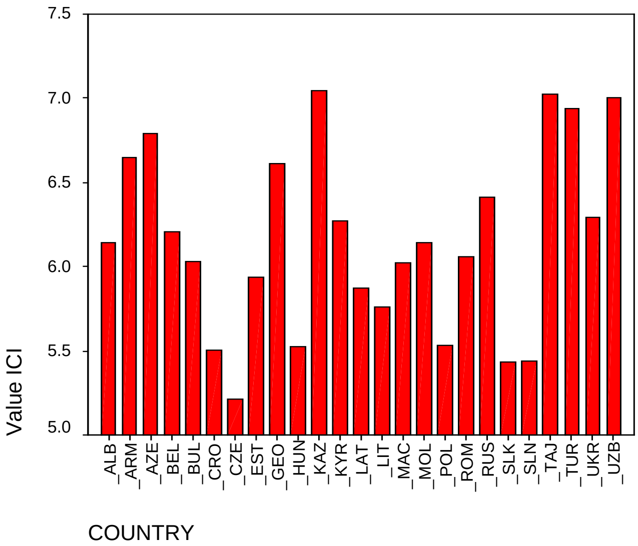
The Measurement Model for the latent factor ICI (Model 2)

$$\begin{pmatrix} LOCAT \\ YCOMM \\ DOMREG \end{pmatrix} = \begin{pmatrix} 1 \\ \lambda_{21} \\ \lambda_{31} \end{pmatrix} \cdot ICI + \begin{pmatrix} \delta_1 \\ \delta_2 \\ \delta_3 \end{pmatrix}$$

The variance-covariance matrix of the error terms:

$$\Theta = \begin{pmatrix} VAR(\delta_1) & & \\ 0 & VAR(\delta_2) & \\ 0 & 0 & VAR(\delta_3) \end{pmatrix}$$

Figure 2 Estimated Scores of the latent factor IC1



B. Factor IC2 of Initial Conditions

Correlations

			Share of services (1990)	Initial Liberalization (1989)	Dependence on CMEA	Dependence on Agriculture
Spearman's rho	Share of services (1990)	Correlation Coefficient	1.000	.447*	.365	.223
		Sig. (2-tailed)	.	.025	.073	.285
		N	25	25	25	25
	Initial Liberalization (1989)	Correlation Coefficient	.447*	1.000	.081	.264
		Sig. (2-tailed)	.025	.	.699	.202
		N	25	25	25	25
	Dependence on CMEA	Correlation Coefficient	.365	.081	1.000	.580**
		Sig. (2-tailed)	.073	.699	.	.002
		N	25	25	25	25
	Dependence on Agriculture	Correlation Coefficient	.223	.264	.580**	1.000
		Sig. (2-tailed)	.285	.202	.002	.
		N	25	25	25	25

*. Correlation is significant at the .05 level (2-tailed).

**. Correlation is significant at the .01 level (2-tailed).

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
Share of services (1990)	25	.27	.55	.3644	7.130E-02
Initial Liberalization (1989)	25	.00	.41	.1028	.1381
Dependence on Agriculture	25	.67	.95	.8084	8.567E-02
Dependence on CMEA	25	.55	.98	.8084	.1113
Valid N (listwise)	25				

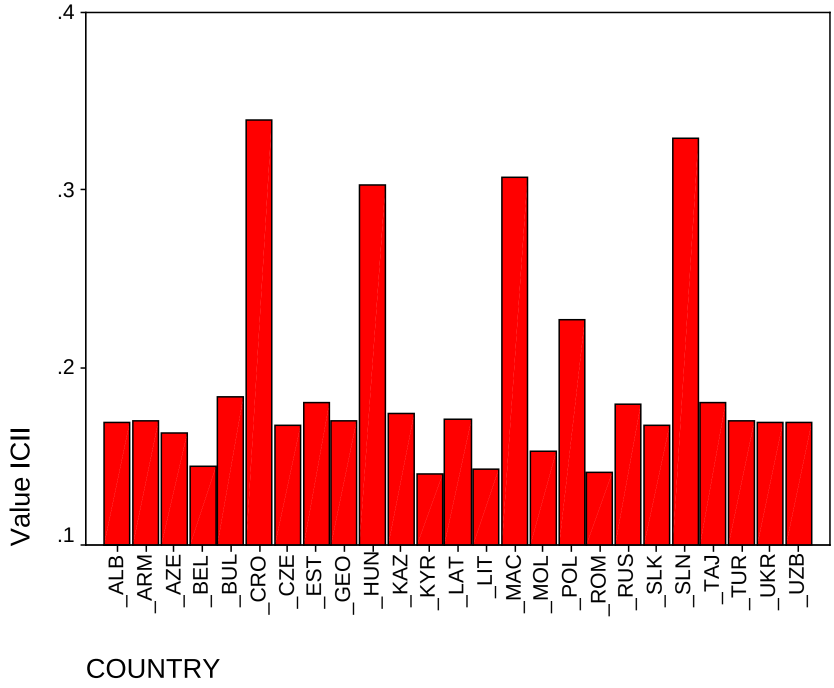
<u>The Measurement Model for the Latent Factor ICII</u>

$$\begin{pmatrix} CMEA \\ SRVSH \\ AGRIC \\ INLIB \end{pmatrix} = \begin{pmatrix} 1 \\ \lambda_{21} \\ \lambda_{31} \\ \lambda_{41} \end{pmatrix} \cdot ICII + \begin{pmatrix} \delta_1 \\ \delta_2 \\ \delta_3 \\ \delta_4 \end{pmatrix}$$

The variance-covariance matrix of the error terms:

$$\Theta = \begin{pmatrix} VAR(\delta_1) & & & \\ 0 & VAR(\delta_2) & & \\ COV(\delta_3, \delta_1) & 0 & VAR(\delta_3) & \\ 0 & 0 & 0 & VAR(\delta_4) \end{pmatrix}$$

Figure 2: Estimated scores for the latent factor ICII



Rank correlation of the two factor on initial conditions:

CORR(ICI, ICII)= -0.245

Appendix III Latent Factor of Reforms

Table 1: Sources of indicators on economic reforms in transition economies[1]

Source	Indicator	Year Coverage	Country Coverage[2]
EBRD[3]	Price liberalization	1991-2001	all transition economies
	Foreign exchange and trade liberalization	1991-2001	
	Small scale privatization	1991-2001	
	Large scale privatization	1991-2001	
	Enterprise reform	1991-2001	
	Competition policy	1991-2001	
	Infrastructure reform (1)	1998-2001	all transition economies
	Banking sector reform	1991-2001	all transition economies
	Reform of non-banking financial institutions (2)	1991-2001	
De Melo et al (1996)	Economic Liberalization	1989-1994[4]	
Heritage Foundation	Trade Policy	1995-2002	All transition economies with the exception of Turkmenistan and Tajikistan
	Fiscal Burden of the Government(3)	1995-2002	
	Government Intervention in the Economy	1995-2002	
	Banking (4)	1995-2002	
	Wage and Price Controls	1995-2002	
	Black Market Activity (5)	1995.2002	
Fraser Institute	Government Size: Consumption, Transfers and Subsidies (6)	Years 1990, 1995, 1999[5]	Albania, Bulgaria, Croatia, Czech Rep., Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Russia, Slovakia, Slovenia, Ukraine
	Structure of the Economy and Use of Markets (7)		
	Freedom of Access to Alternative Currencies (8)		
	Freedom to Trade with Foreign Partners (9)		
	Freedom of Exchange in Capital and Financial Markets (10)		
Freedom House	Privatization (11)	1997-2001	all transition economies
	Macroeconomic Policy (12)		
	Microeconomic Policy (13)		
Kaufmann, Kraay et al(1999, 2002)	Regulatory Framework (14)	1998, 2001	all transition economies

Sources:

European Bank of Reconstruction and Development (http://www.ebrd.com/): see references EBRD(1999-2001)

De Melo, Denizer et al(1996): see references

Heritage Foundation (http://www.heritage.org/): data available online

Fraser Institute (http://www.fraserinstitute.ca/): see reference Gwartney and Lawson(2000) and www.freetheworld.com

[1] For the indicators not described in this Appendix, details are inserted in the main text of the paper.

[2] Country coverage refers only to the transition economies of interest in this paper. The data sources mentioned (with the exception of EBRD) usually include information with worldwide coverage.

[3] Complete series are reported starting with EBRD2000.

[4] Series extended in Havrylyshyn et al(1999) for the period 1995-1998 based on EBRD data.

[5] For some of the mentioned transition economies data are available for the years 1980, 1985 also.

Freedom House (http://freedomhouse.org/): see reference Karatnycky et al(2000)
Kaufmann, Kraay et al(1999, 2002): see references

Notes on indicators:
1/ The indicator summarizes information on reforms in telecommunications, energy, railways and roads areas.
2/ The indicator combines information on reforms of securities markets and non-bank financial institutions such as investment funds, private insurance and pension funds and leasing companies.
3/ It combines information on income tax rates, top corporate profit tax rate and the share of government expenditures in GDP.
4/ This indicator is a measure of government interference in the banking sector, combining information on government ownership of banks, restriction imposed to foreign bank entry, the extent of directed credits, banking regulations and diversity of financial services supplied by banks.
5/ Black Market Activity index uses information on illegal activities in agriculture, manufacturing, services, transportation and labour market as well as smuggling, and piracy of intellectual properties.
6/ Based on the share of government consumption in total consumption and the percentage of transfers and subsidies in GDP.
7/ This measure combines indicators of the share of government enterprises and investment in GDP with the top marginal tax rate on incomes, and with information on the extent of to which businesses are free to set their own prices and the use of military conscription.
8/ Based on information about the freedom citizens have to own foreign currency bank accounts domestically and abroad and a measure of the black market exchange rate premium.
9/ This indicator combines measures of taxes in international trade (in terms of revenues from taxes on international trade as a percent of exports plus imports, mean tariff rate and standard deviation of tariff rates) with measures of non-tariff regulatory trade barriers (including the percent of international trade covered by non-tariff barrier restrictions and the actual size of trade sector compared to an expected size).
10/ Freedom in financial sectors is assessed based on indicators of deposits held in privately owned banks, credit extended to the private sector, interest rate controls and regulations that induce negative interest rates and restrictions on citizens' freedom to engage in capital transactions with foreigners.
11/ The indicator covers the legal framework for privatization as well as the actual state of the privatization process.
12/ This measure combines information on tax reforms, banking reforms and fiscal and monetary policies.
13/ Freedom House rates countries based on combined information on property rights, price liberalization, the ability to operate a business, international trade and foreign investment, and the energy sector.
14/ The indicators is based on a wealth of data sources including Heritage Foundation, Standard and Poor's DRI/Mc-Graw-Hill, World Bank, EBRD, World Economic Forum, Institute Management Development. Together with a companion indicator of 'Government Effectiveness', the measure of 'Regulatory Framework' is meant to capture the ability of the government to implement sound policies. As most of the information included in this aggregate measure does refer to reforms in various areas, we include it in the category of indicators on reforms for illustrative purposes

A. Factor of Liberalization of Relative Prices (RELPRICES)

Correlations

			Price Liberalization	Forex and Trade Liberalization	Trade Policy	Wages and Prices
Spearman's rho	Price Liberalization	Correlation Coefficient	1.000	.697**	.353**	.296**
		Sig. (2-tailed)	.	.000	.000	.000
		N	264	264	195	195
	Forex and Trade Liberalization	Correlation Coefficient	.697**	1.000	.502**	.551**
		Sig. (2-tailed)	.000	.	.000	.000
		N	264	264	195	195
	Trade Policy	Correlation Coefficient	.353**	.502**	1.000	.533**
		Sig. (2-tailed)	.000	.000	.	.000
		N	195	195	195	195
	Wages and Prices	Correlation Coefficient	.296**	.551**	.533**	1.000
		Sig. (2-tailed)	.000	.000	.000	.
		N	195	195	195	195

**. Correlation is significant at the .01 level (2-tailed).

Descriptive Statistics

	N	Mean	Std.	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
Price Liberalization	264	.5527	.1489	-1.900	.150	3.290	.299
Forex and Trade Liberalization	264	.6648	.3512	-.848	.150	-.741	.299
Trade Policy	195	.4591	.2980	.259	.174	-.863	.346
Wages and Prices	195	.4840	.2058	-.290	.174	-.319	.346
Valid N (listwise)	195						

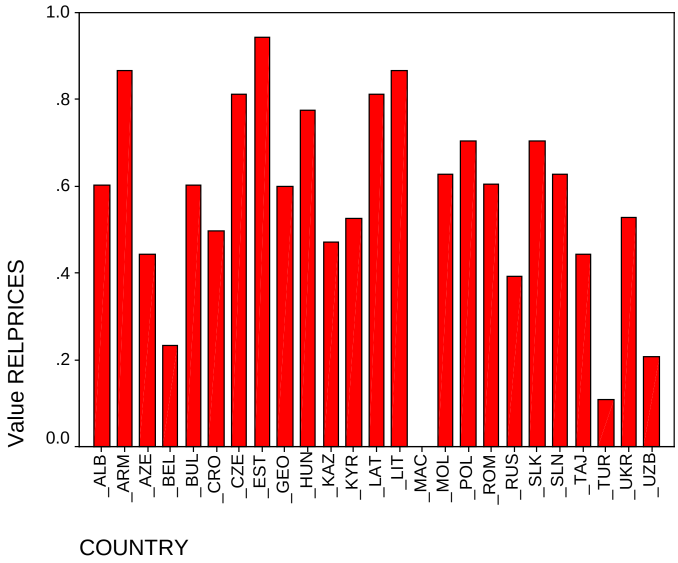
<u>The Measurement Model for the latent factor RELPRICES (Model 2)</u>

$$\begin{pmatrix} NFXTL \\ NHFT \\ NHFWP \end{pmatrix} = \begin{pmatrix} 1 \\ \lambda_{21} \\ \lambda_{31} \end{pmatrix} \cdot RELPRICES + \begin{pmatrix} \delta_1 \\ \delta_2 \\ \delta_3 \end{pmatrix}$$

The variance-covariance matrix of the error terms:

$$\Theta = \begin{pmatrix} VAR(\delta_1) & & \\ 0 & VAR(\delta_2) & \\ 0 & 0 & VAR(\delta_3) \end{pmatrix}$$

Figure 1: Estimated scores of RELPRICES in the 10th year of transition



Note: The score for Macedonia is missing

B. Factor of Enterprise Sector Transformation (NENTREF)

Correlations

			Small Scale Privatization	Large Scale Privatization	Enterprise Reforms	Competition Policy
Spearman's rho	Small Scale Privatization	Correlation Coefficient	1.000	.808**	.816**	.643**
		Sig. (2-tailed)	.	.000	.000	.000
		N	264	264	264	264
	Large Scale Privatization	Correlation Coefficient	.808**	1.000	.803**	.687**
		Sig. (2-tailed)	.000	.	.000	.000
		N	264	264	264	264
	Enterprise Reforms	Correlation Coefficient	.816**	.803**	1.000	.733**
		Sig. (2-tailed)	.000	.000	.	.000
		N	264	264	264	264
	Competition Policy	Correlation Coefficient	.643**	.687**	.733**	1.000
		Sig. (2-tailed)	.000	.000	.000	.
		N	264	264	264	264

**. Correlation is significant at the .01 level (2-tailed).

Descriptive Statistics

	N	Mean	Std.	Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Std. Error
Small Scale Privatization	264	.6697	.3123	-.602	.299
Large Scale Privatization	264	.4387	.2851	-.995	.299
Enterprise Reforms	264	.2989	.2174	-1.012	.299
Competition Policy	264	.2770	.1916	-.684	.299
Valid N (listwise)	264				

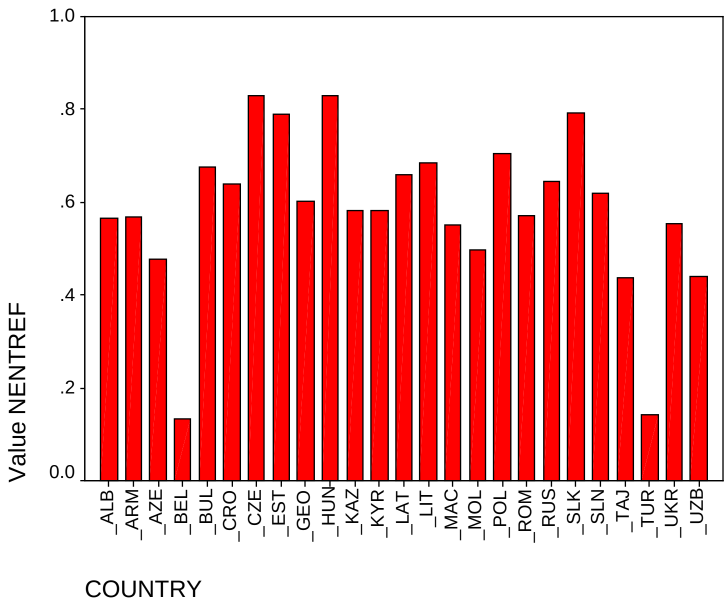
<u>The Measurement Model for the Latent Factor NENTREF</u>

$$\begin{pmatrix} NSSPRIV \\ NLSPRIV \\ NHBC \\ NCOMPOL \end{pmatrix} = \begin{pmatrix} 1 \\ \lambda_{21} \\ \lambda_{31} \\ \lambda_{41} \end{pmatrix} \cdot NENTREF + \begin{pmatrix} \delta_1 \\ \delta_2 \\ \delta_3 \\ \delta_4 \end{pmatrix}$$

The variance-covariance matrix of the error terms:

$$\Theta = \begin{pmatrix} VAR(\delta_1) & & & \\ 0 & VAR(\delta_2) & & \\ 0 & 0 & VAR(\delta_3) & \\ 0 & 0 & COV(\delta_4, \delta_3) & VAR(\delta_4) \end{pmatrix}$$

Figure 2: Estimated scores of NENTREF for the 10th year of transition



Correlations with related indicators

Correlations

			Privatization	NENTREF	Government Intervention
Spearman's rho	Privatization	Correlation Coefficient	1.000	-.896**	.660**
		Sig. (2-tailed)	.	.000	.000
		N	123	123	119
	NENTREF	Correlation Coefficient	-.896**	1.000	-.629**
		Sig. (2-tailed)	.000	.	.000
		N	123	264	195
	Government Intervention	Correlation Coefficient	.660**	-.629**	1.000
		Sig. (2-tailed)	.000	.000	.
		N	119	195	195

**. Correlation is significant at the .01 level (2-tailed).

C. Factor of Reforms in Banking Sector (NFINANCE)

Correlations

			Reforms in Banking	Non-bank financial institutions	Proportion of foreign banks	Interest Rate Spread	Banking and Finance
Spearman's rho	Reforms in Banking	Correlation Coefficient	1.000	.727**	.580**	-.540**	.702**
		Sig. (2-tailed)	.	.000	.000	.000	.000
		N	264	264	186	186	195
	Non-bank financial institutions	Correlation Coefficient	.727**	1.000	.423**	-.488**	.634**
		Sig. (2-tailed)	.000	.	.000	.000	.000
		N	264	264	186	186	195
	Proportion of foreign banks	Correlation Coefficient	.580**	.423**	1.000	-.506**	.328**
		Sig. (2-tailed)	.000	.000	.	.000	.000
		N	186	186	187	162	158
	Interest Rate Spread	Correlation Coefficient	-.540**	-.488**	-.506**	1.000	-.476**
		Sig. (2-tailed)	.000	.000	.000	.	.000
		N	186	186	162	186	151
	Banking and Finance	Correlation Coefficient	.702**	.634**	.328**	-.476**	1.000
		Sig. (2-tailed)	.000	.000	.000	.000	.
		N	195	195	158	151	195

**. Correlation is significant at the .01 level (2-tailed).

Descriptive Statistics

	N	Mean	Std.	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
Reforms in Banking	264	.3495	.2569	.002	.150	-1.067	.299
Non-bank financial institutions	264	.2504	.2117	.457	.150	-.375	.299
Proportion of foreign banks	187	.2360	.2039	.966	.178	.471	.354
Interest Rate Spread	186	.2311	.4277	5.920	.178	41.944	.355
Banking and Finance	195	.4718	.2395	.131	.174	-.190	.346
Valid N (listwise)	143						

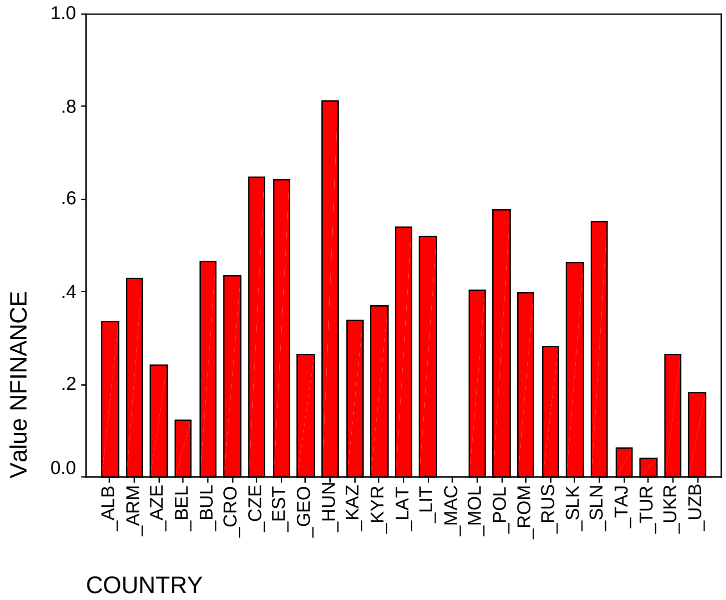
The Measurement Model for the Latent Factor NFINANCE (MODEL 2)

$$\begin{pmatrix} NBNKREF \\ FGBNK \\ NHFBF \\ NNBFI \end{pmatrix} = \begin{pmatrix} 1 \\ \lambda_{21} \\ \lambda_{31} \\ \lambda_{41} \end{pmatrix} \cdot NFINANCE + \begin{pmatrix} \delta_1 \\ \delta_2 \\ \delta_3 \\ \delta_4 \end{pmatrix}$$

The variance-covariance matrix of the error terms:

$$\Theta = \begin{pmatrix} VAR(\delta_1) & & & \\ 0 & VAR(\delta_2) & & \\ 0 & COV(\delta_3,\delta_2) & VAR(\delta_3) & \\ 0 & 0 & 0 & VAR(\delta_4) \end{pmatrix}$$

Figure 3 Progress with financial sector reforms in the 8th year of transition



Note: The score for Macedonia is missing

Correlations with related indicators

Fraser Institute data

Correlations

			NFINANCE	FI Financial Sector
Spearman's rho	NFINANCE	Correlation Coefficient	1.000	.802**
		Sig. (2-tailed)	.	.000
		N	28	28
	FI Financial Sector	Correlation Coefficient	.802**	1.000
		Sig. (2-tailed)	.000	.
		N	28	30

**. Correlation is significant at the .01 level (2-tailed).

EBRD data on credit to the private sector

Correlations

			FINANCE	Credit to the private sector
Spearman's rho	FINANCE	Correlation Coefficient	1.000	.683**
		Sig. (2-tailed)	.	.000
		N	158	129
	Credit to the private sector	Correlation Coefficient	.683**	1.000
		Sig. (2-tailed)	.000	.
		N	129	159

**. Correlation is significant at the .01 level (2-tailed).

Correlations among estimated factors

Correlations

			IC I	NICII	RELPRICES	NENTREF	NFINANCE
Spearman's rho	IC I	Correlation Coefficient	1.000	-.245**	-.672**	-.503**	-.811**
		Sig. (2-tailed)	.	.000	.000	.000	.000
		N	269	268	195	264	158
	NICII	Correlation Coefficient	-.245**	1.000	.064	.153*	.295**
		Sig. (2-tailed)	.000	.	.375	.013	.000
		N	268	268	195	263	158
	RELPRICES	Correlation Coefficient	-.672**	.064	1.000	.705**	.814**
		Sig. (2-tailed)	.000	.375	.	.000	.000
		N	195	195	195	195	158
	NENTREF	Correlation Coefficient	-.503**	.153*	.705**	1.000	.837**
		Sig. (2-tailed)	.000	.013	.000	.	.000
		N	264	263	195	264	158
	NFINANCE	Correlation Coefficient	-.811**	.295**	.814**	.837**	1.000
		Sig. (2-tailed)	.000	.000	.000	.000	.
		N	158	158	158	158	158

**. Correlation is significant at the .01 level (2-tailed).

*. Correlation is significant at the .05 level (2-tailed).

Descriptive Statistics

	N	Mean	Std.	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
RELPRICES	195	.5434	.2196	-.424	.174	-.466	.346
NENTREF	264	.4478	.2254	-.268	.150	-1.037	.299
NFINANCE	158	.3910	.1851	.028	.193	-.517	.384
Valid N (listwise)	158						

APPENDIX IV: Factors of State Governance and Political Environment

Table 1: Sources of Indicators on State Governance and Political Process [1/]

<table>
<tr><th>Source</th><th>Composite Indicator</th><th>Components</th><th>Coverage across time</th><th>Coverage across countries</th><th>Aggregation Method</th></tr>
<tr><td rowspan="2">EBRD</td><td colspan="2">Law effectiveness (company law)[2/]</td><td></td><td rowspan="2">all transition economies</td><td></td></tr>
<tr><td colspan="2">Law extensiveness (company law)[3/]</td><td></td><td></td></tr>
<tr><td rowspan="2">Heritage Foundation</td><td rowspan="2">Economic Freedom[1]</td><td>Government Regulation of Businesses</td><td>1995-2002</td><td rowspan="2">all transition economies</td><td rowspan="2">Simple average</td></tr>
<tr><td>Property Rights Protection</td><td>1995-2002</td></tr>
<tr><td rowspan="4">ICRG</td><td rowspan="4">Political Risk[2]</td><td>Law and Order index</td><td>ST-2000</td><td rowspan="4">all transition economies except Turkmenistan and Tajikistan</td><td rowspan="4">weighted average</td></tr>
<tr><td>Corruption in Politics</td><td>ST-2000</td></tr>
<tr><td>Quality of Bureaucracy</td><td>ST-2000</td></tr>
<tr><td>Government Stability[4/]</td><td>ST-2000</td></tr>
<tr><td>Transparency International</td><td colspan="2">Perception of Corruption</td><td>1995-2001</td><td>all transition economies except Tajikistan and Turkmenistan</td><td>Simple average</td></tr>
<tr><td rowspan="8">Freedom House</td><td rowspan="2">Political Freedom</td><td>Political Rights</td><td>ST-2000</td><td rowspan="2">all transition economies</td><td rowspan="2">Simple average</td></tr>
<tr><td>Civil Liberties</td><td>ST-2000</td></tr>
<tr><td rowspan="4">Democratization</td><td>Political Process[5/]</td><td>1997-2001</td><td rowspan="4">all transition economies</td><td rowspan="4">Simple average</td></tr>
<tr><td>Civil Society[6/]</td><td>1997-2001</td></tr>
<tr><td>Independent Media[7/]</td><td>1997-2001</td></tr>
<tr><td>Governance and Public Administration[8/]</td><td>1997-2001</td></tr>
<tr><td rowspan="2">Rule of Law</td><td>Constitutional, Judicial and Legislative Framework[9/]</td><td>1997-2001</td><td rowspan="2">all transition economies</td><td rowspan="2">Simple average</td></tr>
<tr><td>Corruption[10/]</td><td>1999-2001</td></tr>
<tr><td rowspan="2">Fraser Institute</td><td rowspan="2">Legal Structure and Property Rights</td><td>Private Ownership Rights[11/]</td><td>Years 990, 1995, 1997</td><td rowspan="2">Albania, Bulgaria, Croatia, Czech Rep.,</td><td rowspan="2">Factor analysis</td></tr>
<tr><td>Viability of Contracts[12/]</td><td>Years 990, 1995, 1997</td></tr>
</table>

[1] It also includes other components.
[2] It also includes other component indicators.

		Rule of Law[13/]	Years 990, 1995, 1997	Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Russia, Slovakia, Slovenia, Ukraine	
Kaufmann, Kraay and Zoido-Lobaton (1999a, 1999b, 2002)	Voice and Accountability[14/]		Periods 1997/1998, 2000/2001	All transition economies	Latent variable method
	Political Stability[15/]		Periods 1997/1998, 2000/2001		Latent variable method
	Government Effectiveness[16/]		Periods 1997/1998, 2000/2001		Latent variable method
	Regulatory Quality[17/]		Periods 1997/1998, 2000/2001		Latent variable method
	Rule of Law[18/]		Periods 1997/1998, 2000/2001		Latent variable method
	Control of Corruption[19/]		Periods 1997/1998, 2000/2001		Latent variable method
Polity IV	Executive Recruitment	Regulation of Chief Executive Recruitment[20/]	ST-1999	all transition economies	See reference
		Competitiveness of Executive Recruitment	ST-1999		
		Openness of Executive Recruitment	ST-1999		
	Executive Constraints	Constraints on Executive Decision Rules	ST-1999		
	Political Competition and Opposition	Regulation of Participation	ST-1999		
		Competitiveness of Participation	ST-1999		
	Institutionalized Democracy		ST-1999		
	Institutionalized Autocracy		ST-1999		
	Regime Durability[21/]		ST-1999		
BEEPS	State Capture **'Purchase of→'**	Parliamentary Legislation[22/]	1999	all transition economies, except Macedonia, Tajikistan and Turkmenistan	Simple average
		Presidential Decrees[23/]	1999		
		Central Bank[24/]	1999		
		Criminal Courts[25/]	1999		
		Political Party Finance[26/]	1999		

		Commercial Courts[27/]	1999		
	Governance Obstacles to Business Performance[3]	Excessive Taxes/Regulation[28/]	1999	all transition economies, except Macedonia, Tajikistan and Turkmenistan	Simple average
		Policy Instability[29/]	1999		
		Malfunctioning of the Judiciary[30/]	1999		
		Corruption[31/]	1999		
		Street Crime / Theft/ Disorder[32/]	1999		
		Organized Crime / Mafia[33/]	1999		
WDR1997[4] Private Sector Survey	Predictability of la w and policies[34/]		1996/1997	All transition economies, except Croatia, Romania, Slovenia, Tajikistan, Turkmenistan	Responses to each question in the survey available
	Political instability and security of property[35/]		1996/1997		
	Government – business interface[36/]		1996/1997		
	Law enforcement and bureaucratic red tape[37/]		1996/1997		
	Efficiency of government in providing services[38/]		1996/1997		

ST= Start of Transition (see appendix I)

Sources:
European Bank of Reconstruction and Development (EBRD): EBRD(2000, 2001)
International Country Risk Guide (ICRG) www.icrgonline.com/icrgMethods.asp
Transparency International (TI) http://www.transparency.de/
Freedom House(FH) http://freedomhouse.org/: Karatnycky, Motyl et al(2001)
Fraser Institute(FI) http://www.fraserinstitute.ca/): Gwartney and Lawson(2000)
Kaufmann, Kraay and Zoido-Lobaton(KKZT)
http://www.worldbank.org/wbi/governance/govdata2001.htm: Kaufmann, Kraay et al(1999a, 1999b, 2002)
Polity IV www.bsos.umd.edu/cidcm/inscr/polity: Marshall and Jaggers(2000)
Business Environment and Enterprise Performance Survey (BEEPS)
http://www.worldbank.org/wbi/governance/datasets.htm: Hellman, Jones et al(2000)
WDR97 Private Sector Survey http://www.worldbank.org/wbi/governance/datasets.htm:

Notes:
1/ The indicators not described in this appendix are discussed in the main text (Section II.4)
2/ Public perceptions on the effectiveness of law (based on the EBRD survey on the quality of law)
3/ Existing legal rules concerning pledge, bankruptcy and company laws.
4/ICRG index of Government Stability evaluates the ability of governments to stay in office and pursue their declared programs.
5/ FH Political Process:index summarizes information on executive and legislative elections, popular participation in the political systems and the development of multiparty systems.
6/ FH Civil Society:index assesses the existence and activity of nongovernmental organizations and trade unions, and the participation of interest groups in the political process
7/ FH Independent Media evaluates freedom of press, editorial independence, harassment of journalists, Internet access of private persons etc.
8/Governance and Public Administration summarizes information on legislative bodies, local government institutions, and legislative and executive transparency
9/ FH Constitutional, Legislative and Judicial Framework measure focuses on constitutional reforms, human rights, criminal code reform, the judiciary and judicial independence and ethnic minority rights
10/ FH Corruption indicator reflects perceptions of corruption in civil service, business interests of policy makers, regulations on financial disclosure and conflict of interest, and anticorruption initiatives

[3] Other components also included
[4] World Development Report 1997, World Bank

14/ KKZL Voice and Accountability summarizes information on political process, civil liberties and political rights
15/ KKZL Political Stability measures the likelihood that the incumbent government will be destabilized and overthrown by unconstitutional and/or violent means, including terrorism
16/ KKZL Government Effectiveness reflects perceptions of the quality of public services, bureaucracy, competence and political independence of civil servants and credibility of government's commitment to policies.
17/ KKZL Regulatory Quality measures the incidence of market-unfriendly policies, such as price controls or inadequate bank supervision; it also includes perceptions of burden induced by excessive regulations in the business environment.
18/ KKZL Rule of Law combines information on both violent and non-violent crime, the effectiveness and predictability of judiciary and contract enforceability
19/ KKZL Control of Corruption measures the extent of corruption (as perceived!) both in the business environment and in politics, as well as information on the state capture.(see BEEPS for components of State Capture).
20/ Polity IV Regulation of Chief Executive Recruitment refers to the institutionalized procedures by which chief executives are elected (e.g. hereditary succession, designation within the political elite, competitive elections)
21/ Polity IV Regime Durability is measured as the number of years since the most regime change change.
22/ BEEPS.Parliamentary Legislation reflects the degree to which (respondent) firms' business activities are affected by the sale of Parliamentary votes on laws to private interests
23/ BEEPS Presidential Decrees reflects the degree to which (respondent) firms' business activities are affected by the sale of Presidential decrees to private interests
24/ BEEPS Central Bank illustrates reflects the degree to which (respondent) firms' business activities are affected by Central Bank mishandling of funds
25/ BEEPS Criminal Courts focuses on reflects the degree to which (respondent) firms' business activities are affected by the sale of court decisions in criminal cases
26/ BEEPS Political Party Finance assesses the extent to which (respondent) firms' business activities are affected by illicit contributions paid by private interests to political parties and election campaigns.
27/ BEEPS Commercial Courts refers to the degree to which (respondent) firms' business activities are affected by the sale of court decisions in commercial cases
28/ BEEPS Excessive Taxes and Regulations illustrates the extent to which firms believe that government taxes and regulations constitute an obstacle for the operation and growth of their business.
29/ BEEPS Policy Instability reflects the perception of firms on the extent to which unpredictable changes in government policies and/or regulations contribute to a more risky business environment and discourage investment.
30/ BEEPS Malfunctioning of the Judiciary: firms were asked to assess how much a malfunctioning judiciary affects their performance

A. Legislative and Regulatory Framework (NLAWREG)

Correlations

			Regulation of Businesses	Property Rights	Law and Order
Spearman's rho	Regulation of Businesses	Correlation Coefficient	1.000	.782**	.372**
		Sig. (2-tailed)	.	.000	.000
		N	195	195	89
	Property Rights	Correlation Coefficient	.782**	1.000	.476**
		Sig. (2-tailed)	.000	.	.000
		N	195	195	89
	Law and Order	Correlation Coefficient	.372**	.476**	1.000
		Sig. (2-tailed)	.000	.000	.
		N	89	89	131

**. Correlation is significant at the .01 level (2-tailed).

Descriptive Statistics

	N	Mean	Std.	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
Regulation of Businesses	195	.3875	.2031	.623	.174	.243	.346
Property Rights	195	.4446	.1887	.415	.174	-1.164	.346
Law and Order	131	.6838	.2172	-.822	.212	.725	.420
Valid N (listwise)	89						

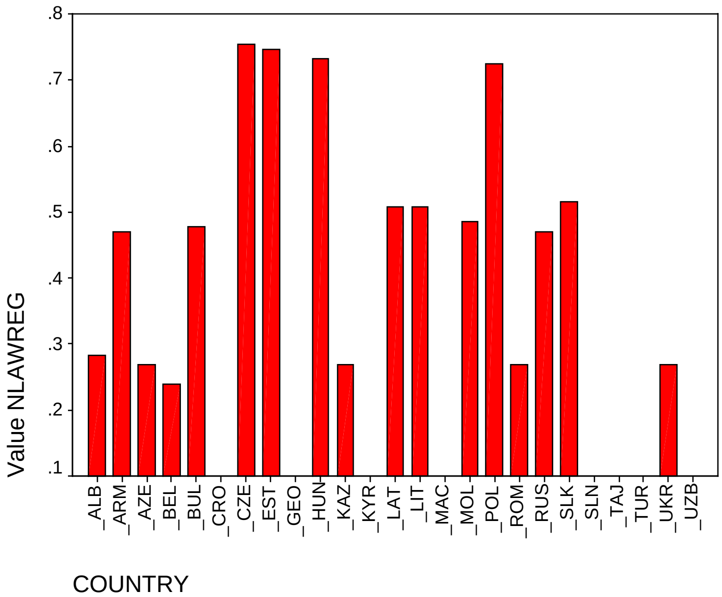
The Measurement Model for the Latent Factor NLAWREG

$$\begin{pmatrix} THFR \\ THFPR \\ LWOD \end{pmatrix} = \begin{pmatrix} 1 \\ \lambda_{21} \\ \lambda_{31} \end{pmatrix} \cdot NLAWREG + \begin{pmatrix} \delta_1 \\ \delta_2 \\ \delta_3 \end{pmatrix}$$

The variance-covariance matrix of the error terms:

$$\Theta = \begin{pmatrix} VAR(\delta_1) & & \\ 0 & VAR(\delta_2) & \\ 0 & 0 & VAR(\delta_3) \end{pmatrix}$$

Figure 1: Progress with laws and regulations in the 8th year of transition



Note: For countries with no BAR data is missing

Correlations with related indicators

1. Freedom House (1999-2001)

Correlations

			Government Public Administration	Legilative and Judiciary Framework	NLAWS
Spearman's rho	Government Public Administration	Correlation Coefficient	1.000	.929**	-.876**
		Sig. (2-tailed)	.	.000	.000
		N	123	123	55
	Legilative and Judiciary Framework	Correlation Coefficient	.929**	1.000	-.880**
		Sig. (2-tailed)	.000	.	.000
		N	123	123	55
	NLAWS	Correlation Coefficient	-.876**	-.880**	1.000
		Sig. (2-tailed)	.000	.000	.
		N	55	55	89

**. Correlation is significant at the .01 level (2-tailed).

2. KKLZ Governance Indicators (1998,2001)

Correlations

			Regulatory Quality	Rule of Law	NLAWS
Spearman's rho	Regulatory Quality	Correlation Coefficient	1.000	.898**	.834**
		Sig. (2-tailed)	.	.000	.001
		N	50	50	11
	Rule of Law	Correlation Coefficient	.898**	1.000	.810**
		Sig. (2-tailed)	.000	.	.003
		N	50	50	11
	NLAWS	Correlation Coefficient	.834**	.810**	1.000
		Sig. (2-tailed)	.001	.003	.
		N	11	11	11

**. Correlation is significant at the .01 level (2-tailed).

3. Fraser Institute data (1990, 1995,1999)

Correlations

			NLAWS	FI Laws and Property Rights
Spearman's rho	NLAWS	Correlation Coefficient	1.000	.600**
		Sig. (2-tailed)	.	.004
		N	22	21
	FI Laws and Property Rights	Correlation Coefficient	.600**	1.000
		Sig. (2-tailed)	.004	.
		N	21	24

**. Correlation is significant at the .01 level (2-tailed).

B. Interference of Politics in Business (NIPB)

Correlations

			Perception of Corruption	Corruption in Politics	Politicized Bureaucracy
Spearman's rho	Perception of Corruption	Correlation Coefficient	1.000	.828**	.638**
		Sig. (2-tailed)	.	.000	.000
		N	143	79	79
	Corruption in Politics	Correlation Coefficient	.828**	1.000	.617**
		Sig. (2-tailed)	.000	.	.000
		N	79	132	100
	Politicized Bureaucracy	Correlation Coefficient	.638**	.617**	1.000
		Sig. (2-tailed)	.000	.000	.
		N	79	100	100

**. Correlation is significant at the .01 level (2-tailed).

Descriptive Statistics

	N	Mean	Std.	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
Perception of Corruption	143	.5698	.1837	-.658	.203	-.250	.403
Corruption in Politics	132	.4028	.1638	.163	.211	-.487	.419
Politicized Bureaucracy	100	.4675	.2434	-.128	.241	-1.361	.478
Valid N (listwise)	79						

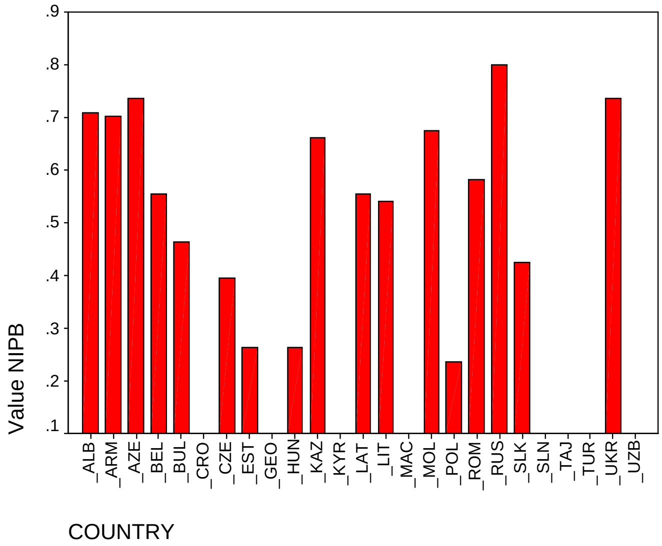
The Measurement Model for the Latent Factor NIPB

$$\begin{pmatrix} CORRY \\ TTICPI \\ IPBUR \end{pmatrix} = \begin{pmatrix} 1 \\ \lambda_{21} \\ \lambda_{31} \end{pmatrix} \cdot NIPB + \begin{pmatrix} \delta_1 \\ \delta_2 \\ \delta_3 \end{pmatrix}$$

The variance-covariance matrix of the error terms:

$$\Theta = \begin{pmatrix} VAR(\delta_1) & & \\ 0 & VAR(\delta_2) & \\ 0 & 0 & VAR(\delta_3) \end{pmatrix}$$

Figure 2: Estimated Scores for NIPB in year 8 of transition



Note: For countries without BAR data is missing

Correlations with related indicators

1. BEEPS Survey 1999

Correlations

			NCORRUPT	Corruption
Spearman's rho	NCORRUPT	Correlation Coefficient	1.000	.642**
		Sig. (2-tailed)	.	.003
		N	19	19
	Corruption	Correlation Coefficient	.642**	1.000
		Sig. (2-tailed)	.003	.
		N	19	22

**. Correlation is significant at the .01 level (2-tailed).

2. Freedom House Indicator on Corruption (from Nations in Transit 1999-2001)

Correlations

			Corruption	NCORRUPT
Spearman's rho	Corruption	Correlation Coefficient	1.000	.875**
		Sig. (2-tailed)	.	.000
		N	75	37
	NCORRUPT	Correlation Coefficient	.875**	1.000
		Sig. (2-tailed)	.000	.
		N	37	79

**. Correlation is significant at the .01 level (2-tailed).

3. KKLZ Governance Indicator on Control of Corruption

Correlations

			Control of Corruption	NCORRUPT
Spearman's rho	Control of Corruption	Correlation Coefficient	1.000	-.718*
		Sig. (2-tailed)	.	.013
		N	50	11
	NCORRUPT	Correlation Coefficient	-.718*	1.000
		Sig. (2-tailed)	.013	.
		N	11	11

*. Correlation is significant at the .05 level (2-tailed).

C. Political Environment (NPOLITIC)

Correlations

			Political Rights	Civil Liberties	Institutionalized Democracy	Absence of Autocracy Traits
Spearman's rho	Political Rights	Correlation Coefficient	1.000	.917**	.888**	.762**
		Sig. (2-tailed)	.	.000	.000	.000
		N	269	269	214	214
	Civil Liberties	Correlation Coefficient	.917**	1.000	.852**	.735**
		Sig. (2-tailed)	.000	.	.000	.000
		N	269	269	214	214
	Institutionalized Democracy	Correlation Coefficient	.888**	.852**	1.000	.847**
		Sig. (2-tailed)	.000	.000	.	.000
		N	214	214	214	214
	Absence of Autocracy Traits	Correlation Coefficient	.762**	.735**	.847**	1.000
		Sig. (2-tailed)	.000	.000	.000	.
		N	214	214	214	214

**. Correlation is significant at the .01 level (2-tailed).

Descriptive Statistics

	N	Mean	Std.	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
Political Rights	269	.5840	.3166	-.300	.149	-1.033	.296
Civil Liberties	269	.5486	.2456	-.539	.149	-.555	.296
Institutionalized Democracy	214	.5472	.3481	-.442	.166	-1.116	.331
Absence of Autocracy Traits	214	.8284	.2586	-1.398	.166	.611	.331
Valid N (listwise)	214						

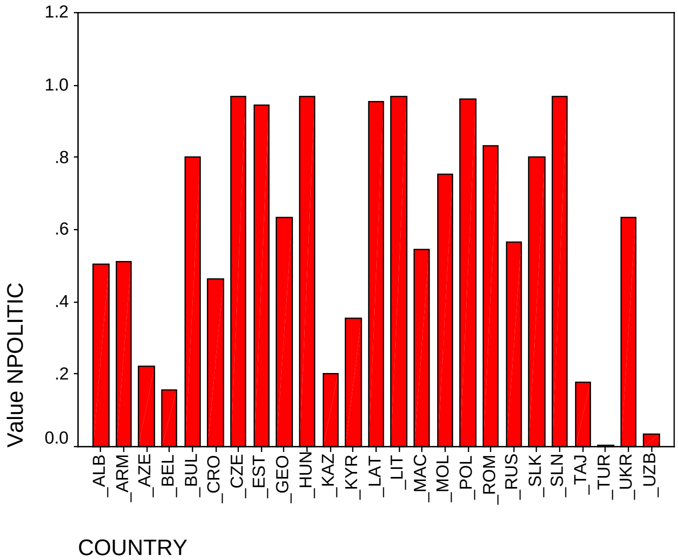
The Measurement Model for the Latent Factor NPOLITIC

$$\begin{pmatrix} NDEM \\ NATCY \\ POLRGH \\ CIVLIB \end{pmatrix} = \begin{pmatrix} 1 \\ \lambda_{21} \\ \lambda_{31} \\ \lambda_{41} \end{pmatrix} \cdot NPOLITIC + \begin{pmatrix} \delta_1 \\ \delta_2 \\ \delta_3 \\ \delta_4 \end{pmatrix}$$

The variance-covariance matrix of the error terms:

$$\Theta = \begin{pmatrix} VAR(\delta_1) & & & \\ COV(\delta_2,\delta_1) & VAR(\delta_2) & & \\ 0 & 0 & VAR(\delta_3) & \\ 0 & 0 & 0 & VAR(\delta_4) \end{pmatrix}$$

Figure 3: Estimated Scores for NPOLITIC in year 8 of transition



Correlation with related indicators

KKLZ indicator on Voice and Accountability

Correlations

			Voice and Accountability	NPOLITIC
Spearman's rho	Voice and Accountability	Correlation Coefficient	1.000	.948**
		Sig. (2-tailed)	.	.000
		N	50	25
	NPOLITIC	Correlation Coefficient	.948**	1.000
		Sig. (2-tailed)	.000	.
		N	25	25

**. Correlation is significant at the .01 level (2-tailed).

Descriptive Statistics

	N	Mean	Std.	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
NLAWREG	89	.5109	.1814	.027	.255	-1.295	.506
NIPB	79	.4684	.1718	-.053	.271	-.926	.535
NPOLITIC	214	.5742	.2929	-.384	.166	-.876	.331
Valid N (listwise)	60						

Correlations of estimated latent factors

Correlations

			IC I	NICII	RELPRICES	NENTREF	NFINANCE	NIPB	NLAWREG	NPOLITIC
Spearman's rho	IC I	Correlation Coefficient	1.000	-.245**	-.672**	-.503**	-.811**	.718**	-.748**	-.774**
		Sig. (2-tailed)	.	.000	.000	.000	.000	.000	.000	.000
		N	269	268	195	264	158	79	89	214
	NICII	Correlation Coefficient	-.245**	1.000	.064	.153*	.295**	-.372**	.341**	.174*
		Sig. (2-tailed)	.000	.	.375	.013	.000	.001	.001	.011
		N	268	268	195	263	158	79	89	214
	RELPRICES	Correlation Coefficient	-.672**	.064	1.000	.705**	.814**	-.380**	.542**	.765**
		Sig. (2-tailed)	.000	.375	.	.000	.000	.001	.000	.000
		N	195	195	195	195	158	79	89	145
	NENTREF	Correlation Coefficient	-.503**	.153*	.705**	1.000	.837**	-.479**	.655**	.642**
		Sig. (2-tailed)	.000	.013	.000	.	.000	.000	.000	.000
		N	264	263	195	264	158	79	89	209
	NFINANCE	Correlation Coefficient	-.811**	.295**	.814**	.837**	1.000	-.620**	.748**	.843**
		Sig. (2-tailed)	.000	.000	.000	.000	.	.000	.000	.000
		N	158	158	158	158	158	78	85	134
	NIPB	Correlation Coefficient	.718**	-.372**	-.380**	-.479**	-.620**	1.000	-.750**	-.719**
		Sig. (2-tailed)	.000	.001	.001	.000	.000	.	.000	.000
		N	79	79	79	79	78	79	79	60
	NLAWREG	Correlation Coefficient	-.748**	.341**	.542**	.655**	.748**	-.750**	1.000	.774**
		Sig. (2-tailed)	.000	.001	.000	.000	.000	.000	.	.000
		N	89	89	89	89	85	79	89	69
	NPOLITIC	Correlation Coefficient	-.774**	.174*	.765**	.642**	.843**	-.719**	.774**	1.000
		Sig. (2-tailed)	.000	.011	.000	.000	.000	.000	.000	.
		N	214	214	145	209	134	60	69	214

**. Correlation is significant at the .01 level (2-tailed).

*. Correlation is significant at the .05 level (2-tailed).

APPENDIX V: Estimated Scores of the Latent Factors

Table 1: Factors of Initial conditions

	IC I	IC II
_ALB	6.14	.26
_ARM	6.64	.26
_AZE	6.79	.25
_BEL	6.21	.22
_BUL	6.03	.28
_CRO	5.50	.53
_CZE	5.22	.26
_EST	5.94	.28
_GEO	6.61	.26
_HUN	5.52	.47
_KAZ	7.05	.27
_KYR	6.27	.22
_LAT	5.88	.27
_LIT	5.76	.22
_MAC	6.02	.48
_MOL	6.15	.24
_POL	5.53	.35
_ROM	6.06	.22
_RUS	6.42	.28
_SLK	5.43	.26
_SLN	5.44	.51
_TAJ	7.02	.28
_TUR	6.94	.26
_UKR	6.29	.26
_UZB	7.00	.26

Table 2: Estimated Scores of RELPRICES

	1990.00	1991.00	1992.00	1993.00	1994.00	1995.00	1996.00	1997.00	1998.00	1999.00	2000.00	2001.00
_ALB	.	.	.	.53	.53	.57	.60	.57	.53	.53	.60	.66
_ARM	.	.	.	.	.34	.51	.68	.68	.72	.81	.87	.87
_AZE	.	.	.	.	.00	.08	.08	.10	.16	.22	.35	.44
_BEL	.	.	.	.29	.29	.33	.28	.19	.19	.17	.21	.23
_BUL	.	.	.	.53	.60	.60	.57	.53	.53	.55	.60	.66
_CRO	.	.	.	.	.50	.50	.50	.50	.50	.50	.57	.63
_CZE	.	.	.	.87	.87	.87	.85	.85	.89	.85	.81	.81
_EST	.	.	.	.79	.83	.79	.83	.87	.87	.87	.94	1.00
_GEO	.	.	.	.	.26	.34	.42	.50	.50	.50	.56	.60
_HUN	.	.	.	.63	.66	.66	.66	.66	.70	.78	.81	.81
_KAZ	.	.	.	.	.	.	.42	.42	.46	.38	.42	.47
_KYR	.	.	.	.	.	.	.42	.42	.47	.53	.53	.53
_LAT	.	.	.	.	.63	.63	.71	.79	.79	.81	.81	.81
_LIT	.	.	.	.	.53	.60	.72	.76	.76	.81	.87	.89
_MAC	.	.	.	.	.	.	.	.	.	.	.	.60
_MOL	.	.	.	.29	.37	.60	.60	.60	.60	.60	.60	.63
_POL	.	.	.	.53	.53	.53	.63	.71	.71	.71	.71	.71
_ROM	.	.	.	.79	.79	.75	.71	.79	.79	.70	.60	.60
_RUS	.	.	.	.45	.45	.41	.49	.53	.39	.39	.39	.43
_SLK	.	.	.	.68	.68	.68	.67	.60	.63	.67	.71	.71
_SLN	.	.	.	.	.53	.53	.55	.55	.59	.63	.59	.55
_TAJ	.	.	.	.	.	.	.18	.18	.24	.32	.44	.44
_TUR	.	.	.	.	.	.	.11	.11	.11	.11	.11	.11
_UKR	.	.	.	.21	.21	.41	.45	.45	.50	.57	.53	.53
_UZB	.	.	.	.	.	.	.18	.16	.16	.11	.11	.21

Table 3: Estimated Scores of NENTREF

	1990.00	1991.00	1992.00	1993.00	1994.00	1995.00	1996.00	1997.00	1998.00	1999.00	2000.00	2001.00
_ALB	.	.06	.08	.25	.35	.50	.57	.57	.57	.57	.57	.59
_ARM	.	.	.18	.20	.22	.38	.49	.51	.54	.54	.54	.57
_AZE	.	.	.04	.04	.08	.15	.19	.37	.40	.38	.40	.48
_BEL	.	.	.04	.14	.16	.20	.15	.13	.13	.13	.13	.13
_BUL	.	.09	.16	.25	.34	.43	.44	.56	.58	.61	.68	.68
_CRO	.	.17	.26	.32	.40	.49	.60	.62	.62	.64	.64	.64
_CZE	.	.22	.39	.59	.74	.76	.79	.79	.79	.81	.83	.83
_EST	.	.04	.20	.44	.62	.73	.76	.76	.76	.79	.79	.81
_GEO	.	.	.06	.12	.12	.34	.54	.58	.60	.60	.60	.60
_HUN	.	.26	.40	.56	.62	.71	.76	.79	.85	.83	.83	.83
_KAZ	.	.	.08	.15	.22	.27	.47	.56	.56	.58	.58	.58
_KYR	.	.	.19	.26	.46	.50	.54	.58	.58	.58	.58	.58
_LAT	.	.04	.28	.35	.43	.49	.64	.63	.65	.65	.66	.66
_LIT	.	.04	.23	.45	.58	.60	.68	.67	.67	.68	.68	.71
_MAC	.	.15	.15	.30	.40	.42	.53	.53	.55	.55	.58	.60
_MOL	.	.	.05	.14	.26	.42	.46	.48	.51	.49	.51	.50
_POL	.	.39	.45	.54	.63	.65	.66	.70	.70	.70	.72	.76
_ROM	.	.15	.19	.31	.34	.38	.51	.53	.53	.55	.57	.61
_RUS	.	.03	.22	.40	.48	.56	.58	.64	.64	.63	.64	.66
_SLK	.	.22	.39	.58	.63	.65	.70	.78	.78	.79	.79	.81
_SLN	.	.15	.17	.37	.43	.54	.56	.60	.60	.62	.62	.66
_TAJ	.	.	.08	.09	.11	.18	.20	.21	.33	.35	.40	.44
_TUR	.	.	.04	.04	.06	.09	.11	.25	.23	.23	.19	.14
_UKR	.	.	.05	.11	.21	.36	.43	.48	.48	.48	.53	.55
_UZB	.	.	.04	.11	.25	.40	.44	.46	.46	.46	.44	.44

Table 4: Estimated Scores of NFINANCE

	1990.00	1991.00	1992.00	1993.00	1994.00	1995.00	1996.00	1997.00	1998.00	1999.00	2000.00	2001.00
_ALB	.	.	.	.	.30	.28	.28	.28	.34	.34	.42	.
_ARM	.	.	.	.	.09	.24	.25	.29	.40	.43	.43	.
_AZE	.	.	.	.	.04	.19	.19	.19	.24	.24	.24	.
_BEL	.	.	.	.	.	.32	.16	.14	.12	.12	.13	.
_BUL	.	.	.	.23	.24	.31	.31	.40	.47	.49	.54	.
_CRO	.	.	.	.	.	.40	.41	.44	.44	.50	.57	.
_CZE	.	.	.	.56	.61	.61	.61	.62	.65	.70	.70	.
_EST	.	.	.	.48	.48	.50	.52	.63	.64	.69	.75	.
_GEO	.	.	.	.	.04	.19	.20	.25	.26	.27	.31	.
_HUN	.	.	.	.49	.52	.62	.63	.81	.81	.81	.85	.
_KAZ	.	.	.	.	.	.	.24	.31	.33	.34	.36	.
_KYR	.	.	.	.	.	.	.32	.40	.41	.37	.37	.
_LAT	.	.	.	.	.	.50	.54	.57	.54	.58	.58	.
_LIT	.	.	.	.	.25	.42	.48	.51	.52	.53	.57	.
_MAC	.	.	.	.	.	.	.	.	.	.	.	.
_MOL	.	.	.	.	.26	.30	.31	.32	.38	.40	.41	.
_POL	.	.	.	.46	.46	.54	.55	.58	.62	.64	.70	.
_ROM	.	.	.	.	.32	.48	.48	.45	.40	.45	.44	.
_RUS	.	.	.	.	.	.32	.41	.45	.28	.19	.19	.
_SLK	.	.	.	.42	.48	.50	.50	.47	.46	.47	.56	.
_SLN	.	.	.	.	.55	.56	.55	.55	.53	.56	.56	.
_TAJ	.	.	.	.	.	.	.	.07	.08	.06	.08	.
_TUR	.	.	.	.	.	.	.01	.01	.04	.04	.	.
_UKR	.	.	.	.	.11	.25	.26	.26	.26	.26	.26	.
_UZB	.	.	.	.	.	.	.17	.18	.18	.18	.19	.

Table 5: Estimated Scores of NLAWREG

	1990.00	1991.00	1992.00	1993.00	1994.00	1995.00	1996.00	1997.00	1998.00	1999.00	2000.00	2001.00
_ALB	.	.	.	.51	.52	.51	.41	.29	.29	.28	.27	.
_ARM	.	.	.	.	.	.	.	.	.49	.47	.47	.
_AZE	.	.	.	.	.	.	.	.	.	.27	.27	.
_BEL	.	.	.	.	.	.	.	.	.27	.26	.24	.
_BUL	.	.	.	.49	.49	.48	.49	.48	.48	.48	.48	.
_CRO	.	.	.	.	.	.	.	.	.	.28	.28	.
_CZE	.	.	.	.78	.79	.79	.78	.76	.75	.75	.74	.
_EST	.	.	.	.	.	.	.	.	.	.75	.75	.
_GEO	.	.	.	.	.	.	.	.	.	.	.	.
_HUN	.	.	.	.75	.74	.73	.73	.73	.73	.73	.72	.
_KAZ	.	.	.	.	.	.	.	.	.	.27	.27	.
_KYR	.	.	.	.	.	.	.	.	.	.	.	.
_LAT	.	.	.	.	.	.	.	.	.	.51	.52	.
_LIT	.	.	.	.	.	.	.	.	.	.51	.51	.
_MAC	.	.	.	.	.	.	.	.	.	.	.	.
_MOL	.	.	.	.	.	.	.	.	.	.50	.49	.
_POL	.	.	.	.52	.63	.72	.72	.72	.72	.72	.72	.
_ROM	.	.	.	.28	.28	.28	.28	.28	.28	.27	.27	.
_RUS	.	.	.	.53	.52	.49	.48	.48	.47	.47	.37	.
_SLK	.	.	.	.76	.65	.52	.52	.52	.52	.52	.51	.
_SLN	.	.	.	.	.	.	.	.	.	.74	.65	.
_TAJ	.	.	.	.	.	.	.	.	.	.	.	.
_TUR	.	.	.	.	.	.	.	.	.	.	.	.
_UKR	.	.	.	.	.	.	.	.	.27	.27	.27	.
_UZB	.	.	.	.	.	.	.	.	.	.	.	.

Table 6: Estimated Scores of NIPB

	1990.00	1991.00	1992.00	1993.00	1994.00	1995.00	1996.00	1997.00	1998.00	1999.00	2000.00	2001.00
_ALB	.	.	.	.	.37	.45	.58	.59	.52	.71	.	.
_ARM	.	.	.	.	.	.	.	.	.68	.70	.70	.
_AZE	.	.	.	.	.	.	.	.	.	.73	.74	.
_BEL	.	.	.	.	.	.	.	.	.42	.48	.55	.
_BUL	.	.	.	.	.32	.39	.35	.42	.41	.46	.55	.
_CRO	.	.	.	.	.	.	.	.	.	.67	.52	.
_CZE	.	.	.	.	.30	.26	.35	.33	.36	.40	.41	.
_EST	.	.	.	.	.	.	.	.	.	.26	.26	.
_GEO	.	.	.	.	.	.	.	.	.	.	.	.
_HUN	.	.	.	.	.18	.15	.20	.21	.26	.26	.26	.
_KAZ	.	.	.	.	.	.	.	.	.	.59	.66	.
_KYR	.	.	.	.	.	.	.	.	.	.	.	.
_LAT	.	.	.	.	.	.	.	.	.	.55	.55	.
_LIT	.	.	.	.	.	.	.	.	.	.54	.53	.
_MAC	.	.	.	.	.	.	.	.	.	.	.	.
_MOL	.	.	.	.	.	.	.	.	.	.68	.68	.
_POL	.	.	.	.	.18	.15	.21	.22	.24	.50	.51	.
_ROM	.	.	.	.	.	.43	.52	.54	.56	.58	.60	.
_RUS	.	.	.	.	.50	.59	.66	.67	.69	.80	.81	.
_SLK	.	.	.	.	.30	.32	.46	.49	.47	.43	.43	.
_SLN	.	.	.	.	.	.	.	.	.	.35	.36	.
_TAJ	.	.	.	.	.	.	.	.	.	.	.	.
_TUR	.	.	.	.	.	.	.	.	.	.	.	.
_UKR	.	.	.	.	.	.	.	.	.56	.61	.74	.
_UZB	.	.	.	.	.	.	.	.	.	.	.	.

Table 7: Estimated Scores of NPOLITIC

	1990.00	1991.00	1992.00	1993.00	1994.00	1995.00	1996.00	1997.00	1998.00	1999.00	2000.00	2001.00
_ALB	.	.26	.53	.65	.69	.63	.55	.52	.50	.48	.	.
_ARM	.	.	.46	.60	.63	.56	.40	.34	.45	.51	.	.
_AZE	.	.	.34	.24	.17	.16	.17	.21	.22	.22	.	.
_BEL	.	.	.54	.48	.47	.41	.23	.16	.16	.16	.	.
_BUL	.	.73	.80	.82	.83	.83	.82	.80	.80	.81	.	.
_CRO	.34	.47	.53	.47	.47	.46	.46	.46	.46	.	.	.
_CZE	.	.83	.83	.91	.97	.97	.97	.97	.97	.96	.	.
_EST	.	.	.73	.69	.70	.76	.88	.94	.94	.94	.	.
_GEO	.	.	.35	.41	.35	.42	.50	.57	.63	.63	.	.
_HUN	.71	.85	.85	.91	.97	.97	.97	.97	.97	.97	.	.
_KAZ	.	.	.34	.28	.22	.20	.20	.20	.20	.20	.	.
_KYR	.	.	.48	.50	.48	.53	.50	.50	.42	.35	.	.
_LAT	.	.	.74	.68	.70	.77	.83	.89	.95	.95	.	.
_LIT	.	.	.82	.88	.94	.95	.97	.97	.97	.97	.	.
_MAC	.34	.32	.44	.65	.61	.55	.55	.55	.61	.67	.	.
_MOL	.	.	.37	.37	.45	.52	.58	.64	.70	.76	.	.
_POL	.67	.83	.83	.83	.83	.90	.96	.96	.96	.97	.	.
_ROM	.	.29	.43	.51	.52	.54	.68	.82	.83	.83	.	.
_RUS	.	.	.65	.63	.63	.63	.63	.63	.57	.49	.	.
_SLK	.	.83	.83	.73	.72	.79	.78	.76	.80	.90	.	.
_SLN	.34	.62	.83	.91	.97	.97	.97	.97	.97	.97	.	.
_TAJ	.	.	.39	.08	.01	.01	.01	.08	.18	.18	.	.
_TUR	.	.	.11	.02	.00	.00	.00	.00	.00	.00	.	.
_UKR	.	.	.67	.59	.57	.63	.64	.64	.64	.63	.	.
_UZB	.	.	.17	.08	.00	.00	.02	.03	.03	.03	.	.

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STUDY 2

Effects of Initial Conditions, Reforms and Institutions on Economic Developments during Transition: A Path Analysis Approach

Abstract

The overriding objective of the empirical analysis in this study is to disentangle the relative roles that initial conditions and the process of reforms and institution building specific to transition played in supporting and/or hindering economic activities in the post-communist countries. The analysis focuses on 24 post-communist countries in Eastern Europe and Eurasia and on the transition period until year 2000. There are two main defining features of the analysis that I develop. First, in the spirit of the theoretical literature of Optimal Speed of Transition, I analyze the issue that observed aggregate growth is the net result of the expansion of the private sector and of the collapse of the state sector. For this purpose I decompose aggregate growth rates into growth in value added in the private sector and the corresponding developments in the state sector. I find that even among the most advanced transition economies there are significant differences in terms of the way in which developments in the two sectors combine into aggregate economic performance. The second main feature of the current analysis is the focus on interactions among the determinants of economic performance of the two sectors. I introduce and employ the method of Path Analysis in order to analyze an empirical simultaneous equation model that connects initial conditions, reforms, institutions and growth in the private and state sectors. The main advantage of the method of path analysis is that it enables the empirical analysis of direct, indirect and total effects of factors included in the model. This empirical set-up allows me to qualify previous empirical findings in several respects, and to also analyze empirically new hypotheses that have not been tested before. In line with my predecessors, I find sizeable total effects of initial conditions on economic developments in the state and the private sectors. However, the effects of initial conditions on growth in the private sector appear to be more of an indirect nature, as they are mediated by reforms and by the process of institution building. On the non-linear effect of reforms, I also find that reforms have positive total effects on activities in the private sector and negative total effects on activities in the state sector. In terms of direct effects, I obtain that reforming the state-owned enterprises and the financial system had a significant influence on the observed activities in the private sector. In this respect I estimate that the largest direct effect is associated with changes in the regulatory and economic conditions in the financial sector. However, price liberalization appears to have only an indirect effect (although sizeable) on the performance of the private sector, mainly due its influence on the other types of reforms. As regards developments in the state sector, I find direct significant negative effects on the growth in the sector for all the economic reforms considered in the analysis. In this respect the largest direct effect is associated with cumulative past changes in reforms in the financial system. The endogenous nature of the reform process is mediated in the model by the role of institutions built during transition. The sample data that I employ support the hypothesis of endogenous institutions. I find significant direct effects from the expansion of the private sector to contemporaneous changes in the political environment. Furthermore, weak economic growth in both sectors (private and state) relate to increases in (international observers') perceptions on pervasive corruption in transition countries. Changes in the institutional environment are further propagated in the system via their feedback effects on the reform process.

Keywords: transition, path analysis, structural equation modeling, simultaneous equation model, initial conditions, reforms, institutions, output collapse, economic growth, private sector, state sector, Eastern Europe, Eurasia

Effects of initial conditions, reforms and institutions on economic developments during transition: a path analysis approach

INTRODUCTION

In the literature on the transition process in the post-communist countries it has been largely acknowledged that the economic success of the process is highly dependent on the ability of transition economies to initiate and sustain the development of an active private sector. The analysis in this study substantiates this assertion to a large extent by a close examination of the developments, in terms of economic growth, in the private and the state sectors in transition. The overriding objective is to disentangle the relative roles that initial economic conditions (inherited from the central planning period), the process of reforms and institution building during transition played in supporting and/or hindering economic activities in the private and the state sector.

The analysis focuses on the transition process in 24 post-communist countries in Eastern Europe and Eurasia, covering the period that starts with the first year of transition (specific to each country) and until year 2000.

There are two main defining features of the empirical analysis I develop in this study. First, in line with the main setup of the theoretical literature of the Optimal Speed of Transition, pioneered by Aghion and Blanchard(1994), and of the empirical studies of Hernandez – Cata(1997) and Berg, Borenzstein et al(1999), I analyze the issue that aggregate growth rates observed during the transition process are the net result of the expansion in the private sector and a corresponding shrinking of the state sector. For this purpose I decompose aggregate growth rates into growth rates of activities in the private sectors and the corresponding developments in the state sector. I find that, even among the most advances transition economies, there are significant differences in terms of the way developments in the two sectors complement each other. Countries such as Poland and Slovenia, where highest cumulative growth during transition is observed, relied on a strong expansion of the private sector, but also on a limited decline in the state sector. High cumulative aggregate growth recorded during transition in Hungary and Slovak Republic, on the other hand, is a result of an even stronger growth in the private sector, but also a deeper decline in the state sector. The much weaker results in terms of cumulative aggregate growth recorded in the CIS countries during transition are similarly explained by a collapse of state sector activities and weak developments in the private sector.

The second main feature of the current analysis is the focus on interactions between determinants of growth in the two sectors. I introduce the method of path analysis as an alternative method employed for the estimation of simultaneous equations system that allows for explicit estimation of direct, indirect and total effects in the system. Together with the method of Confirmatory Factor Analysis (as introduced in the previous study in this thesis), the method of path analysis is the backbone of the methodology of Structural Equation Modeling. Path analysis is covariance –based and it can be employed for the empirical analysis of direct and indirect interactions among the variables connected by means of a simultaneous equation model.

In building an empirical model that can help explain at least part of the developments in the state and the private sectors, I focus on three main types of factors: initial conditions, economic reforms and institutions in transition. For the category of initial conditions I select indicators that reflect economic features of transition economies at the beginning of transition in terms of initial private sector share in total economy, previous exposure with economic reforms (as implemented during the communist regime) and the reliance on trade with CMEA partners. For the indicators of reforms I rely on the latent factors of enterprise sector transformation and reforms in the financial system estimated in the previous study in this thesis. Additional indicators of reforms are included in terms of EBRD indices of price liberalization and reforms with international trade and currency convertibility. Aspects of the process of institution building in transition are reflected by the latent factor of political environment that I estimated in the previous study, as well as by two additional indicators that I employ separately: a measure of the extent to which the government protects the private property, and a measure of corruption, as perceived by international observers.

The simultaneous equation framework I employ, coupled with the method of path analysis, offers the possibility to analyze not only the direct effects of initial conditions, reforms and changes institutional environment on the activities in the two sectors, but also to capture the interactions among the explanatory factors at different levels as following:

- interactions between initial conditions and reforms
- interactions among specific types of reforms
- interactions between initial conditions and changes in institutional environment
- interactions between reforms and institutions
- interactions among specific types of institutional aspects.

The current analysis qualifies existing empirical findings in several respects and it also produces results on hypotheses that have not been tested before. In this introduction I only introduce a subset of the results. In line with my predecessors, I find sizeable significant effects of initial conditions on developments during transition. However, the effects of initial conditions on growth in the private sector are more of an indirect nature, as they are mediated by the role played by reforms and the process of institution building. For the state sector, I interpret the estimated results as providing additional empirical support for the disorganization hypothesis formulated by Blanchard and Kremer(1997). In countries with previous exposure to reforms and less reliance on CMEA trade state owned enterprises appeared to have been in a better position to cope with shocks experienced during the transition process.

On the non-linear effect of reforms, as detected in alternative empirical studies that focus on aggregate growth, the results in this study partly concur with Hernandez-Cata(1997) and Berg, Borenzstein et al(1999) in reflecting the fact that reforms had positive direct effects on activities in the private sector, and corresponding negative direct effects on activities in the state sector. Such direct effects on private sector activities are estimated for reforms in the enterprise sector and in the financial system only. Price liberalization appears to have only an indirect effect on the private sector activities (although a sizeable one) via its impact on the other types of reforms. In terms of magnitudes of direct effects of specific reforms on the private sector, I estimate the largest effect as being associated with changes in regulatory and economic conditions in the financial sector. As regards the state sector, I estimate direct adverse effects for all of the reforms considered in the analysis, with the largest direct effect estimated for cumulative past changes in the reforms in the financial system.

Endogeneity of the reform process is mediated in the model by the role of institutions. The sample data supports a model with endogenous institutions. I find direct significant effects from developments in the private sector to contemporaneous changes in the political environment. Furthermore, adverse developments in the private sector and the state sector appear to be associated with increases in the perceptions of more pervasive corruption in the country. Changes in the institutional environment are further propagated in the system via their feedback effects on the reform process.

Despite the rich structure of the effects detected in the model, of which only a limited set is described above, I find that initial conditions, reforms and institutional developments are not enough to explain growth developments in the two sectors. While the relatively limited explanatory potential of the analysis is partly attributed to data deficiencies (especially for the first years of transition), I also argue that there are some potentially important factors missing from the current analysis. Such factors are discussed in terms of the role of de novo firms in generating growth in the private sector, the limited ability to capture the role of investments for growth of private firms, as well as in terms of issues related to the developments in the unofficial economy.

The structure of the study is the following: in Section I the main concepts of the method of path analysis are introduced, with a particular emphasis on the calculation of indirect and total effects in a system of simultaneous equations. Section II focuses on some stylized facts of the transition process in the post-communist countries. The section also includes a comparison that reveals significant differences in aggregate growth rates for the post-communist countries across data series, as calculated based on two main sources: IMF and World Bank. Section III is dedicated to a detailed review of the existing theoretical and empirical research efforts on transition, with a particular emphasis on the studies that I find most relevant for the analysis in this study. Section IV is split in three parts: subsection IV.1 is dedicated to the decomposition of aggregate growth into growth of the private sector, and the corresponding developments in the state sector; subsection IV.2 includes the discussions on the process of building an empirical simultaneous equation model for transition economies and of the results obtained in the process; in sub-section IV.3 I discuss some of what I consider to be the main limitations of the constructed empirical model, relative to a conceptual model introduced at the beginning of section IV. Section V concludes.

Section I: Introduction to path analysis

The method of path analysis originates in the work of the biometrician Sewall Wright dating from 1920[1]. In the framework of simultaneous equation models, Wright proposed a set of rules that relate the population moments of the variables to the structural parameters in the model. Latent variables and methods of estimating direct and indirect effects in a simultaneous equations system were already present in Wright's work. The modern version of path analysis, as incorporated in the methodology of Structural Equation Modelling, came with the work of Jöreskog(1973) and Wiley(1973), where matrix algebra is employed in order to develop general structural equation models that incorporate features of path analysis. The rapid spread of the method has been facilitated with the creation of a SEM – dedicated software, LISREL, thereafter.

The objective in this section is to introduce the main concepts related to the method of path analysis, as relevant for the empirical analysis in the next sections. The, by now, classical textbook reference on the methodology of Structural Equation Modelling, including the method of path analysis is Bollen(1989).

Diagrams and Equations

As in the case of regression analysis, the method of path analysis is covariance-based and it is employed to analyse relationships between variables included in a model. While path analysis relies on the statistical foundations of regression analysis, there are two main features that are specific to the method: 1) the use of path diagrams, as means to represent a model (along with the model equations), and 2) decomposition of the estimated effects into direct, indirect and total effects between variables in the model.

In order to illustrate the common features of path analysis and multivariate regression analysis, consider the following multivariate regression as an example:

$$(1) \qquad y = \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + \varepsilon_y$$

[1] See Goldberger(1972) for a description of Wright's work.

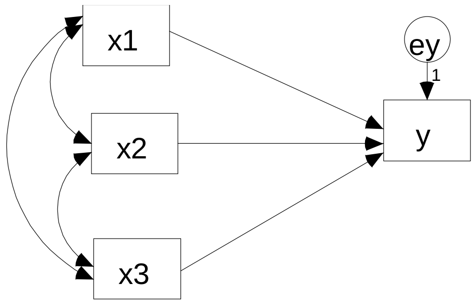
where all variables are written in deviations from the mean, and the usual assumptions on the error term apply. Least- square regression of y on x_1, x_2 and x_3 chooses estimates for the parameters βs such that the sum of squared errors is minimized. The resulting estimates (b_1, b_2, b_3) solve the equations:

$$\begin{cases} \text{var}(x_1)b_1 + \text{cov}(x_1,x_2)b_2 + \text{cov}(x_1,x_3)b_3 = \text{cov}(x_1,y) \\ \text{cov}(x_2,x_1)b_1 + \text{var}(x_2)b_2 + \text{cov}(x_2,x_3)b_3 = \text{cov}(x_2,y) \\ \text{cov}(x_3,x_1)b_1 + \text{cov}(x_3,x_2)b_2 + \text{var}(x_3)b_3 = \text{cov}(x_3,y) \end{cases}$$

where the $\text{cov}(\_,\_)$ and $\text{var}(\_)$ terms represent the sample moments of the variables in the analysis.

Consider now representing the assumptions embedded in the multivariate regression equation (1) in a path diagram, as in Figure 1.

Figure 1 Path Diagram Corresponding to Equation (1)



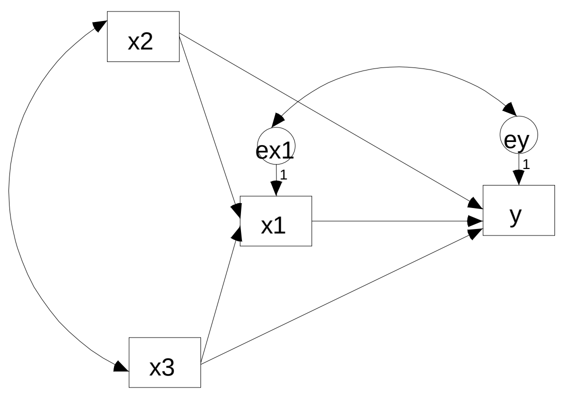
The paths (i.e arrows) from the explanatory variables x1, x2 and x3 to the dependent variable y stand for the parameters βs that are to be estimated. The double-headed arrows connecting the predictors represent their intercorrelations. If explanatory variables were orthogonal, then the (standardized) regression coefficients would simply be the correlations of the predictors with the dependent variable y. However, when the correlations between pairs of explanatory variables are far from negligible, then the regression coefficients reflect both the size of the correlation of the predictor with the dependent variable, and the size of the correlations among the explanatory variables. An obvious advantage of representing the model in a path diagram is that it makes the researcher more alert to the assumptions embedded in the model specification, which are not apparent from the specified equation. In the path analysis framework, however, the equation is, of course, identical to the specification in equation (1).

Assume further that, based on existing theoretical knowledge, there are reasons to believe that the explanatory variable x1 is actually driven by the other two explanatory variable, x2 and x3. In other words, the correlations (covariances) between x1 and x2, and between x1 and x3, are better replaced by direct paths from x2 to x1, and from x3 to x1. Modifying the model accordingly gives us a simultaneous equation model with y and x1 as dependent variables, and x2 and x3 as (assumed) exogenous variables. The two equations of the model write as:

$$(2) \qquad \begin{cases} y = \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + \varepsilon_y \\ x_1 = \gamma_2 x_2 + \gamma_3 x_3 + \varepsilon_{x1} \end{cases}$$

and the corresponding path diagram is illustrated in Figure 2.

Figure 2 Path Diagram Corresponding to System (2)



The diagram above tells us that, apart from what we read in the equations of model (2), the exogenous variables may be correlated, and also that there is possible correlation between the error terms of the two equations. As we know from the theory of simultaneous equation models, estimation of structural parameters is conditional on the model being identified. An easy way to see that the model (2) above is not identified is to consider the number of unknowns (that is, parameters to be estimated) and the number of equations available, based on sample moments. The unknowns to be determined correspond to the regression coefficients βs and γs, and the covariance between the two error terms $COV(\varepsilon_y, \varepsilon_{x1})$, summing up to 6 parameters in total. The available equations, in terms of sample moments, are only 5 in total[2]. This clearly suggests there is not enough information to estimate the unknown parameters in the system. In order to identify the model, we need to impose at least one constraint on the parameters in the system. Exclusion restrictions[3] are most common in empirical applications of simultaneous equation models in economics. If we constrain the model by assuming, say, there is no effect of x2 on x1 ($\gamma_2 = 0$), then the system is just - identified and the model structural parameters can be estimated.

An alternative way to identify the model focuses on the covariance structure of the error terms. In the example above, we can consider constraining the covariance between the two error terms to a fixed value, usually zero, instead of constraining one of the structural parameters. A just-identified model is obtained, and we can then proceed with the estimation of the unconstrained parameters in the system. At times, such a hypothesis may prove restrictive, in that it indicates that the only observed covariance between variables x1 and y is induced by the two common predictors x2 and x3. However, it is a hypothesis that can be tested in a similar manner as hypotheses on the other parameters in the system are tested. The possibility to test restrictions on the covariance structure of the error terms gives more freedom to the researcher in formulating a model according to existing theories. From this perspective, the method of path analysis proves useful in more complex analyses, of simultaneous equations systems with a richer covariance structure for the error terms. By requiring explicit specification of assumptions on covariances of pairs of error terms, corresponding to the equation in the model, the method invites the researcher to consider the trade-off between exclusion restrictions and constraints on the error covariances. Nonetheless, it

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[2] Multiply the first equation in system (2) successively by x1, x2 and x3, and then take expectations. This results in three equations with known sample moments. Two more equations are obtained by multiplying the second equation in system (2) by x2 and x3, and then by taking expectations.

[3] That is, imposing the constraint that one of the regression coefficients is zero.

does not substitute in any way for the solid theoretical justifications required to support the identifying assumptions.

Issues of estimation[4]

The general specification of a simultaneous equation model in matrix terms writes as:

$$(3) \qquad y = B \cdot y + \Gamma \cdot x + \zeta$$

where:

$y = (mx1)$ vector of endogenous variables[5]

$x = (n \times 1)$ vector of exogenous and/or predetermined variables

$B =$ $(m \times m)$ matrix of structural coefficients corresponding to the endogenous variables in the system

$\Gamma = (m \times n)$ matrix of structural coefficients corresponding to the exogenous and/or predetermined variables

ζ = $(m \times 1)$ vector of error terms

The usual assumptions on the error terms apply, in that $E(\zeta) = 0$ and $COV(x, \zeta) = 0$.

Additional notations needed are:

Ψ = the population variance – covariance matrix of the error terms ζ

$\Phi =$ the population variance – covariance matrix of the exogenous variables x

$\Sigma =$ the population variance – covariance matrix of the endogenous variables y and the exogenous variables x.

The model (3) is defined as non-recursive if the coefficient matrix B cannot be written in a lower- triangular form. The model is also said to be partially recursive when

[4] Given that the main hypothesis and the estimation procedure are the same as described in Section I.2 in Study 1, where Confirmatory Factor Analysis is introduced, the presentation in the current section is kept at a general, informative level only.

[5] In a structural equation model, the endogenous and exogenous variables can be either observed (manifest), unobserved (latent) or both. In this section I focus on systems in observed variables only.

B is lower-triangular, but the matrix Ψ is not diagonal. A fully recursive system, on the other hand, has a lower-triangular matrix B and a diagonal covariance structure (Ψ) for the error terms. While a fully recursive system is always identified, in general and in the less than fully recursive simultaneous equation systems we need additional identifying assumptions to make estimation of the structural parameters possible. As noted above, some of the identifying assumptions come in the form of exclusion restrictions (constraints on the B matrix)[6] and /or constraints on the covariance structure of the error terms (constraints on the Ψ matrix)[7].

As the example above reveals, the method of path analysis works on the assumption that the population variance – covariance matrix of the endogenous and exogenous (and/or predetermined) variables Σ can be written in terms of the structural parameters of the specified model:

$$\Sigma = \Sigma(\theta)$$

where θ is the vector of (all) unconstrained parameters in the model, and $\Sigma(\theta)$ is called the variance-covariance matrix *implied* by the model. The implied covariance structure of the endogenous and the exogenous variables ($\Sigma(\theta)$) writes as:

$$\Sigma(\theta) = \begin{bmatrix} (I-B)^{-1}\left(\Gamma\Phi\Gamma^T + \Psi\right)\left((I-B)^{-1}\right)^T & (I-B)^{-1}\Gamma\Phi \\ \Phi\Gamma^T\left((I-B)^{-1}\right)^T & \Phi \end{bmatrix}$$

The matrix $\Sigma(\theta)$ can also be written in matrix _block terms as:

$$\Sigma(\theta) = \begin{bmatrix} \Sigma_{yy}(\theta) & \Sigma_{xy}^T(\theta) \\ \Sigma_{xy}(\theta) & \Sigma_{xx}(\theta) \end{bmatrix}$$

where each block corresponds to the relationships between endogenous variable (yy), endogenous and exogenous variables (xy), and the exogenous variables (xx).

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[6] See Greene(1997) for a detailed theoretical treatment of identification of simultaneous equation systems based on exclusion restrictions.

[7] See Hausman and Taylor (1983) and Hausman, Newey et al.(1987) for theoretical treatments of covariance restrictions. A summary of the identification methods for specific types of system, as well as the general case of non-recursive systems, is to be found in Bollen(1989).

After the model identification is ensured[8], the general objective in the estimation process is to generate, based on the model specification and the sample moments of the variables *S*, estimates that imply a variance – covariance matrix $\Sigma(\hat{\theta})$ as close as possible to *S*. A perfect fit for the model is obtained when $S = \Sigma(\hat{\theta})$. For over-identified models, there will be differences between elements in the two matrices and the larger the differences the more likely is that the model is misspecified.

The method used for the estimation of the simultaneous equation models specified in the current analysis is the SEM variant of Full Information Maximum Likelihood that allows for an efficient use of information in the sample in presence of missing data. A description of the method and its advantages is included in Section I.2, in Study 1 in this thesis.

As in the case of Confirmatory Factor Analysis, with path analysis models there are three levels at which the results are evaluated:

- parameters estimates
- equations
- the model

The quality of parameter estimates is evaluated in the usual manner in terms of magnitude, size and individual t-tests for statistical significance. Comparisons of the relative magnitude of the estimated effects are best made in terms of the standardized coefficients, obtained by multiplying the estimated parameter by the ratio of the standard deviation of the dependent variable and the standard deviation of the respective explanatory variable.

At the equation level, the measure of Squared Multiple Correlation (SMC[9]) tells us the extent to which the variance of the dependent variable in an equation is explained by the explanatory variables included in the equation.

At the model level, the same overall fit indices, as introduced for Confirmatory Factor Analysis, prove useful for the evaluation of the extent to which the sample data supports the specified model.

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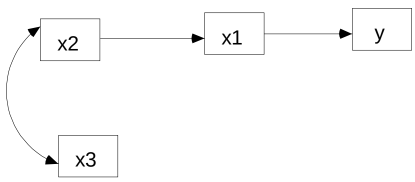
[8] For complex models, theoretical identification is next to impossible, such that empirical identification procedures need to be relied upon. See Study 1 for a discussion of empirical identification.

[9] Denoted R-square when results are reported in Section IV.

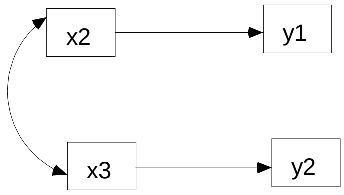
Effect Decomposition

The second main feature that makes the method of path analysis attractive from an empirical perspective is that it allows for the decomposition of the effects estimated in a simultaneous equation system into direct effects, indirect effects and total effects. In the example in Figure 2, the direct effects are given by the estimates of the structural parameters βs and γs. An indirect effect, for example, is the effect of the predictor x2 on y, via the mediator x1, and it is calculated as the product of the coefficients corresponding to the two connected paths: $\beta_1\gamma_2$. The total effect of x2 on y is then calculated as the sum of the direct effect of x2 on y, as represented by β_2, and the corresponding indirect effect, $\beta_1\gamma_2$.

A richer classification of effects is given in Fox(1980) in that, apart from the direct and indirect effects which have a 'causal' nature, there are also effects of 'noncausal' nature. The non-causal components can be induced in a simultaneous equation system by the covariances among exogenous variables. A non-causal component between an endogenous and an exogenous variable is termed as 'unanalyzed', as it depends on a relationship between exogenous variables for which a causal order (a path with a specific direction) is not defined. An example of an unanalysed, non-causal component is illustrated in the following diagram:



The 'effect' between x3 and y in this case is of a non-causal nature, and unexplained in the model, as it is driven by the covariance of x3 with x2 (which, in turn, has a causal indirect effect on y). Another type of non-causal components may be generated between endogenous variables, in which case they are called spurious. Consider the example in the diagram below:



In this case, a covariance may be observed between y1 and y2, but it is not due to a direct, or even indirect but of a causal nature, relationship between the two variables, but rather driven by (distinct) causes, which are correlated with each other. In estimating a simultaneous equation model, it is of course of interest to capture the effects of a 'causal' nature, while at the same time control for possibly spurious components.

Consider the following notations:

- The matrix of direct effects among the endogenous variables in the system:

$$(4) \qquad D_{yy} = B$$

- The matrix of direct effects of the exogenous variables on the endogenous variables:

$$(5) \qquad D_{yx} = \Gamma$$

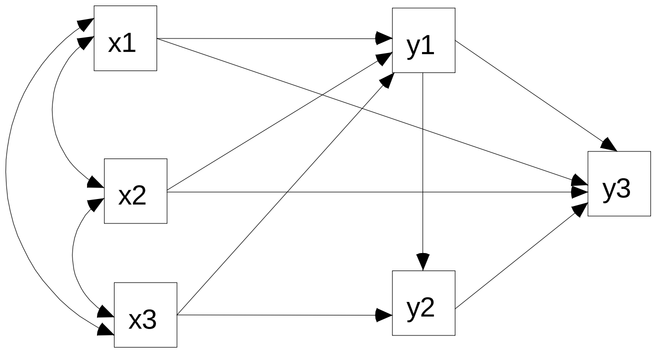
The matrix of all direct effects in the system in block_matrix form writes as:

$$D = \begin{bmatrix} 0 & Dyx \\ 0 & Dyy \end{bmatrix}$$

with elements in the first (block) column being zero, as no direct effects are allowed among the exogenous variables, and also from the endogenous variables to the exogenous variables.

As explained in Fox(1980), a recursive simultaneous equation model can be thought of as a directed network, where the value matrix of the network is given by the structural parameters. Consider the example illustrated in Figure 3.

Figure 3



The blocks in matrix D, including the direct effects specified in the model[10] described by the diagram in the figure, write as:

$$D_{yy} = \begin{bmatrix} 0 & \beta_{12} & \beta_{13} \\ 0 & 0 & \beta_{23} \\ 0 & 0 & 0 \end{bmatrix} \text{and } D_{xy} = \begin{bmatrix} \gamma_{11} & 0 & \gamma_{13} \\ \gamma_{21} & 0 & \gamma_{23} \\ \gamma_{31} & \gamma_{32} & 0 \end{bmatrix}$$

where β_{ij} corresponds to the direct path from the endogenous variable y_i to the endogenous variable y_j; similarly, in matrix D_{yx}, the parameter γ_{ij} is assigned to the direct path from the exogenous variable x_i to the endogenous variable y_j.

By using the properties of directed graphs, we can calculate the indirect effects of length two (that is, including two successive paths only) between each pair of the variables in the model, by taking the square of the value matrix D:

$$D^2 = \begin{bmatrix} 0 & D_{xy} D_{yy} \\ 0 & D_{yy}^2 \end{bmatrix}$$

For our example, the component blocks of the resulting matrix D^2 translate into:

[10] Note that we can immediately tell that the model is identified, as it is fully recursive.

$$D_{yx}D_{yy} = \begin{bmatrix} 0 & \gamma_{11}\beta_{12} & \gamma_{11}\beta_{13} \\ 0 & \gamma_{21}\beta_{12} & \gamma_{21}\beta_{13} \\ 0 & \gamma_{31}\beta_{12} & \gamma_{31}\beta_{13} + \gamma_{32}\beta_{23} \end{bmatrix}$$

and

$$D_{yy}^2 = \begin{bmatrix} 0 & 0 & \beta_{12}\beta_{23} \\ 0 & 0 & 0 \\ 0 & 0 & 0 \end{bmatrix}$$

In the matrix $D_{yx}D_{yy}$ we see, for example, that there is only one indirect path between the exogenous variable x1 and the endogenous variables y3, via the endogenous variable y1. The size of this indirect effect is calculated by multiplying the direct effects corresponding to the corresponding existing paths. The total indirect effect (of length 2) of the exogenous variable x3 on the endogenous variables y3 is the sum of two components: an indirect effect of x3 on y3 via the endogenous variable y1, and another indirect effect between the two variables via the endogenous variable y2.

In the matrix D_{yy}^2, that includes the indirect effects of length two between pairs of endogenous variables, we see there is only one effect of this type, respectively the indirect effect of the endogenous variable y1 on the endogenous variable y3.

In a similar manner, the indirect effects of length three between pairs of the variables in the system are calculated by raising the matrix D to the power of three. The general (block_matrix) form of the resulting matrix writes as:

$$D^3 = \begin{bmatrix} 0 & D_{xy}D_{yy}^2 \\ 0 & D_{yy}^3 \end{bmatrix}$$

The total effects between each pair of variables in the system are then calculated by summing up all the direct and indirect effects (of any possible length) in the system:

$$T = D + D^2 + D^3 + \ldots + D^m$$

where m is the number of the endogenous variables in the system.

The block components of the matrix T of total effects are the following:

(6) $$T_{xy} = D_{xy} + D_{xy}D_{yy} + D_{xy}D_{yy}^2 + D_{xy}D_{yy}^3 + \ldots + D_{xy}D_{yy}^{m-1} = D_{xy}\left(\sum_{i=0}^{m-1} D_{yy}^i\right)$$

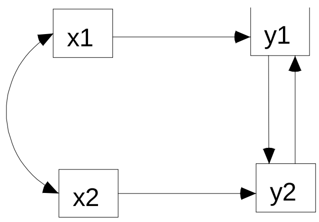
and

(7) $$T_{yy} = D_{yy} + D_{yy}^2 + D_{yy}^3 + D_{yy}^4 + \ldots + D_{yy}^{m-1} = \sum_{i=0}^{m-1} D_{yy}^i - I$$

The sum of indirect effects only can be traced back by subtracting the direct effects from the total effects.

It can be shown that the calculation of indirect and total effects in a simultaneous system, as introduced above, generally applies to both recursive and non-recursive systems. However, for the non-recursive systems (where there are feedback effects from some of the endogenous variables) the concept of system stability needs to be considered for a correct specification of a model. In order to illustrate the core idea behind the issue of system stability in the context of path diagrams, consider the hypothetical model represented in the diagram in Figure 4.

Figure 4 Feedback effects



The model in the figure above tells us that an increase in x1 by one unit induces an increase of γ_{11} in y1, which, in turn, propagates the change to y2. The magnitude of the change in the endogenous variable y2, as a result of a unit change in x1, will therefore be given by $\gamma_{11}\beta_{12}$. The change in y2 will be further propagated in the system, due the direct effect y2 has on y1. The change that feeds back into y1 is given by $\gamma_{11}\beta_{12}\beta_{21}$, and so on. The total effects of the exogenous variable x1 on the endogenous variables y1 and y2 can be written as infinite sums as following:

$$T_{x1:y1} = \gamma_{11} + \gamma_{11}\beta_{12}\beta_{21} + \gamma_{11}(\beta_{12}\beta_{21})^2 + ... = \gamma_{11}\sum_{i=0}^{\infty}(\beta_{12}\beta_{21})^i$$

$$T_{x1:y2} = \gamma_{11}\beta_{12} + \gamma_{11}\beta_{12}(\beta_{12}\beta_{21}) + \gamma_{11}\beta_{12}(\beta_{12}\beta_{21})^2 + ... = \gamma_{11}\beta_{12}\sum_{i=0}^{\infty}(\beta_{12}\beta_{21})^i$$

such that the two effects converge to finite values if and only if $|\beta_{12}\beta_{21}| < 1$. Otherwise the system is unstable.

The total effects given in (6) and (7) above can be written in terms of the original system matrices as:

$$T_{xy} = \Gamma\left(\sum_{i=0}^{m-1} B^i\right)$$

$$T_{yy} = \sum_{i=0}^{m-1} B^i - I$$

As explained in Bentler and Freeman(1983), the system stability condition illustrated above translates, in general, in the convergence of the series $\left(\sum_{i=0}^{m-1} B^i\right)$, as $m \to \infty$. A matrix series is convergent, that is $B^k \to 0$ as $k \to \infty$, if and only if the absolute value of the largest eigenvalue of the matrix is less than one:

$$(8) \qquad \rho(B) < 1$$

A sufficient, but not necessary, condition for system stability is given as:

$$\rho(BB^T) < 1$$

in that, if true, then the system is stable, but if not true, then we need to check condition (8).

If condition (8) holds, then the total effects in the system can be calculated as:

$$T_{xy} = \Gamma(I - B)^{-1}$$
$$T_{yy} = (I - B)^{-1} - I$$

Based on these theoretical considerations, in empirical applications of path analysis for non-recursive systems, a stability index is calculated for each distinct feedback loop in the system. Values higher than one obtained for the stability index indicate that the system is misspecified, as it is not stable.

A note on the exact meaning of the total effects, calculated as above, is in order. In relation to the decomposition of effects into 'causal' (direct and indirect) and 'noncausal'(unexplained and spurious) made in Fox(1980), the concept of total effects in this section refers only to the sum of the effects of a 'causal' nature. The calculation of the 'noncausal' effects is explained in the article mentioned above.

Finally, as discussed in details in Bollen(1989), the term 'causal' that path analysis operates with does not mean to convey that the method helps the researcher 'discover' causality in a system[11]. As with alternative empirical methods available, what the method does is to help us understand to which extent the available sample data provide evidence for the specified model. Model specification is critically dependent on the theory that supports it. Therefore, causal effects[12] are best supported by the theoretical (or conceptual) model that invites the empirical analysis in the first place.

[11] Which is the reason why I used the term causal in quotes throughout this section.
[12] The debate on causal interpretation of empirical results is as lively today as it was in the 1970s. For highly interesting readings see McKim and Turner(1997).

Section II Stylized Facts of Transition

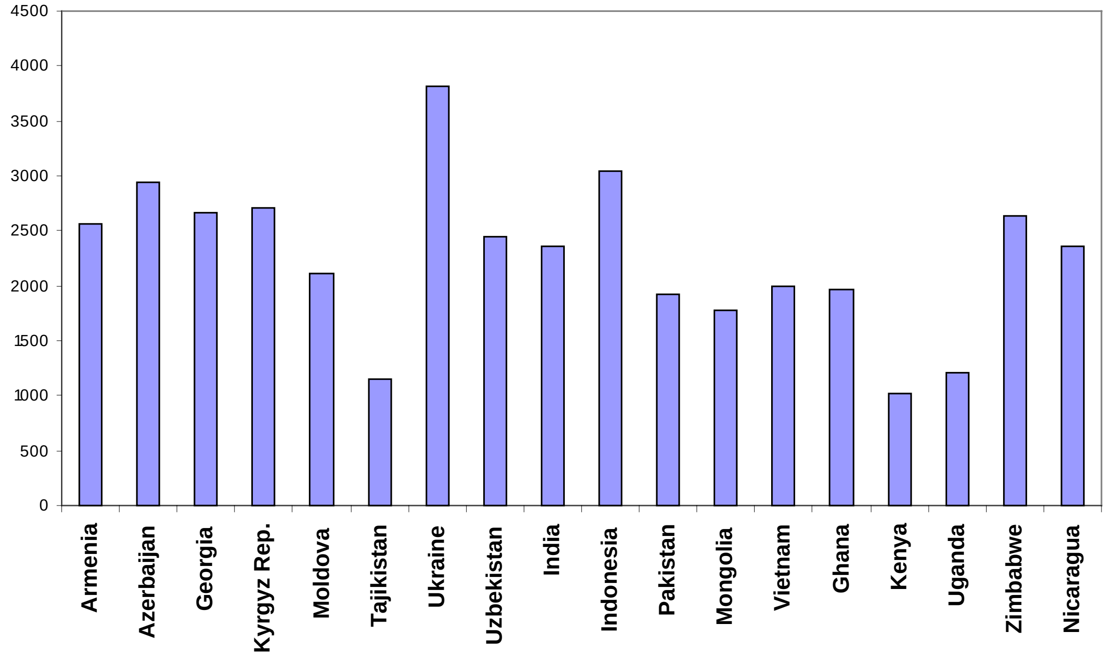
This study is concerned with a specific group of countries that have at least one historical feature in common: prior to early 1990s they had been ruled by communist political leadership, and the dominant economic system was central planning. In the aftermath of the political turmoil that triggered the demise of communist regimes in Central and Eastern Europe, and Eurasia, the post-communist countries started their search for a new political identity and a more efficient economic system. A decade later we learn that a successful transition process involves deep transformations not only of the economic system, but also at the political, institutional and civic levels.

The main objective of this study is the analysis of the role of initial conditions, economic reforms and institutional factors in promoting economic growth in transition economies. This section includes short descriptions of the transition process in the post-communist countries in terms of economic, political and institutional developments since the start of transition and until the year 2000[1]. In line with the established tradition in the literature, a particular classification of countries along regional dimensions is employed: the group of Central and Eastern Europe (CEE) includes Croatia, Czech Republic, Hungary, Poland, Slovak Republic and Slovenia; in South-Eastern Europe (SEE) we find Albania, Bulgaria, Macedonia and Romania. Countries that gained their state independence from the former USSR are grouped as following: the BALTIC countries, including Estonia, Latvia and Lithuania; countries in the CAUCASUS region are Armenia, Azerbaijan and Georgia; the CENTRAL CIS[2] group includes Belarus, Russia, Moldova and Ukraine, and the CENTRAL ASIA group includes Kazakhstan, Kyrgyz Republic, Tajikistan, Turkmenistan and Uzbekistan. The period of interest begins with the first year of transition (specific to each country)[3] and it ends in year 2000. A broad perspective of the (recent) levels of economic development reached in transition economies is reflected in Figure 1 and Figure 2.

[1] Indicators and data sources are mostly discussed in Study 1 in the thesis. See also Appendix 1 in this study for original sources of the additional indicators employed. A useful discussion and summary of data sources for transition economies in general are provided in Filer and Hanousek(2001).
[2] Commonwealth Independent States
[3] See Appendix I in Study I for initial years of transition across countries.

Figure 1

Low Income Countries (GDP_Cap in PPP / Year 2000)



Lower Middle Income Countries (GDP_Cap in PPP / Year 2000)

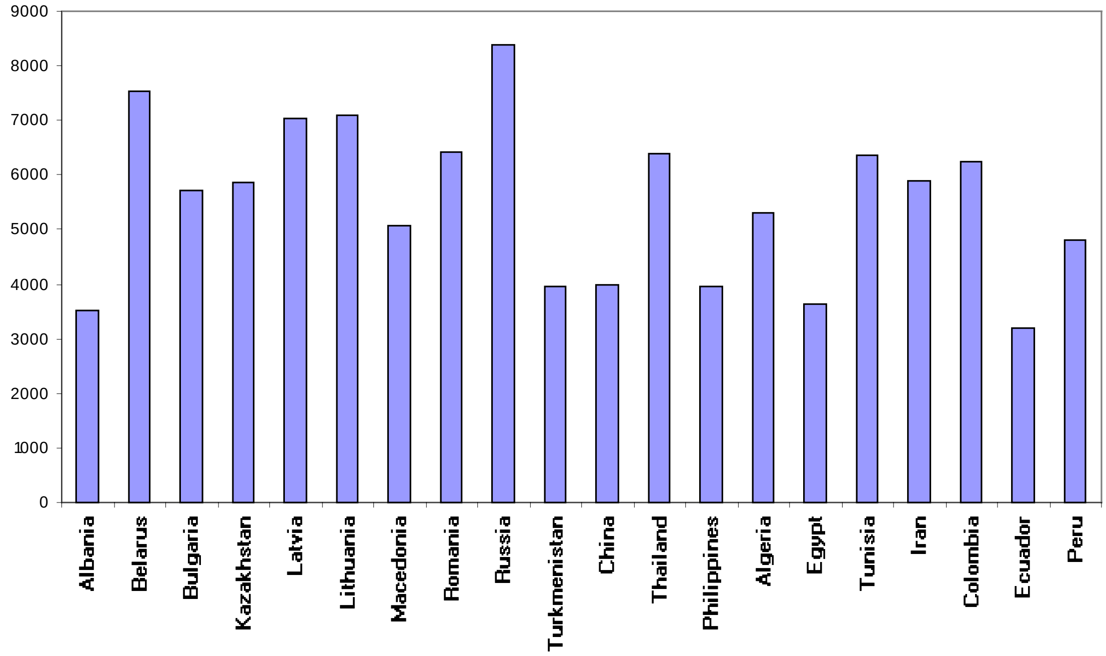
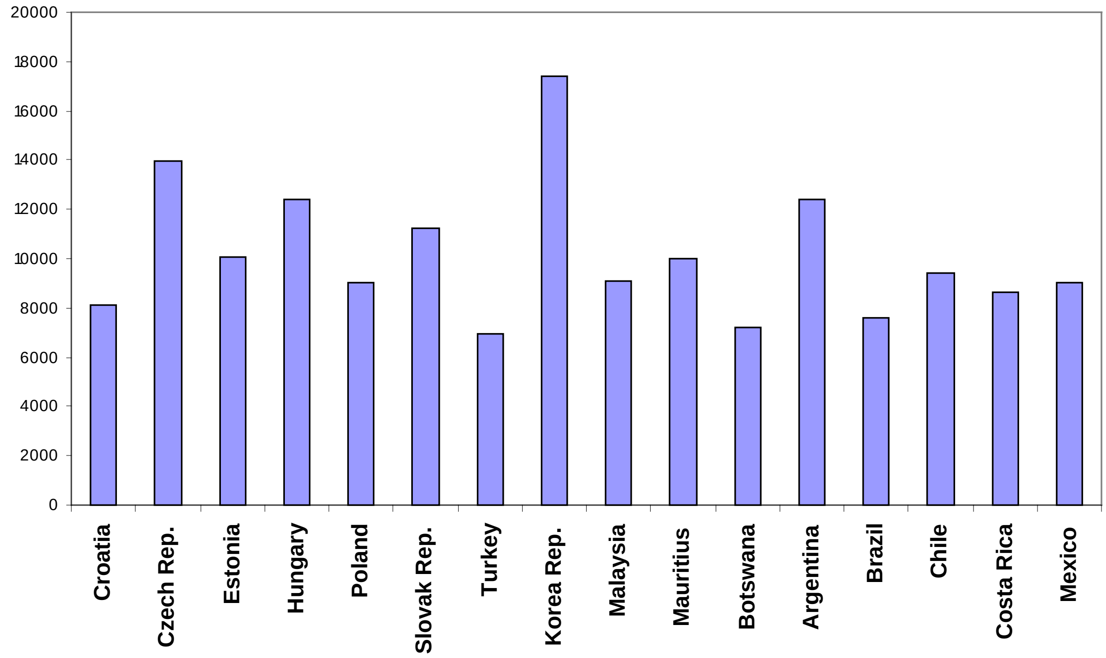
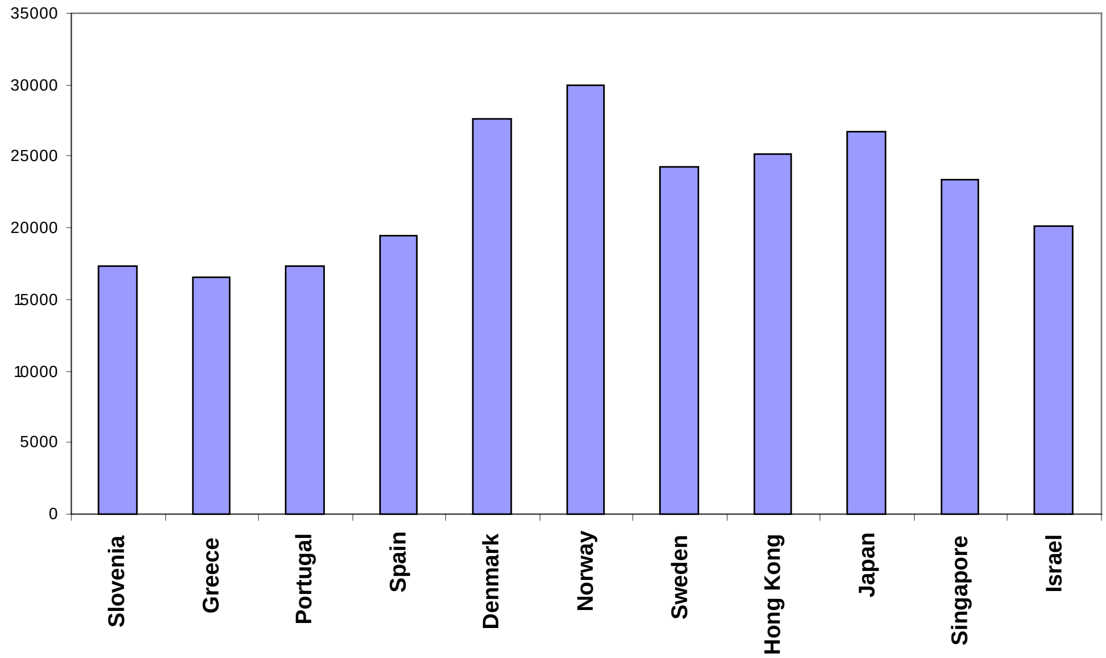


Figure 2

Upper Middle Income Countries (GDP_Cap in PPP / Year 2000)



High Income Countries (GDP_Cap in PPP / Year 2000)



Transition countries are grouped according to the World Bank definition of low – income countries (GNI per capita in year 2000 of 755USD or less), lower – middle income countries (GNI per capita in year 2000 between 755USD and 2995USD), upper – middle income countries (GNI per capita in year 2000 between 2995USD and 9265USD), and high – income countries (GNI per capita higher than 9265USD). Note that the graphs illustrate the levels of GDP per capita in year 2000. Other countries in the world are also included in order to provide a comparative perspective.

Some of the former USSR republics, such as the Caucasus countries, Moldova, Ukraine, Tajikistan and Kyrgyz Republic are included in the group of low – income countries, with levels of economic developments similar to countries such as Indonesia, Zimbabwe and Nicaragua. Most of transition economies, with the exception of CEE, are to be found in the group of lower-middle income countries, with Belarus and Russia at the upper end of the scale. Among other countries in the world, similar levels of economic development, as revealed by levels of GDP per capita in PPP terms, are observed in Thailand, Tunisia, Iran and Colombia. The least developed transition country in this group appears to be Albania, with a level of GDP per capita similar to China, Egypt and Ecuador.

The CEE countries and Estonia are classified as upper-middle income countries, with GDP per capita levels similar to some of the Latin American countries, such as Argentina, Chile, Costa Rica and Mexico. Slovenia was the only post-communist country included in the group of high – income countries in year 2000, when similar levels of GDP per capita are recorded for Greece, Portugal, Spain and Israel.

As explained in the next section, the main factors thought of as instrumental in reaching these different levels of development in the post-communist countries during transition can be grouped in three main categories: initial conditions, economic reforms and policy measures, and changes in political institutions.

Despite their common communist history, transition economies differed in terms of economic conditions inherited from the communist period. Table 1 illustrates some of the component indicators currently employed for characterizing the initial conditions in the post-communist countries at the onset of transition. There are three main types of initial conditions emphasized in this study: initial economic liberalization, dependency on trade in the former socialist block, CMEA, and the initial share of the private sector.

Table 1 Initial Economic Conditions

	CMEA Share (1990)	Initial GDP per capita (1989)	AgriculturеShare (1989)	Industry Share (1989)	Services Share (1989)	Initial Liberaliz. (1989)	Private Sector Share
CEE							
Croatia	5.6	2795	0.1	0.35	0.55	0.41	10
Czech Rep.	9.8	3363	0.07	0.58	0.35	0	5
Hungary	9.8	2805	0.14	0.36	0.5	0.34	19
Poland	16.5	2166	0.13	0.52	0.35	0.24	27
Slovak Rep.	9.8	3353	0.07	0.58	0.35	0	6
Slovenia	4.6	6331	0.05	0.44	0.51	0.41	11
Average	***9.35***	***3469***	***0.09***	***0.47***	***0.44***	***0.23***	***13.00***
SEE							
Albania	2.3	723	0.26	0.37	0.37	0	5
Bulgaria	15.3	2450	0.11	0.59	0.3	0.13	10
Macedonia	5.6	1369	0.12	0.43	0.45	0.41	14
Romania	3.3	1790	0.14	0.59	0.27	0	17
Average	***6.63***	***1583***	***0.16***	***0.50***	***0.35***	***0.14***	***11.50***
Baltic							
Estonia	27.2	4303	0.2	0.44	0.36	0.07	10
Latvia	31.3	4304	0.19	0.45	0.36	0.04	10
Lithuania	33.7	3389	0.27	0.45	0.28	0.04	10
Average	***30.73***	***3999***	***0.22***	***0.45***	***0.33***	***0.05***	***10.00***
Caucasus							
Armenia	21.3	1163	0.11	0.55	0.34	0.04	30
Azerbaijan	33.1	1639	0.22	0.44	0.34	0.04	10
Georgia	19.1	1615	0.22	0.43	0.35	0.04	15
Average	***24.50***	***1472***	***0.18***	***0.47***	***0.34***	***0.04***	***18.33***
Central CIS							
Belarus	44.50	3319	0.22	0.49	0.29	0.04	5.00
Moldova	24.80	2426	0.32	0.37	0.31	0.04	10.00
Russia	17.90	4061	0.15	0.48	0.37	0.04	6.00
Ukraine	24.60	1504	0.21	0.44	0.35	0.04	10.00
Average	***27.95***	***2828***	***0.23***	***0.45***	***0.33***	***0.04***	***7.75***
Central Asia							
Kazakhstan	17.80	2397	0.29	0.34	0.37	0.04	5.00
Kyrgyz Rep.	21.30	1254	0.33	0.40	0.27	0.04	15.00
Tajikistan	22.10	914	0.27	0.34	0.39	0.04	10.00
Turkmenistan	33.60	1727	0.29	0.34	0.37	0.04	10.00
Uzbekistan	24.00	1468	0.31	0.33	0.36	0.04	10.00
Average	***23.76***	***1552***	***0.30***	***0.35***	***0.35***	***0.04***	***10.00***

We can see that, on average, countries in the CEE region started the transition process with a higher level of initial economic liberalization[4], when compared to countries in the other regions. Countries also differed in terms of their involvement in the CMEA block, as reflected by the measure of CMEA trade, calculated as percent of GDP in year 1990. In view of the subsequent developments in transition, dependency on CMEA markets is considered as an initial impediment. From this perspective, relatively more favorable initial conditions are observed in countries in the CEE and SEE regions.

Progress achieved during a decade of transition in terms of implemented economic reforms and institutional changes is reported in Table 2. The indicators on economic reforms included in table are the EBRD index of removal of state control on prices (normalized in [0,1]), a composite measure of reforms with privatization and restructuring of state-owned enterprises (SOEs) (normalized in [0,1}), and a composite measure of reforms in the financial sector (also normalized in [0,1]). The scores are reported for year 2000 in all transition economies, with the exception of Turkmenistan, for which the level of reforms in the financial sector refers to year 1999. According to the European Bank of Reconstruction and Development index of price liberalization, by year 2000 most transition economies reached similar levels with price liberalization, with the exception of Belarus and Turkmenistan. The scores on enterprise sector reforms have been estimated in Study 1 of this thesis as a latent factor (NENTREF), based on component indicators of small-scale privatization, large-scale privatization, competition policy, and the imposition of hard budget constraints to SOEs. For year 2000, the measure indicates that higher general progress with reforming the SOEs has been achieved in countries in the CEE and Baltic regions, followed at a distance by the SEE countries. From this respect, much is left to be done in countries in Central CIS and Central Asia, especially in Belarus and Turkmenistan where the reform process appears to have stopped altogether. In terms of reforms in the banking sector, and other non-bank financial institutions, the CEE and Baltic regions maintain the lead, although with weaker progress than in the case of enterprise sector reforms. The reported scores correspond to the latent factor NFINANCE estimated in Study 1.

[4] The index of initial economic liberalization is described in Study 1. It is a normed measure ranging in [0,1].

Table 2 Progress with Economic Reforms and Institutions

	EBRD Price Lib. (2000)	Enterprise Reforms (2000)	Finance Reforms (2000)	Politics (1999)	Government Regulations (HF) (2000)	Property Rights (HF) (2000)	Percep. of Corruption (TI) (1999)
CEE							
Croatia	0.61	0.70	0.57	0.97	0.75	0.75	0.73
Czech Rep.	0.61	0.90	0.70	0.96	0.38	0.25	0.54
Hungary	0.70	0.90	0.85	0.97	0.50	0.25	0.48
Poland	0.70	0.79	0.70	0.97	0.50	0.25	0.58
Slovak Rep.	0.61	0.87	0.56	0.90	0.50	0.50	0.63
Slovenia	0.70	0.71	0.56	0.97	0.25	0.38	0.40
Average	***0.66***	***0.81***	***0.66***	***0.96***	***0.48***	***0.40***	***0.56***
SEE							
Albania	0.61	0.46	0.42	0.48	0.63	0.75	0.77
Bulgaria	0.61	0.70	0.54	0.81	0.75	0.50	0.67
Macedonia	0.61	0.63	n.a.	0.67	n.a	n.a	0.67
Romania	0.61	0.58	0.44	0.83	0.75	0.75	0.67
Average	***0.61***	***0.59***	***0.47***	***0.70***	***0.71***	***0.67***	***0.70***
Baltic							
Estonia	0.61	0.86	0.75	0.94	0.25	0.25	0.43
Latvia	0.61	0.70	0.58	0.95	0.50	0.50	0.66
Lithuania	0.61	0.71	0.57	0.97	0.50	0.50	0.62
Average	***0.61***	***0.76***	***0.63***	***0.95***	***0.42***	***0.42***	***0.57***
Caucasus							
Armenia	0.61	0.52	0.43	0.51	0.75	0.50	0.75
Azerbaijan	0.61	0.38	0.24	0.22	0.75	0.75	0.83
Georgia	0.70	0.63	0.31	0.63	0.75	0.63	0.77
Average	***0.64***	***0.51***	***0.33***	***0.45***	***0.75***	***0.63***	***0.78***
Central CIS							
Belarus	0.21	0.09	0.13	0.16	1.00	0.75	0.66
Moldova	0.70	0.54	0.41	0.76	0.75	0.50	0.74
Russia	0.61	0.64	0.19	0.49	0.75	0.63	0.76
Ukraine	0.61	0.51	0.26	0.63	0.75	0.75	0.74
Average	***0.53***	***0.45***	***0.25***	***0.51***	***0.81***	***0.66***	***0.73***
Central Asia							
Kazakhstan	0.61	0.59	0.36	0.20	0.75	0.75	0.77
Kyrgyz Rep.	0.61	0.59	0.37	0.35	0.75	0.75	0.78
Turkmenistan	0.3	0.16	0.04	0	0.75	0.75	0.83
Uzbekistan	0.61	0.51	0.26	0.63	0.75	0.75	0.74
Average	***0.53***	***0.46***	***0.26***	***0.30***	***0.75***	***0.75***	***0.78***

HF=Heritage Foundation; TI=Transparency International

They also indicate that progress with restructuring their banking system, as reported for year 2000, is very weak in countries in Central CIS and Central Asia.

What information in Table 2 does not reveal is the fact that the time pattern of the three types of reforms differed considerably. While price liberalization was implemented very early in transition by most countries, enterprise reforms started with small-scale privatization during the first years, but the process of large-scale privatization and hardening of budget constraints proved more difficult[5]. Countries adopted different strategies in terms of speed and methods employed in privatizing the medium and large-scale SOEs[6], and the relative success of such strategies is still subject to research. The indicator of reforms in the financial sector is meant to reflect the efforts with early dismantling the monobank system inherited from communist regime, as well as the general restructuring and privatization of the banking system that followed later in the process of transition[7].

Progress with institution building is reflected in Table 2 by indicators of political environment, government regulation of economic activities, protection of property rights, and the Transparency International measure of Perception of corruption.

The indicator of political environment corresponds to the latent factor NPOLITIC estimated in Study 1, based on component measures of institutionalized democracy, elements of autocracy and civil rights. The scores of the latent factor are normalized in [0,1]. Higher scores for the factor indicate a polity with relatively more developed democratic institutions, and less autocratic behavior of the political leadership. The reported data refer to year 1999, with the exception of Croatia where the last data point available is from 1998. There is a marked difference in the degree of democratization of the political system in countries in CEE, SEE (except Albania) and the Baltic countries, when compared to the remaining former Soviet republics. Particularly low scores of the indicator on democracy are reported for Turkmenistan and Belarus, followed by Kazakhstan and Azerbaijan. As with the process of price liberalization, what happened during the transition process was that countries, that today

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[5] See EBRD(1999) for a detailed account on the progress with the enterprise sector reforms.
[6] See Lieberman, Nestor et al(1997) for methods of mass privatization employed in transition economies.
[7] See EBRD (1998) for a descriptive analysis of developments in the financial sector during the transition period.

have a highly democratic society, usually started the process of democratization immediately after the fall of the communist leadership.

The indicator on Government Regulation of Economic Activities is calculated based on the corresponding measure constructed by Heritage Foundation. The original HF indicator is normalized in [0,1], and it has an inverse scale: a low value is assigned to countries were government regulations are not perceived as hindering the official business activities in the country, while the maximum value of 1 corresponds to cases where the government seriously impedes the creation of new start-ups, corruption is pervasive, and regulations appear to apply randomly. In all transition economies there appears to be scope for improvements in the way the implemented government regulations interact with the activity of economic agents. Particularly severe situations are observed, as of year 2000, in countries in South Eastern Europe, Central CIS and Central Asia. Countries such as Estonia, Czech Republic and Slovenia register the most favorable climate for business activities from this respect across transition countries.

The second indicator on the institutional environment, the measure of Property Rights, is also calculated based on the information collected by Heritage Foundation. Its scale is similar as in the case of Government Regulations, in that a high value is assigned to countries where private property is not allowed, or not protected by the government, and pervasive corruption in the judicial system makes the contract enforcement process very difficult, if at all possible. Lower values of the indicators are assigned to cases with an efficient judicial system, and where protection of private property is legally enforced by the government. Scores on Property Rights Protection are slightly better for countries in Central Asia and Caucasus, when compared with the scores on the previous indicator, but they still reflect a very weak level of institutional development in these countries. The CEE and the Baltic countries maintain the lead from this respect also, although they are still half - way from a fully developed and efficient institutional system.

Institutional deficiencies in transition economies are also reflected by the Transparency International indicator of corruption, as perceived by international observers. Particularly high levels recorded for the indicator on corruption parallel alternative survey and anecdotic evidence on widespread corruption in countries in SEE, and the former Soviet Republics (with the exception of Estonia).

As this study is mainly concerned with economic developments during transition, as reflected by growth rate of GDP, I dedicate the remaining of this section to the comparison of rates of economic growth in the post-communist countries. I find that the extent of economic growth and / or decline during transition is sometimes difficult to grasp, due to different results obtained when alternative indicators are considered.

Growth Rates Compared

The use of growth rates of real GDP is not without problems[8], in that estimates provided by various sources differ considerably. The IMF reports levels of real GDP in national currency units at constant prices, where the base year is country specific (IMF(2002)). With World Bank, I find growth rates of real GDP based on GDP levels reported in national currency units at constant market prices corresponding to year 1995. In the current study, I employ growth rates of GDP per capita in PPP terms, based on the data on PPP_GDP per capita reported in WorldBank(2002). The PPP rates used to calculate the corresponding GDP levels in international dollars come from the International Comparison Program, with OECD as a primary source of data, and correspond to the last round of the ICP Programme of 1999[9].

In Table 3[10] a comparison of growth rates of real GDP per capita is reported, based on data on real GDP per capita reported by IMF and World Bank (WB), and the growth rates of GDP_PPP per capita that I construct for the purpose of the current analysis (PPP). For all three cases, growth rates are calculated as:

$$Growth_t = 100 \cdot \left[\ln(GDP_t) - \ln(GDP_{t-1}) \right]$$

The first three columns in Table 3 include total (cumulated) growth in GDP levels corresponding to the period specified next to the country name. Ideally, the period of calculation should cover the transition period, but in some cases I choose a shorter period based on data availability considerations.

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[8] Further problems with data are discussed in Section III.
[9] See World Bank Data Documentation, as well as the OECD website.
[10] Note that Table 3 is split in two component tables.

Table 3 Growth Rates Compared

Country (period with data available for all series)	Growth of GDP_Cap (%)			Difference		Average Annual Growth		
	WB	***IMF***	***PPP***	***PPP-WB***	***PPP-IMF***	***WB***	***IMF***	***PPP***
	(1)	(2)	(3)	(4)=(3)-(1)	(5)=(3)-(2)	(6)	(7)	(8)
SEE								
Albania (1991-2000)	13.31	18.80	20.96	7.66	2.16	1.33	1.88	2.10
Bulgaria(1991-2000)	-11.62	-41.00	-1.51	10.11	39.49	-1.16	-4.10	-0.15
Macedonia(1991-2000)	-14.88	5.10	1.49	16.36	-3.61	-1.49	0.51	0.15
Romania(1991-2000)	-13.44	-15.40	3.23	16.67	18.63	-1.34	-1.54	0.32
Average	***-6.66***	***-8.13***	***6.04***	***12.70***	***14.17***	***-0.67***	***-0.81***	***0.60***
CEE								
Croatia(1991-2000)	-0.34	???	12.60	12.94	???	-0.03	???	1.40
CzechRep. (1993-2000)	13.55	13.00	25.88	12.33	12.88	1.69	1.63	3.23
Hungary(1990-2000)	9.25	9.30	24.36	15.11	15.06	0.84	0.85	2.21
Poland(1991-2000)	35.89	37.10	46.52	10.63	9.42	3.59	3.71	4.65
SlovakRep.(1991-2000)	5.01	???	21.94	16.93	???	0.50	???	2.19
Slovenia(1992-2000)	29.18	???	42.58	13.40	???	3.24	???	4.73
Average	***15.42***	***???***	***28.98***	***13.56***	***???***	***1.64***	***???***	***3.07***
BALTIC								
Estonia(1991-2000)	3.15	-9.30	23.51	20.36	32.81	0.31	-0.93	2.35
Latvia(1991-2000)	-25.31	-37.90	-18.62	6.68	19.28	-2.53	-3.79	-1.86
Lithuania(1991-2000)	-31.84	-32.60	-18.31	13.53	14.29	-3.18	-3.26	-1.83
Average	***-18.00***	***-26.60***	***-4.47***	***13.53***	***22.13***	***-1.80***	***-2.66***	***-0.45***
CAUCASUS								
Armenia (1992-2000)	-16.75	-28.60	-17.68	-0.93	10.92	-1.86	-3.18	-1.96
Azerbaijan (1992-2000)	-52.25	-41.70	-44.94	7.31	-3.24	-5.81	-4.63	-4.99
Georgia (1992-2000)	-81.45	-53.10	-102.80	-21.35	-49.70	-9.05	-5.90	-11.42
Average	***-50.15***	***-41.13***	***-55.14***	***-4.99***	***-14.01***	***-5.57***	***-4.57***	***-6.13***
CENTRAL CIS								
Belarus(1992-2000)	-5.51	-4.40	5.80	11.31	10.20	-0.61	-0.49	0.64
Moldova(1992-2000)	-73.19	-75.40	-75.65	-2.46	-0.25	-8.13	-8.38	-8.41
Russia (1991-2000)	-36.76	-47.80	-18.50	18.27	29.30	-3.68	-4.78	-1.85
Ukraine(1992-2000)	-63.68	-68.20	-49.93	13.76	18.27	-7.08	-7.58	-5.55
Average	***-44.79***	***-48.95***	***-34.57***	***10.22***	***14.38***	***-4.87***	***-5.31***	***-3.79***
CENTRAL ASIA								
Kazakhstan(1992-2000)	-14.07	-22.70	5.23	19.30	27.93	-1.56	-2.52	0.58
KyrgyzRep.(1992-2000)	-37.22	-27.10	-21.73	15.49	5.37	-4.14	-3.01	-2.41
Tajikistan (1992-2000)	-87.41	???	-80.78	6.63	???	-9.71	???	-8.98
Turkmenistan(1992-2000)	-44.71	-45.50	-33.71	11.00	11.79	-4.97	-5.06	-3.75
Uzbekistan (1992-2000)	-19.05	-2.00	1.06	20.11	3.06	-2.12	-0.22	0.12
Average	***-40.49***	***-24.33***	***-25.99***	***14.51***	***-1.66***	***-4.50***	***???***	***-2.89***

Table 3 Growth Rates Compared (continued)

Country (period with data available for all series)	Years with negative growth rates (initial years only)			Output Decline (initial years only)		
	WB	***IMF***	***PPP***	***WB***	***IMF***	***PPP***
	(9)	(10)	(11)	(12)	(13)	(14)
SEE						
Albania(1991-2000)	1991-1992	1991-1992	1991-1992	-32.17	-35.20	-26.46
Bulgaria(1991-2000)	1991-1993,	1991-1994	1991-1992	-14.50	-39.10	-14.79
Macedonia(1991-2000)	1991-1995	????	1991-1994	-26.20	???	-15.16
Romania(1991-2000)	1991-1992	1991-1992	1991-1992	-20.03	-21.70	-14.21
Average				***-23.22***	***-32.00***	***-17.66***
CEE						
Croatia(1991-2000)	1991-1993	???, 1993	1991-1993	-40.90	???	-36.41
CzechRep (1993-2000)	1991-1993	???	???	-11.81	???	???
Hungary(1990-2000)	1990-1993	1990-1993	1990-1991	-18.06	-19.10	-13.32
Poland(1991-2000)	1991	1991	1991	-7.31	-7.00	-7.16
SlovakRep(1991-2000)	1991-1993	???	1991-1993	-25.74	???	-19.00
Slovenia(1992-2000)	1991-1992	???	???-1992	-5.16	???	-1.78
Average				***-18.16***	***-13.05***	***-15.54***
BALTIC						
Estonia(1991-2000)	1991-1994	1991-1994	1991-1993	-35.29	-39.50	-28.61
Latvia(1991-2000)	1991-1993	1991-1993	1991-1993	-57.59	-61.20	-59.25
Lithuania(1991-2000)	1991-1994	1991-1994	1991-1994	-52.95	-53.00	-48.22
Average				***-48.61***	***-51.23***	***-45.36***
CAUCASUS						
Armenia (1992-2000)	1992-1993	1992-1993	1992-1994	-52.89	-66.70	-54.66
Azerbaijan (1992-2000)	1992-1995	1992-1995	1992-1995	-82.93	-77.30	-85.10
Georgia (1992-2000)	1992-1994	1992-1994	1992-1994	-121.04	-84.60	-144.08
Average				***-85.62***	***-76.20***	***-94.61***
CENTRAL CIS						
Belarus(1992-2000)	1992-1995	1992-1995	1992-1995	-39.31	-36.10	-31.01
Moldova(1992-2000)	1992-1996	1992-1996	1992,1994,96	-67.78	-69.20	-64.49
Russia (1991-2000)	1991-1996	1991-1996	1991-1996	-51.45	-62.20	-37.40
Ukraine(1992-2000)	1992-1998	1992-1999	1992-1998	-70.94	-74.10	-62.48
Average				***-57.37***	***-60.40***	***-48.84***
CENTRAL ASIA						
Kazakhstan(1992-2000)	1992-1995	1992-1995	1993-1995	-32.73	-35.40	-23.77
KyrgyzRep(1992-2000)	1992-1995	1992-1995	1992-1995	-56.12	-55.00	-48.47
Tajikistan (1992-2000)	1992-1996	???	1992-1997	-102.27	???	-101.02
Turkmenistan(1992-2000)	1992-1997	1992-1997	1992-1997	-76.88	???	-74.92
Uzbekistan (1992-2000)	1992-1996	1992-1995	1992-1994	-27.70	-18.50	-15.08
Average				***-59.14***	***-36.30***	***-52.65***

For example, although Czech Republic started the transition in year 1991, the growth rates included in the table cover only the period 1993-2000, as data for initial years are missing.

Cumulative growth for transition economies differs considerably according to the three data series, as reported in columns (1), (2) and (3) in Table 3. It appears that growth rates calculated in PPP terms are systematically higher than growth recorded in constant local currencies, but there are significant differences between growth rates of real GDP (in constant local currencies) from IMF and World Bank also. As calculated in column (5) the differences between IMF growth of real GDP and the PPP GDP per capita growth range, on average across regions, between –2% for countries in Central Asia to 22% for the Baltic countries. Average differences on cumulative growth between the World Bank data on real GDP and the PPP growth rates are illustrated in column (4), ranging from -5% for countries in Caucasus to 14.51% for the Baltic countries.

According to the PPP data, I find that the highest average cumulative growth (until year 2000) has been recorded for countries in Central and Eastern Europe, with Poland and Slovenia as best performers (around 30% net cumulative growth during 1991/1992 – 2000). The weakest performance in the region in terms of growth is calculated for Croatia, in that the net total growth during 1991-2000 is 12.6%, compared to Poland (47%) and Slovenia (43%). The World Bank data for real GDP per capita growth shows much lower levels of cumulative growth for all countries, and even with the opposite sign. With this data, Croatia shows a negative total cumulative growth of –0.34% during the same period, while for Slovak Republic I calculate total cumulative growth of real GDP of 5.01% (compared to 22% in PPP terms). Growth in Poland is 10% lower than in PPP terms, and for Slovenia a difference of 13% is calculated. The corresponding IMF numbers could not be calculated for some countries in CEE, as data for initial transition years are missing. For the available years, however, I find that GDP cumulative growth rates, based on data reported by IMF, are similar to cumulative growth rates based on real GDP in constant local currency data reported by World Bank.

The second best 'regional' performer in terms of cumulative growth is South Eastern Europe, with an average across countries in the region of 6.04 in PPP terms.

According to the IMF and World Bank data in LCU, South Eastern Europe actually recorded negative cumulative growth, during the period 1991-2000, of –7% (WB) or –8% (IMF). Differences at the country levels are even more striking, in that the IMF data indicates a total cumulative growth of –41% for Bulgaria, while according to PPP data the total decline was much less severe (-1.5%). The corresponding level with World Bank LCU data is –11% for Bulgaria. Similarly large discrepancies are calculated for Romania (PPP data indicate positive cumulative net growth of 3%, while IMF and WB LCU data reveal a decline of 13-15%) and Macedonia. Among countries in the SEE region, Albania proves to be the best performer in term of economic growth, according to all three series (21% in PPP terms, 19% in IMF, and 13% in WB). The picture conveyed by PPP data for Albania is closer to the corresponding IMF cumulative level.

Large differences in cumulative economic performance, as shown by the three indicators, are found with countries in the other regions also. It is difficult to distinguish a systematic pattern in the degree to which the three types of growth rates differ among each other. Estonia, for example, is another case where total cumulative growth proves positive and relatively high in PPP terms (24%), but negative with the IMF data (-9%). World Bank LCU data give us a total net growth of 3% for Estonia during 1991-2000. The same applies for Uzbekistan, in that there are large differences between WB data (-19%), IMF data (-2%) and PPP data (1.06%). On average, across regions, the worst performers (in PPP terms) are found in the Caucasus group (-55% total decline during 1992-2000), followed by countries in Central CIS (with an average of -35%).

Despite the differences (sometimes large) in absolute terms among the three series, on aggregate they appear to convey similar rankings of countries in terms of their economic performance. I obtain large, and statistically significant, Spearman correlation coefficients for each pair of the three data series: the largest correlation is found between the World Bank and the IMF data in LCU terms (0.950), followed by the correlation between WB and PPP data (0.933). The correlation coefficient between the IMF and PPP series is 0.902.

Of a special interest in the transition literature is not only the total performance during transition but also the initial output decline that is observed during the first years. In columns (9), (10) and (11) I specify the initial years when the countries successively registered negative growth. The symbol '???' means that no data is available for the initial years in that particular data series. In general, the three series provide the same picture on the time pattern of the initial decline in output. Slightly (one year) shorter recessions are indicated by the PPP series for Bulgaria, Macedonia, Hungary, Estonia and Uzbekistan.

With all the three series, the duration of initial recessions appears to be higher in the former USSR republics, and especially in CIS (6 years for Russia, and 7 years for Ukraine), and some countries in Central Asia (6 years for Tajikistan and Turkmenistan). According to the PPP series, initial recessions in CEE and SEE regions lasted for at most 3 years (with the exception of Macedonia), while 2 years is usually the norm. In the Baltic regions, Estonia and Latvia struggled with economic decline during the first 3 years of transition, while Lithuania also recorded a 4th year of recession.

Wherever data allows, I also calculate the incidence of initial output decline (columns (12), (13) and (14)) as the sum of the negative growth rates for initial years. Note that for countries that recorded reversals to negative growth later in transition, the initial output gap refers only to the first successive years with negative results. For example, Bulgaria registered negative growth during the first two years of transition (1991-1992) according to PPP data, then positive growth for the next few years, just to be back in red in 1996-1998. Initial output decline for Bulgaria is calculated as the sum of the negative growth rates recorded during the period 1991-1992. The same applies for all the other countries that registered reversals to negative growth later in the process of transition.

Average regional differences (PPP-WB) in output gaps, calculated based on WB data on real GDP in LCU and on data in PPP terms, range between –9% for Caucasus to 8.5% in Central CIS. With the exception of Caucasus (where the PPP data indicate a larger decline of GDP than the LCU data), initial output collapse appears to be smaller in PPP terms than with the corresponding series in constant local currency, as reported by World Bank. Differences between PPP data and the IMF data are mixed, in that output collapse is reported as larger in PPP terms for CEE (a difference of -2.5%), Caucasus (-18.4%) and Central Asia (-16%), but smaller for the remaining regions. The same applies for differences between the IMF and the WB data on output in constant local currency. The largest difference is recorded for Central Asia, where the IMF data indicates a lower output decline (by 23%) than the corresponding WB series.

Comparisons across regions, in PPP terms, indicate the most severe initial recession in the war-torn countries in Caucasus (with an average decline of –94%). Output collapse in the remaining formerly Soviet regions appear to be relatively similar, ranging from –52% for Central Asia to –45% in the Baltic region. However, note that in the Baltic region, the output collapse in Estonia is much less severe (-29%) than in the other former Soviet Republic. The same applies to Kazakhstan (-24%) and Uzbekistan (-15%). In the other two regions, CEE and SEE, average output declines appear to be similar, ranging between –15% (CEE) and -18% (SEE). In the SEE region, it is interesting to note that, while being the best performer in the region in terms of cumulative net growth during the period 1991-2000, Albania displays the largest initial output collapse in the region (-26%).

Similar rankings of countries in terms of the magnitude of initial recessions are found for the IMF and the PPP data. The Spearman correlation coefficient calculated for the two series is 0.983, and statistically significant at the 0.01 level. This result is, however, tentative, as it is based on a small number of observations (at most 25). The correlation coefficient between the PPP and the WB series is 0.920, while the corresponding result for the IMF and WB series appears to be weaker (0.891).

In summary, the review of growth rates calculated in constant local currencies and PPP terms reveal, sometimes marked, differences across countries and time. Given the pattern observed for the differences in growth rates, there are only a few general conclusions that could be drawn, as following:

- Cumulated growth of GDP per capita in PPP terms is systematically higher than the cumulative growth calculated based on the IMF and the Word Bank data in constant local currency (LCU) terms
- Initial output declines do not always appear to be lower in PPP terms, when compared to the other two series.

- Regardless of the data series used, countries in the CEE region maintain the lead in terms of (average) cumulated economic growth since the start of transition. The second best performer is the SEE region.
- Initial output collapse is, on average, similar in the SEE and CEE regions, but cumulative growth in CEE is significantly higher than in the SEE region.
- Among the regions formerly part of USSR, the best performers in terms of cumulative growth are to be found in the Baltic region (on average).
- Economic performance in the Baltic countries appears to be more similar to the other former Soviet republics in terms of the magnitude of the initial output collapse, but not in terms of cumulative net growth during the entire period under consideration.
- The deepest initial output collapse is recorded for the Caucasus region. On average, the Caucasus region also registered lowest cumulative growth up to year 2000.

As a concluding remark on differences in data on growth in transition, it is to be expected that employing a particular data series will result in parameter of different magnitudes, in absolute values, than similar results based on an alternative series meant to convey the same type of information. However, given that the three series convey a very similar picture in terms of country rankings, there is some chance that these differences do not severely affect the robust relationships of variables in a model when alternative series are employed.

Section III Possible explanations for output collapse and recovery: some of the existing theoretical and empirical literature

As indicators of cumulative growth presented in the previous section suggest, the typical pattern for growth during transition reveals an initial output collapse, followed by recovery. The exact shape of the output path differs among countries, in that a U-shape is observed for countries in the CEE region, as they more than reached the pre-transition levels of output, while for other transition economies, and in particular the former USSR republics, an L-shape trajectory of output is observed. The latter eventually entered a period of positive growth, but rather modestly such that they did not reached their pre-transition levels of output even after 10 years since the start of the process.

Multiple questions arise around the observed trajectories of output. At early stages, debates and search for answers for the following questions emerged: Why did the output collapsed during the first years of transition in all countries, with no exception? Was it inevitable? What are the factors that best explain the initial transitional recession? Why does it appear to coincide in time with the moments when price liberalization was first adopted? Were reforms too hasty in the beginning of transition? Are reforms detrimental to growth? Or, is it that initial negative developments in output are in fact a consequence of the legacy of communism? Are reforms choice variables, or is there a connection between the speed of reforms, the effect of reforms and initial conditions?

In time, the debates gradually shifted towards the institutional features of transition economies, based on the observation that countries with best economic performance, also prove to have better institutions. Although in its infancy, the research efforts on the role of institutions during transition from central planning to a market system focus on the possible beneficial effects of changes in political systems towards democratisation, the necessity of better state governance (in terms of regulations, rule of law, and protection of property rights) and the negative developments in terms of corruption, as a reflection of poor institutional environment.

The objective in this section is to provide a review of some of the existing theoretical and empirical literature on the role of economic reforms and institutional developments in the post-communist countries during the transition period, with a particular emphasis on research directly related to economic growth during transition. It is by no means a comprehensive review in that much of existing research efforts are not included. Valuable sources of information from that perspective are Roland(2000) and Norgaard(2000).

The section is organized as following. It starts with possible explanations for the output collapse based on data considerations, and then gradually moves towards theoretical models designed to reveal the mechanisms of initial transitional recessions and, to a lesser extent, subsequent recovery. Results found in some of the empirical studies on growth in transition follows, with the main emphasis on effects of initial conditions and economic liberalization on economic growth in the post-communist countries. The following paragraphs focus on the emerging (empirical) literature on institutions in transition. Finally, a summary of existing results is then provided.

Data Issues

At least part of the observed initial output fall is deemed to be mainly a statistical exaggeration, due to poor quality of aggregate data. When considering growth during the transition period in relation to the pre-transition levels, caution is required as the levels of output reported during the communist period usually overstate the 'true' levels of economic activity in the communist countries. Central planning was notoriously deceiving, where economic units had strong incentives to overstate production levels, as a combined result of the necessity to fulfil plan quotas and the incentive structure that linked bonuses of ministers, managers and workers to the levels of achieved production. Åslund(2001) estimates that the over-reporting of output in the communist countries amounted to around 5%. Winiecki(1991) also mentions an audit of a few hundreds Russian enterprises, carried out in early 1980s, revealing that every third enterprise had been found at fault for 'doctored reports' on plan fulfilment. Moreover, apart from simply falsifying the reported data, the managers of the socialist enterprises found additional shortcuts to plan fulfilment: to the extent that the required inputs for production were not easily available, the managers would decide using sub-standard inputs as substitutes without corresponding reductions in the price of the final product;

another method was to report cosmetic changes in a product as major innovations and increase their price ‘accordingly’.

While valid for many of the formerly communist countries, such arguments cannot be generalized to all transition economies. In Hungary and Poland, for example, the SOEs had been assigned economic autonomy from central planning prior to the transition period, such that they had no plan quotas to report. From that perspective, incentives to over – report were weak. An additional argument that limits the explanatory potential of over-reporting is articulated in what is known as the ‘ratchet effect’ under socialism[1]. Within the framework of principal – agent relationship between the government and the managers of the socialist enterprises, incentives of managers to report plan over-fulfilment were limited by the fact that over-fulfilment today would translate into a mandatory plan level tomorrow. Therefore, realising that bonuses today come at the cost of higher no-bonus efforts in the future, managers would rather maintain the appearance of realistic plan allocations in the present.

Incentives to over-report were not only present at the level of economic units. The communist authorities had a strong bias towards maintaining the illusion of a prosperous economic system. On Romania, for example, in Ionete(1993) we learn that during 1980s, the authorities deliberately manipulated aggregate statistics in order to inflate the aggregate levels of economic results. They would often replace the ‘realised’ levels of the reported aggregate economic indicators by their corresponding planned levels, especially for the economic sectors that were more difficult to monitor formally. Household production in Romania reportedly grew three times higher according to the official statistics during the period 1985-1988. When accounting for growth in services (such as tailoring), the value of inputs supplied by the customers was included in the total level of activity of the respective units[2]. Starting with 1986 the situation of statistical exaggerations became acute. According to the author’s calculation, in 1987 the reported national income was 15% higher than the real level, and in 1988 the corresponding difference reached the level of 18%.

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[1] See Roland(2000) for discussions and references.

[2] The author estimates that, in general, the customer-brought materials amounted to 50% of the total value of services in tailoring and maintenance.

Problems with the official aggregate data are to be expected during the transition period also, although for different reasons. The Polish statistical authorities distinguish between 'statistical underground' and 'economic underground' (OECD(1997)).

'Statistical underground' refers to economic activities that are not adequately covered by the existing reporting procedures. Especially during the first years of transition, the ability of statistical offices to gather data on economic activities of the relevant economic agents was rather weak. At the onset of transition there were serious disruptions in the official channels for reporting statistical data from the state owned enterprises to central statistical bureaus, while methods to gather data on private sector activities were yet to be developed. Åslund(2001) mentions that in Hungary enterprises with fewer than 50 employees were not covered by aggregate statistics for years, and yet it is to be expected that a large part of the private firms were small-sized at that stage in transition. Through time, countries in CEE and SEE made considerable efforts to improve methods of data collection on the economy, as described in OECD(1997). Data revisions in Russia are discussed in Bartholdy(1997).

The concept of 'economic underground' refers to hidden activities, not reported officially for tax, or social security payments, considerations. Official GDP data for transition economies are believed to understate the total level of economic activity also because of the rapid expansion of the unofficial economy, especially in the former USSR republics. Once transition started, the incentive for over-reporting in SOEs during the communist regimes would turn practically overnight into an incentive to under-report. Incentives to evade taxes by under-reporting their levels of activities are present with the private firms also. It is difficult to comprehend the extent to which extent the development of the unofficial sector affects the growth rate of total economy. Existence of underground activities is not specific to the transition period, in that the communist rule also co-existed with what was coined as 'the second economy', although motivated by shortages. With transition, incentives for pursuing underground activities changed, while the phenomenon still remained, and also flourished in some cases[3]. Dallago(1995) discusses the evolution of the unofficial economy in Hungary, starting with 1980s and until the first two years of transition. We learn that the ability of

[3] For estimates of unofficial economy in transition countries see Kaufmann and Kaliberda(1996) and Lacko(2000)

the Hungarian statistical office to account for the size of the unofficial sector improved considerably through time. If in 1980 only 13% of the sector was being accounted for in the official statistics, in 1992 around 40% of the total unofficial sector size was included in official statistics[4]. During the period 1991-1992, the total share of the unofficial sector in official GDP was believed to have reached 25-30%. Due to improved data collection however, the level of total GDP in Hungary is considered not to be severely underestimated (the author estimates that the official growth rate of GDP was underestimated by less than 1.5% per year as a result of unrecorded economic activities). The situation is much more severe in other transition economies. For Ukraine, survey evidence in Smallbone, Welter et al.(2001) reveals that private sector activity is seriously understated due to an estimated level of 20-50% concealed sales by legally registered private firms. Under-reporting of sales by officially registered private firms is also estimated in Johnson and McMillan(2000) at the 28.9% level in Russia, 7.4% in Slovakia, 5.7% in Romania and 5.4 % in Poland, based on data collected in 1997. In Albania, despite the high rates of official growth observed, it is still believed that the unofficial sector is as high as 50% of the total economy (Hashi(2001)). In some countries official statistics already include estimates for the activity in the underground economy, although to a very limited extent (OECD(1997)). Particularly poor statistics are believed to be provided by the war-torn countries, such as Armenia, Azerbaijan, Georgia, Moldova and Tajikistan as the statistical systems in those countries collapsed altogether during war time (Åslund(2001)).

Potential Causes of the Output Collapse

Despite data inaccuracy, the evidence on the output fall in all of the post-communist countries at the beginning of transition process remains strong. Initial output collapses are considered to be too deep to be explained mainly on data quality grounds. Winiecki(1991) argues that at least part of the output collapse was inevitable in that, during the communist regimes, the state enterprises produced goods of very poor quality for which there was hardly any demand. Åslund(2001) reckons that, on average, the share of goods for which there was basically no genuine demand would reach around

[4] That is, 60% of the unofficial sector was still unaccounted for in the official aggregate data.

20% of GDP in the last year of communism. Shortages and soft budget constraints induced the socialist enterprises to also engage in highly wasteful auxiliary activities, meant to help meet plan fulfilment objectives, such as: the use of own transportation systems (even helicopters), with no regard for the associated huge costs, the hoarding of inputs generating huge inventories[5] that would eventually be wasted, internal production of tools (often at very large costs). Evidently, such activities would cease or at least be greatly reduced during the transition period, especially with the imposition of hard budget constraints for the SOEs. Further inevitability of output loss was due to the disappearance of precautionary purchases of food by the population that, during communism, were induced by shortages of even basic food items.

Apart from the disappearance of precautionary acquisitions made by households and absent genuine demand for low-quality goods produced by the SOEs, there are additional factors that contributed to a decline in the demand for the SOEs products, such as the collapse of CMEA trade. Studies analysing the contribution of CMEA dissolution to the output collapse provide various estimates (not necessarily directly comparable)[6]: Rodrik(1992) attributes all of the Hungarian decline in GDP during 1990-1991 to the Soviet trade collapse, 60% of the decline in former Czechoslovakia, and between 25-30% of the declined in Poland. More recent estimates in Rosati(1995) and Gacs(1995) attribute the output decline to the dissolution of CMEA to a lower extent in Hungary in particular. Rosati(1995), for example, estimates that the collapse of exports to Soviet Union in year 1991 could explain more than 50% of the GDP fall in Hungary, around one third of the GDP fall in Poland, but it accounts for more than the entire registered fall of GDP in Bulgaria. The impact of the Soviet trade shock on Romania is found to be negligible.

Gomulka(1998) argues that three other potentially major causes for the output collapse, apart from the CMEA dissolution, were the following: the collapse of the defence industry and of the state-financed investments, and demand and supply shocks triggered by price and trade liberalization and the hardening of the budget constraints for the SOEs. On the demand side, price liberalization and elimination of subsidies

[5] Berg and Blanchard(1994) estimate that the total reduction in inventory accounted for two thirds of the total decline in Poland's GDP in 1990.
[6] See Aslund(2001) for a summary of results and further discussions on the Soviet trade shocks and the associated removal of trade subsidies.

induced sudden price increases and a decline in the purchasing power of households. On the supply side, the realignment of prices triggered changes in the structure of supply. Part of the output decline is explained as due to the asymmetry in the speed of adjustment of the relative prices and demand, on the one hand, and the speed of adjustment of the supply, on the other hand. Stabilization is believed by the author to have had a significant contribution to the patterns of transition, in terms of the timing of decline and recovery, but only a minor contribution to the cumulative output decline. While the timing of stabilization policies coincided with the timing of the output collapse in some countries in CEE, and especially Poland, this is not the case for Russia and other countries in CIS, where stabilization came later in the process.

Disruptions on the supply side, as a result of economic liberalization, are modelled in various theoretical studies. Trade liberalization is believed to have induced disruptions in production chains and a breakdown of the links between the producers and their suppliers of inputs. Blanchard and Kremer(1997) formulates a model of disorganization with inefficient bargaining due to information asymmetries between SOEs and the suppliers of inputs. The elimination of central planning meant that enterprises were in the position of negotiating with each supplier for the necessary inputs on a one-to-one basis. The model relies on the assumption of strong complementarity of inputs and take-it-or leave it price offers from enterprises to each of the suppliers of those inputs. If suppliers have alternative uses for their products, they would bid the prices up in their negotiations with the SOEs. The higher the number of inputs an enterprise needs, the higher the chances that negotiation with at least one supplier would fail, thus triggering the collapse of the entire associated production of the enterprise. The model of disorganization predicts that the greater the complexity of the production processes (as measured by the number of necessary inputs), the larger the observed output collapse should be. Some empirical evidence for the effect of disorganization on the output decline is provided in the study, based on the Russian input-output data, as well as in Konings and Walsh(1999) for Ukraine.

At the other end of the supply chain, disruptions in the SOEs' links to their customers are also believed to have contributed to the output collapse. Roland and Verdier(1999) model assumes relation-specific investments and frictions in the search for new customers. A long-term relationship with a new business partner implies the necessity of specific investments. With liberalization, the uncertainty on the quality of customers created in the market may persuade the enterprise to wait and keep searching, before deciding to invest in a specific relationship with a customer. Therefore, during the search process, one would expect a fall in investment and a decline of output. The disruptive effects in the model are reinforced if one assumes that the domestic SOEs expect some foreign investment in the future, such that their option value of waiting is increased.

Calvo and Corricelli(1993) hypothesizes that the sharp increases in nominal interest rates that followed initial economic liberalization, induced substantial credit reductions partly due to the refusal of banks to provide firms with funds for input purchases, but also due to reduced borrowing incentives on the firms' side, for fears of insolvency. When testing for the credit crunch effect on Polish data, Berg and Blanchard(1994) do not find significant evidence. Further doubts on the credit crunch hypothesis arise from the observed fact that output collapse was experienced in all transition economies, despite their different monetary policies adopted.

Credit constraints, this time directly between suppliers and their customers, are also modelled in Marin and Schnitzer(1999). The buyers of inputs are assumed to need relation specific investment and be credit constrained. Barter is introduced as a device to alleviate buyers' credit problem[7]: accumulated payment arrears, corresponding to inputs received, gives them an increased bargaining power in negotiations with their suppliers that would find it costly to enforce payments. However, if the stock of arrears becomes too large, the supplier may decide to stop input deliveries, and therefore buyers' production ceases. Associated empirical evidence, based on Ukrainian data, suggests inverted U-shaped relationships between barter, financial constraints (as reflected by inter-enterprise arrears) and firms' outputs. Up to a point, large arrears appear to be associated with larger levels of production, but when the arrears become too large no output is produced anymore.

Competing theoretical hypotheses on the role of labour market frictions Atkeson and Kehoe(1996), and the monopoly behaviour of enterprises after liberalization Blanchard(1997), as well as the associated counter-arguments, are summarized and

[7] See Roland(2000) for alternative literature on causes and consequences of barter deals.

discussed in Roland(2000). Additional explanations for the output collapse, though considered to have had a minor impact, are also summarized in Gomulka(1998).

Reforms and Reallocation of Resources

There are reasons[8] to believe that output collapse does not necessarily constitute such bad news in the context of transition from central planning to a market economy. Gomulka(1998) argues that an early transitional recession is beneficial to the recovery of output and further growth (much in the spirit of the Schumpeterian creative destruction). Radical reforms are interpreted as large block of innovations, as they induce a reallocation of resources from the old, inefficient state sectors to the newly created private sector. Furthermore, economic liberalization eventually induces restructuring of the state enterprises, thus creating a basis for efficiency even in the state sector.

Recovery of output, as driven by the emergence of an efficient private sector, can only occur later in the process of transition, as the starting new enterprises does not happen overnight. Atkeson and Kehoe(1997) emphasizes that the process of starting new businesses requires physical and organizational capital, that can only be developed in time, through learning by doing. Therefore, at initial stages of transition, their model predicts a fall in physical investment, as the focus of the private sector is on the investment in organizational capital.

Output decline and recovery are modelled in a unified framework of interactions between the old (state) sector and the new (private) sector by the theoretical studies that belong to Optimal Speed of Transition (OST) literature[9], initiated by Aghion and Blanchard(1994). The starting point of the OST models is that economic liberalization and hardening of soft budget constraints induced the SOEs to significantly reduce employment. Liberalization is also believed to have benefited the initial development of the private sector, although there are limits to which the newly created firms can grow in early stages (due to lack of expertise and scarce external financing). Part of the labour

[8] Apart from the aspects touched upon in this section, there are welfare considerations that I did not include in this discussion. See Winiecki(1991) and Åslund(2001) for discussions to start with.
[9] For reviews and discussions of the OST literature see Boeri(2000) and Roland(2000).

released from the state sector is initially absorbed by the private sector but, if aggressive reforms lead to too rapid a closure of and/or employment reductions in the state sector, the relatively small sized private sector will not be able to instantly absorb all the labour released by the SOEs. Therefore, large pools of unemployment are to be experienced. High unemployment is assumed to initially induce faster job creation in the private sector due to lower wages. However, large unemployment strikes back to the reform process due to its fiscal and political economy implications. In Aghion and Blanchard(1994), high unemployment imposes pressures on the fiscal budget due to the large unemployment benefits that need to be financed. In the same time, the reduction of state – sector activities translates into lower budget tax revenues generated by the state sector. This induces the government to increase the tax rates on employment (levied equally on the state and the private sector), which harms the private sector development. Therefore, when unemployment reaches sufficiently high levels, its fiscal effects dominate the initial effect on wages, thus impeding private job creation and the development of the private sector.

The model of Chadha and Corricelli(1994) hypothesizes that even if the unemployment is stable, differential effective taxation of state and private enterprises would eventually harm private sector development. Effective taxation on the state sector is believed to be higher due to problems with tax collection from the private sector that consists mostly of small businesses. As a consequence, the fiscal balance deteriorates even with stable unemployment, and the government is induced to levy even higher taxes on the private sector. However, in relation to the fiscal oppression of the private sector, an additional argument that supports fiscal deterioration with stable unemployment can be conceived with differential effective taxation in the opposite way: to the extent the government tolerates tax arrears from the SOEs, the fiscal balance worsens and the government needs to tax the private sector to a larger extent in order to be able to meet its fiscal claims. Such a hypothesis does not even necessarily require speedy enterprise closures in the state sector.

Castanheira and Roland(2000) introduces the effect of excessive speed of state sector restructuring via the depression of output and savings. An optimal speed of transition in the model implies that accumulation of capital in the private sector induces a decrease in the marginal product of capital used in private firms, and therefore a continuous shrinking of the state sector. Along the optimal path, output does not decline as the growth in the private sector more than compensates the state sector shrinking. Deviations from the optimal path would be observed if the speed of enterprise closures in the state sector is too rapid. Even with no associated fiscal effects, the authors envisage three main effects that eventually lead to a reduction in output and savings. A first effect would be lower wages (due to massive labour releases from the state sector) and increased returns to investments. This substitution effect would then lead to a higher rate of capital accumulation. However, there is also an income effect associated to excessive state sector dismantling, in the form of output loss in enterprises that are prematurely closed. The income effect would exert a downward pressure on savings. The third effect, the consumption – smoothing effect, relies on the assumption that, as consumers expect future enterprise closures in the state sector, they would smooth their savings across time. Departures from the optimal speed of transition due to too slow a closure of SOEs can also be predicted by the model if one assumes hard budget constraints[10] for the SOEs. With soft budget constraints, the SOEs would prevent labour from migrating to the private sector by offering higher wages, and thus investments in the private sector would be discouraged. With hard budget constraints in SOEs, the (more efficient) private sector would bid wages up and attract labour away from the state sector.

The bottom line of the OST literature is that too hasty a restructuring of the state sector will impede the private sector development, and thus induce output declines. A case is thus made for a gradual approach in implementing economic reforms. The models also predict that a hump-shaped dynamics of unemployment is to be expected. However, as discussed in Boeri(2000), some of the assumptions on which the OST models rely, as well as some of their predictions, do not seem to be confirmed by empirical evidence. On the assumptions side, the OST models usually assume a fixed labour supply, and that the flows of employment from the state sector to the private sector is necessarily mediated by unemployment. Moreover, the speed of closure of the state – owned enterprises is assumed to be a control variable for the government. A first empirical observation is that labour supply has been significantly declining in all

[10] Hard budget constraints in the context of the model means that SOEs cannot pay wages in excess to the marginal product of labour.

transition economies. Empirical evidence on employment changes in transition economies suggests that employment in SOEs was indeed declining rapidly, that employment in the private sector was soaring, and that an inverted U-shape evolution of unemployment is observed (unemployment initially increased, and the decreased). However, the unemployment was initially rising not because of massive layoffs from the SOEs, but due to very low outflows from the pool of unemployment. The bulk of job creation was concentrated in self-employment and the new small private sector, but large shifts from state employment to private employment were direct, rather than mediated by intervening unemployment spells. Moreover, survey evidence suggests that a significant outflow from state sector jobs was associated with voluntary quits, and not necessarily layoffs, and a significant component of outflows from unemployment (more than 40%) actually consisted of withdrawals from the labour force participation, rather than official employment in the private sector. Finally, even if part of the basic set-up applies, arguments advanced in the OST models cannot be the whole story as they fall short of explaining the severity of the output declines observed in early stages of transition.

Alternative feedback effects of unemployment, and adverse effects of economic reforms in general, on the process of restructuring of the state sector and development of the private sector are suggested by political economy arguments. Expected adverse effects of reforms presumably erode the consensus on continuing the implementation of reforms as they induce loses for certain categories of agents in the economy[11]. If the losers dominate the political process, they oppose aggressive reforms and thus slow down the speed of reallocation of resources and the creation of improved business conditions for the private sector. Such political economy arguments are therefore used to favour normative prescriptions for a gradual implementation of reforms. An alternative view is that, with gradualism, the initial losers of economic liberalization would oppose further implementation of reforms. However, there is a competing argument in Hellman(1998) suggesting that it was actually the winners of gradual reforms who, after benefiting from initial reforms, preferred to maintain the status-quo thus created and opposed further reforms. Gradualism in this view creates opportunities

[11] See Roland(2000) for extensive discussions on such models.

for vested interests to be formed in initial stages of transition and block the subsequent continuation of the reform process[12].

Empirical Studies of Growth in Transition

Disentangling the relative roles of initial conditions, economic reforms and macroeconomic policies implemented during transition in explaining the output developments in the post-communist countries is one of the main objectives in the empirical analysis of economic growth in transition countries. As there are numerous such empirical studies I will focus only on the empirical studies that I consider relevant from the perspective of the analysis in the current study[13].

The empirical work on the role of economic liberalization in explaining the output performance during the transition period in the post-communist countries relies heavily on the indicators of economic liberalization defined in De Melo, Denizer et al(1996). The authors constructed an aggregated index of economic liberalization (LI) as a weighted average[14] of three component indicators: liberalization of internal markets, liberalization of external trade and an indicator of reforms that facilitate private sector entry. The index of economic liberalization was originally constructed for the period 1989-1994, and subsequently extended by Havrylyshyn, Wolf et al(1999) for the period 1995-1998. The component indicators of the index LI are calculated as following: the measure of liberalization of internal markets is based of the EBRD index of price liberalization, which the authors further adjusted in order to also reflect the abolition of state trade monopolies; the indicator of external markets corresponds to the EBRD index on trade and foreign exchange liberalization; the measure of private sector entry is calculated as a sum of the scores of the three EBRD indicators on large-scale privatisation, small-scale privatisation, and reforms in the banking sector. Private sector entry is meant to reflect the opening up of the economy to the private sector development.

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[12] Debates on gradualism versus shock therapy are presented and discussed in Wyplosz(1999).

[13] For a classification of references to literature on transition economies, according to various research issues, the reader is directed to WorldBank(2002b)

[14] As the authors specify, the weights used in aggregation are obtained through consultations with experts and other senior executives.

Based on the aggregate index of economic liberalization (LI), the authors then construct an index of Cumulative Economic Liberalization (CLI), where the level of CLI for a particular point in time t is obtained as the sum of the levels of LI from 1989 until the year t. The indicator CLI is meant to capture both the duration and the intensity of reforms since year 1989 onward. In the study, CLI is used as an explanatory variable in a cross-country analysis of total growth of real GDP for 26 transition economies during the period 1989-1994. Additional explanatory variables included in the analysis are a dummy variable for war and conflicts, and the per capita level of income in 1989. A significant positive linear relationship between cumulative liberalization and growth during 1989-1994 is found. Also based on the fact that CLI appeared to perform better as an explanatory variable than the original indicator LI (in terms of the resulting R-square values), the authors conclude that both duration and intensity of reforms are important to economic development during transition. The authors also analyse the links between real GDP growth and the component indices of CLI in 1993/1994. The association appears to be stronger between real GDP growth and the indicators of cumulative liberalization of internal markets, and cumulative liberalization of external markets, but it is weaker in the case of the index of private sector development (privatisation and reforms in banking). Further enquiries are made in the study on the link between inflation and economic liberalization. Regression analysis produces a strong negative relationship between (average) inflation and cumulative economic liberalization; the relationship appears to be weaker when CLI is substituted with the component indices. The authors thus conclude that countries that failed to liberalize experienced higher inflation during 1991-1994. Additional results in the paper emphasize that war and conflicts experienced by some of the transition economies, especially former Soviet republics, carried a high toll in terms of output contraction: the estimated annual cost associated with conflicts amounts to a decline in GDP of 9%. Finally, when analysing the patterns of growth by reform groups, the findings are that each reform group follows a similar pattern of output decline, output declines for the slow reformers begin to accelerate when reforms begin, and declines in output were generally more prolonged and more severe in countries that were slower in implementing reforms.

Selowsky and Martin(1997) advance the hypothesis that economic liberalization has a non-linear effect on growth. They employ the liberalization index defined above to test for the effect of reforms on growth. As a dependent variable the authors use a series of growth rates of real GDP, adjusted such that it accounts for the size of the unofficial economy[15]. The results of their study indicate a strong rejection of the hypothesis that the effect of reforms on growth is entirely contemporaneous. The estimation of a dynamic model, with lagged liberalization, reveals that the impact of reforms is much stronger than previously predicted when only contemporaneous reforms were considered. Significant differences are found between the European transition countries and the former Soviet Republics. The contemporaneous effect of reforms is found to be positive for the CEE and SEE countries, but negative for the former Soviet republics. The authors speculate that this difference in results can be attributed to more adverse initial conditions that characterize the FSU countries, but they do not explicitly control for initial conditions.

The hypothesis that the conditions inherited from the communist regime were instrumental for subsequent developments during transition is empirically introduced and tested in De Melo, Denizer et al(2001)[16]. The authors use the method of factor analysis to construct two aggregate indices of initial conditions: the index of initial structural distortions (with higher loadings on the component indicators of the initial share of industry in GDP, degree of urbanization, dependence on CMEA trade, natural resource endowments and the 1989 level of income in PPP dollars), and the index of initial macroeconomic imbalances (with higher loadings on the component indicators of repressed inflation, black market exchange rates, terms of trade loss for the CIS countries, history of reforms already implemented by the communist regimes, and the pre-transition growth rates). The indicators of initial conditions are then employed in a regression analysis of growth of real GDP, together with the indicator of cumulative economic liberalization CLI. In a cross-section analysis a significant relationship is found between macroeconomic distortions and economic performance, but not for the index of initial structural distortions. The parameter estimate associated to the indicator

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[15] The authors specify that the results on the unadjusted growth rates are largely the same.
[16] The study was initially disseminated in 1997, in the form of World Bank Policy Research Working Paper (1866)

of reforms is negative and statistically significant. In a panel context, the main results are that economic reforms have statistically significant non-linear effects on economic performance (that is, contemporaneous levels of cumulative liberalization have a significant negative effect, while the parameter estimates attached to lagged levels of CLI are positive and statistically significant), initial macroeconomic imbalances have a negative impact on growth throughout the period under consideration, but their impact diminishes over time, and parameter estimates for structural distortions also have a negative impact throughout the period, but no particular trend is detected. When comparing the relative roles of reforms and initial conditions, economic liberalization appears to have the highest explanatory power among all factors included in the growth regression. Interactions between reforms and initial conditions are also considered, the conclusion being that the evidence does not support the hypothesis of impaired effectiveness of reforms due to unfavourable initial conditions. However, an indirect effect of initial conditions on growth via their effect on policy choices is detected, but the direct effects of initial conditions on growth appear to be stronger in magnitude than the indirect effects through the channels of economic liberalization.

Fischer, Sahay et al(1996) largely confirm previous results on the importance of economic reforms for spurring growth in transition economies, as well as the adverse direct effects of initial conditions. However, their objective is to also include the role of stabilization policies (as proxied by inflation and a dummy variable for the exchange rate regime) in the analysis of growth in transition economies during the period 1992-1994. The authors pool cross-section and time series data for 25 post-communist countries and specify an empirical model of annual growth rates of real GDP in terms of a dummy variable for fixed exchange rate regimes, the cumulative liberalization index CLI, specific initial conditions (such as CMEA trade dependence, initial level of per capita GDP, the break-up of USSR in 1992) and country fixed effects. The parameter estimate of CLI is found positive and statistically significant, and so is the dummy for the exchange rate regime. In a separate regression analysis of inflation rates, the exchange rate regime dummy is found to be negative and statistically significant. The authors interpret the results as evidence that macroeconomic stabilization appears to be both a necessary and sufficient condition for growth. Their analysis indicates that countries that had succeeded in reducing inflation also began to grow.

The result of stabilization would later be substantiated in studies that considered a longer time span, and a consensus has been settled that stabilization is indeed a necessary condition for growth but not sufficient. The latter conclusion is better supported by the evidence, in that no country experienced positive growth before stabilizing the economy, but it was also the case that, after a short period of positive growth following the output declines, some countries reversed to recession again. In the study I mentioned, the authors speculate that there is a threshold for the inflation rate (believed to be around 50%) below which inflation does not influence economic growth in transition economies anymore. Christoffersen and Doyle(1998) tests and confirms the hypothesis of a kinked relationship between inflation and growth, but the threshold inflation level they estimate is 13%.

Hernandez-Cata(1997) has a particular hypothesis on how economic liberalization and stabilization (as proxied by inflation) affect economic performance in 26 transition countries during 1990-1996. Based on the assumption of no capital accumulation at the aggregate level, the theoretical model in the study distinguishes between old (inefficient) firms and new (efficient) firms[17]. Economic liberalization launches the process of capital reallocation from the old firms to the new firms. If it is assumed that the new firms can use the capital released by the inefficient sector immediately, then the model predicts positive growth from the very beginning of transition. However, if the assumption is relaxed, in that it takes time for the new firms to restructure the capital they inherit from the old sector and put it to productive uses, then there is an initial period of capital under-utilization, and a (temporary) corresponding output decline. Much in the spirit of the OST literature, economic liberalization has two opposing effects: a negative effect on the 'old' firms (presumably the state- owned enterprises) and a positive effect on the new, emerging firms (most likely private). Therefore, the initial net effect of economic liberalization at the aggregate level can be negative if the positive effect on the new firms is dominated by the negative effect on the old firms. The model also implies that the more aggressive the initial liberalization, the deeper the initial contraction, although it creates scope for a stronger growth later in the process. As regards inflation, it is assumed that initial high

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[17] Efficiency is defined as a higher marginal product of capital in the new firms, compared to the old firms.

inflation induced high uncertainty and chaotic macroeconomic conditions for businesses, such that it discouraged investment and fostered the concentration of resources in speculative activities related to price increases. The empirical analysis defined along the terms of the theoretical model confirms the differential role of economic liberalization on the state and the private sectors, and the adverse effect of inflation. The author also adjusts the official GDP data in order to account for the size of the unofficial economy. The model is then re-estimated to determine the effects of liberalization and inflation (together with other control variable) on the officially recorded output, when the non-reported output is being controlled for. The interesting result is that the combined effects of the dummy variables employed to control for regional differences between FSU and the European transition economies drop to zero, thus suggesting that, after controlling for economic reforms and inflation, the major difference between countries in the former USSR and the other post-communist countries has been the under-reporting of output.

Åslund, Boone at al.(1996) challenge the result that cumulative economic reforms have a robust positive effect on economic performance. With reference to De Melo, Denizer et al(1996) in particular, the authors find that, when including a dummy variable for war and a dummy for the rouble zone countries, then the positive effect of cumulative economic liberalization (CLI) disappears. However, the authors do not test for the non-linear effect of reforms, or for initial conditions. An interesting early result is this study refers to their analysis of private sector development. When regressing private sector shares in GDP on the measure of cumulative liberalization, they find a significant positive relationship between cumulative economic liberalization and private sector development (as proxied by the shares in GDP).

Heybey and Murrell(1997) disputes the empirical results on the effects of economic reforms on two main grounds. First, they argue that index of cumulative liberalization does not really tell us very much about the speed of reforms. The authors emphasize the distinction between policy stance and policy changes. In that sense, some transition economies already had a certain level of economic liberalization right from the beginning, due to the economic reforms implemented by the communist regimes before 1989. With a cumulative index of economic liberalization starting from 1989, the initial higher levels of liberalization could not be distinguished from the subsequent changes in reforms. However, even if one does not consider the 1989 levels of economic liberalization in the calculation of the cumulative liberalization indicator, problems with CLI remain, especially if one bases the calculations on the calendar years, and not on transition time. The ‘cumulation’ problem, as defined by the authors, refers to fact that CLI cumulates the liberalization scores over time, and it does not reflect the speed of reforms accurately. Most of the former Soviet Republics started the transition to a market economy in year 1992, as opposed to Hungary and Poland, for which the initial transition year is considered 1990. Therefore, political economy apart, a score in 1992 is likely to be lower for countries that started the process later simply because they had less time available for implementing reforms. In this case, spurious correlation between the CLI series, based on calendar years, and average growth can be expected, if only because both are correlated with the number of years the countries spent under communism. Yet another problem with the cumulative index of price liberalization is that it would not accurately reflect reversals of reforms, although cases of reversals with reforms are more of an exception that the rule[18].

The second ground on which Heybey and Murrell(1997) criticize some of the previous empirical studies of economic growth in transition economies is that they did not control for the potential endogeneity of economic reforms and simultaneity bias. The simultaneity bias is generated by omitting variables that are correlated to both reforms and growth (such as initial conditions). The endogeneity problem is based on the hypothesis that the speed of reforms is an endogenous variable, driven by the contemporaneous economic performance in transition. The authors then proceed to calculate a new variable for the speed of reforms, based on the component indicators of economic liberalization defined in De Melo, Denizer et al(1996), as the average change in liberalization levels over the first years of reforms. The analysis is based on transition time (such that the initial year differs among countries), rather than calendar years. The authors also employ the level of liberalization in the last year of the communist regime as a separate variable, in order to account for initial levels of economic reforms the countries started the transition with. The simultaneity bias problem is controlled for by including measures of initial conditions in the analysis; the potential problem of

[18] Reversals are observed in price liberalization in some of the Soviet republics in the aftermath of the Russian crisis in 1998.

endogeneity of economic reforms is tackled by estimating a simultaneous equation models that includes an equation for growth and an equation for the speed of reforms. Their main results suggest there is a two - way causation between growth and reforms: the error terms in the two equations are significantly correlated to each other, suggesting the omission of variables that affect both growth and the speed of reforms in opposite directions. A higher initial level of liberalization is found to lead to higher growth during the period under consideration, but a non-linear relationship between the speed of liberalization and growth is not detected. The, by now, usual adverse effects of initial conditions are found, and it appears that initial conditions had a relatively more important impact on growth during transition than policy changes.

Caution on the interpretation of the positive effects of economic liberalization on growth in transition is also expressed in Falcetti, Raiser et al(2002). The paper analyzes the relative initial conditions and reforms in spurring growth, but employs a different indicator for reforms than the previous studies. The authors use the simple average of the EBRD indices of price and trade liberalization and small-scale privatization as a measure for economic liberalization. For initial conditions, largely the same component indicators, as defined in De Melo, Denizer et al(2001), are used for constructing aggregate indicators of initial conditions[19]. The authors settle for the first principal component obtained, defined as a linear combination of initial macroeconomic distortions, time spent under communism, distance to EU, CMEA and natural resource wealth. The time-varying explanatory variables included in the regression analysis are defined over the transition time, rather than the calendar years. In cross-sectional analysis[20], the findings concur with Heybey and Murrell(1997) in that the effect of initial conditions on average growth seems to dominate the effect of reforms, even after seven years of transition. When controlling for endogeneity of reforms (that is, reforms are modeled as a function of initial conditions, growth and the degree of political liberalization), the results indicate that the impact of growth of reforms is statistically insignificant, and the point estimate obtained for the impact of reforms on growth is negative, and '*not very significant*'. The results prove to be sensitive to the starting year

[19] Based on the principal component method.
[20] The dependent variable here is an index of real GDP, with the base year defined as the first transition year.

of transition considered for the CIS countries, in that if the starting point is changed to 1991, instead of 1992, then the estimates attached to growth and initial conditions in the equations for reforms are both statistically insignificant. The authors then exploit the longitudinal structure of the data and formulate a dynamic model, including lagged reforms, initial conditions and linear and quadratic time trends in the growth equations. The equation for reforms includes contemporaneous and lagged growth rates and initial conditions. The results based on OLS show a positive impact of reforms on growth, both contemporaneously (but imprecise) and with a lag. Initial conditions effects confirm the hypothesis that the role of initial conditions, while important, diminishes over time. When the non-linear time trend is introduced, the parameter estimates of current and lagged reforms are significantly reduced in magnitude and not statistically significant anymore. With 3SLS estimates, when the lags of reforms and growth are used as instruments, the difference in results proves dramatic: a significant positive contemporaneous effect of growth on reforms is detected and reforms have a non-linear effect in growth. Parameter estimate of lagged reforms is positive and statistically significant, while the estimate of contemporaneous effect of reforms is negative. While the difference in the point estimates for contemporaneous and lagged reforms in the growth equation is almost zero, an F-test on no reforms fails to reject the hypothesis of no net effect of reforms on growth. Based on these results, the authors reinforce the doubts on the hypothesis of a robust positive effect of reforms on growth.

In what follows, among the empirical studies that aimed at disentangling effects of specific group of reforms, as defined by the component indicators constructed in De Melo, Denizer et al(1996), I only focus on Berg, Borensztein et al(1999), as the analysis in the next sections was greatly inspired by their work at a conceptual level. The study is quite rich, as it touches on various issues related to empirical analysis of growth in transition economies, but I only focus on the set-up of the models as well as on some of the most robust results. The objective of the study is to assess the relative roles of macroeconomic variables, economic reforms and initial conditions in explaining output performance in transition economies since the start of transition and up to year 1996. The main differences from the, by then, existing empirical studies are the following: 1/ the study emphasizes the differential effects on policies and initial conditions on the private sector and the states sector; 2/ effects of initial conditions are modeled as time dependent; 3/ the endogeneity of macroeconomic variables (fiscal balance in particular) is controlled for, but not the endogeneity of reforms; in this respect, weak exogeneity of reforms is assumed, in that they are uncorrelated with contemporaneous levels of growth, but not with the lagged levels of growth; 4/ no link from initial conditions to reform is considered, which, as the authors acknowledge, is a possible reason why the reported results may understate the overall importance of the initial conditions. The authors adopt a general-to-specific modeling approach in their search for determinants of growth during transition, starting with a large number of potentially explanatory variables including contemporaneous and lagged (up to the 3rd lag for the reform variables) of macroeconomic and reform variables (in the form of the three component indicators of economic liberalization), various indicators of initial conditions, and other control variable. Some of the variables in the initial set are then discarded based on an extensive process of searching for significant estimates, developed according to a specific set of rules. Regression analysis is carried out for both growth rates and levels of real GDP. I will only present the results produced by specifications with the real GDP growth rate as the dependent variable.

At the conceptual level, the authors consider the decomposition of aggregate output as following:

$$y_t = \alpha_t y_t^P + (1 - \alpha_t) y_t^S$$

where:

$y_t^P =$ total output produced by the private sector

$y_t^S =$ total output produced by the state sector

$\alpha_t =$ the (time-variant) share of the private sector in total output

If the differential impact of reforms and initial conditions on the two sectors is not controlled for, a regression analysis produces estimates of the net effects of reforms and initial conditions. It is thus possible to obtain a negative net effect of reforms on aggregate output, but that does not warrant the conclusion that reforms are bad for growth! The net result could be explained by the dominance, at stages, of the negative effects that reforms have on the output in the state sector over the associated positive effects on the private sector. As the share of the private sector increases in the economy, positive effects of reforms would also surface. The authors therefore isolate the time – invariant effects on growth by estimating equations of the form:

$$y_t = \beta_0 Policies_t + \beta_1 (\alpha_t Policies_t)$$

For initial conditions, a piecewise linear function is defined such that it distinguishes between an initial effect, a subsequent linearly increasing/decreasing path, and then a flat effect after a certain point in time.

The analysis, based on the OLS regression, detects a strong adverse effect of increases in inflation on the growth of the private sector, and a puzzling positive effect of inflation on the state sector, while no statistically significant contemporaneous effect of the levels if inflation is found. Similarly puzzling effects for the fiscal balance suggest that a tight fiscal policy appears to sustain growth in the state sector, while impeding growth in the private sector. On the reforms side, internal liberalization has a positive impact on the private sector, and a negative impact on the state sector, but the results are not robust. Trade and foreign exchange liberalization is estimated to have had a positive contemporaneous effect of the state sector, and a negative corresponding effect on the growth in the private sector. For the lagged effects of trade and foreign exchange liberalization, the estimated effects change signs in time. The indicator on private sector reforms (banking and privatization) does not produce any statistically significant contemporaneous effect, but the indicator proves significant at one lag: positive for the private sector, and negative for the state sector.

The authors report that the main robust finding on economic reforms is that (on average) they helped all countries in the later transition years[21], and most countries even in earlier stages of transition. They argue there is little support for the belief that reforms had an aggregate destructive effect at the beginning of transition and they are to be blamed for the initial output collapse. The most robust results[22] on initial conditions suggest that, on the aggregate, their combined effect was to generate negative growth in

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[21] Except Turkmenistan, where the private sector has been maintained at very low levels during the entire period of transition.
[22] Relative to alternative specifications of the model

the first year of transition, followed by diminishing, but still negative, effects on growth over time.

Decompositions of the fitted aggregate output growth rates[23] into the contributions of the major groups of explanatory variables reveals the following results:

- The output decline at the onset of transition is overwhelmingly attributed to initial conditions and, to a much lesser extent, to macroeconomic imbalances.
- No evidence is found that, after controlling for other factors, structural reforms aggravated the initial output collapse despite the negative effects some of reforms had on the state sector.
- Economic reforms are reflected as the driving force behind recovery. Diminishing effects of adverse initial conditions also helped recovery.

The analysis of the differences between the former USSR republics and the European transition countries reveals that the larger initial output decline in the former countries is attributable to the initial conditions to a certain extent, but also to the fact that the former Soviet republics started implementing reforms later in the transition process. The poorer growth registered in the former Soviet region during the later years of transition (up to 1996) is blamed more on less advanced reforms, than on initial conditions.

Empirical Studies on Institutions in Transition

When looking for institutional considerations in relation to the economic performance during transition, although it is widely believed that institutions are instrumental in fostering economic development, the corresponding research literature on transition economies is very much in its infancy. To my knowledge, there is yet no convincing theoretical study that relates the quality of institutions and state governance in transition economies to the developments in terms of economic performance. The empirical literature at the macroeconomic level includes only a handful of studies that attempt to relate institutions to economic growth in the post-communist countries. As it

[23] The fit of the model is almost perfect. As the authors acknowledge, this is probably due to the data mining approach.

will be briefly described, valuable sources of information on the potential role of institutions are the survey studies at the micro level on perceptions of managers of local firms on various institutional aspects.

One of the first studies that analyzes the empirical links between state governance and economic performance in transition economies is Johnson, Kaufmann et al(1997). The objective of the study is actually the analysis of the unofficial sector[24] in the post-communist countries, but it also includes empirical results that relate measures of state governance to the official growth rates of real GDP. The main hypothesis in the study is that high levels of taxation, pervasive corruption and poor government regulations of business activities drive firms into the unofficial sector. The stylized theoretical model in the study indicates the existence of two stable equilibria: a 'good' equilibrium, where all firms operate in the official sector, and a 'bad' equilibrium, where all firms are active in the unofficial sector. The intermediate state with some firms operating in the official sector, and some others in the unofficial sector, is unstable: in the spirit of 'cobweb' dynamics, depending on which side of the intermediate state they are, firms would either be attracted by the good equilibrium, or by the bad one. In countries with poor state governance, it is more likely that the equilibrium with no official sector will hold. As firms sink underground, the tax revenues available to the government for providing/improving public goods in the official sector disappear, which makes the official sector completely unattractive. The empirical implication is that in countries with poor state governance we will therefore observe lower levels of activity in the official sector. The model is tested empirically by employing two main sets of measures: measures that proxy the quality of state governance, in terms of corruption and regulation of business activities, and measures meant to represent the quality of public goods (reflecting the quality of the legal system). Measures of structural reforms (the index cumulative liberalization discussed above, and the EBRD measures of reforms) are also included in the analysis. The results on official growth rates of real GDP (calculated as indices relative to year 1989) indicate a negative, and statistically significant, relation between growth and levels of corruption and crime in transition economies. The result on government regulation of business activities (as reflected by Heritage Foundation data) is only weakly significant

[24] I defer the discussion of the theoretical model in the paper for the next study in this thesis.

in the growth regression, although with the expected sign. Positive associations are found between the measures of legal environment (i.e. public goods) and the official GDP growth. In summary, the study does provide some indication that the countries with poor state institutions appear to record poorer macroeconomic performance. As mentioned, the core of study analysis actually consists on discussion on the developments in the unofficial sector, to which I will come back to in the next study.

Similar results are also found in Brunetti, Kisunko et al(1997), although based on a different data set. The authors rely on survey data on the institutional framework in the post-communist countries, collected by the World Bank in 1997[25]. The measures of institutional developments focus on the predictability of law changes, political stability of the government, protection of property rights, reliability of the judicial system and the levels of bureaucratic corruption. Regression analysis of growth rates of GDP[26] (averaged for 1993-1995) on the institutional measures and other control variables indicate statistically significant, and with the expected sign, estimated parameter coefficients attached to the institutional variables. Among the institutional indicators included, less robust results are obtained for the predictability of law changes. The authors also recognize the possibility of a reverse causality between institutions and economic performance. IV estimation is therefore carried out with indicators of political rights being employed as instruments for institutional reliability. The authors conclude there is little empirical evidence of effects running from economic performance to institutions. However, it is difficult to accept the measures of democracy as good instruments in such an empirical setup, given the strong probability that democracy is somehow correlated with economic performance.

Multivariate regression is also employed in Havrylyshyn and van Rooden(2000) for the comparative analysis of the roles of structural reforms and institutions in fostering economic performance in the post-communist countries. The institutional measures employed in the study are obtained from several sources: Heritage Foundation (protection of property rights, government regulations, fiscal burden imposed on economic agents), Freedom House (political rights, civil liberties, rule of law,

[25] The survey has a broader coverage across countries, also including Africa, the Americas, Western Europe and Middle East. See Study 1 for more details.

[26] The authors also perform a similar analysis for foreign direct investment in transition economies.

macroeconomic governance, public administration), EBRD (indices of legal reforms), World Bank (survey data collected in 1998), Euromoney (political risk). There are nine resulting measures of institutional environment obtained, and an additional composite indicator of institutions is constructed by means of principal component analysis. The results of the empirical analysis in the study are mixed in terms of robustness of results. The authors conclude that institutions appear to have a significant influence on growth but, once economic liberalization and stabilization policies are accounted for, the effect of legal and political factors is substantially reduced. The authors do not consider possible reverse causality from growth to institutions.

Grogan and Moers(2001) builds on the empirical analysis mentioned above in their attempt to analyze the role of institutions during transition. The authors largely employ the same data sources as the previously cited study, but also add the measures on corruption and crime, and legal safeguards reported by Wall Street Journal CEER[27]. A distinction is made in the study between formal institutions (rule of law, investment laws, property rights protection) and informal institutions (as proxied by Freedom House data on civil society). In a first stage of the analysis, average growth during 1990-1998 is regressed on each of the institutional variables, with results indicating that the formal institutions appear to have a stronger effect on growth than the informal ones. When additional control variables (macroeconomic stabilization, economic liberalization, initial conditions, inflation and government consumption) are added, on an individual basis, in the growth equation some of the institutional variables lose significance or even change signs. Informal institutions in particular prove least robust, in that no statistical significance for the corresponding estimate is obtained at any stage when control variables are present. However, the authors do not interpret the evidence as indicating lack of robustness, but attribute the weak significance to high multicollinearity between the explanatory variables. In a second stage of the analysis, the authors consider testing and controlling for endogeneity of institutions. IV estimation employs a measure of ethnolinguistic fractionalization[28] as an instrument for the quality of institutions. Results of 2SLS regressions indicate statistical significance,

[27] Central European Economic Review

[28] The indicator reflects the probability that two persons from the country population, when randomly selected, will not belong to the same ethnolinguistic group. The maintained assumption is that the more polarized a society is, the lower quality of institution that it has.

and larger magnitudes, for the estimates attached to all the institutional variables employed. Based on these results the authors conclude that there is some indication that correlation between institutions and growth is of a causal nature. Furthermore, exogeneity for the measures of property rights and civil society could not be supported. The final conclusion of the study is therefore that, contrary to Brunetti, Kisuonko et al(1997), there is some indication that reverse causality is present between institutions and growth. However, while acknowledging it is very difficult to find good instruments for the quality of institutions, I doubt that the measure of ethnolingusitic fractionalization, as employed for developing countries in Africa, is a good instrument for institutions in the post-communist countries, if only because diversity in terms of ethnolinguistic groups in the transition economies is much more limited than it is the case on the African continent.

A common feature of the studies cited above is that they employ measures for a large range of institutions (political system, state governance in terms of regulations, judicial system and protection of property rights, corruption, quality and rule of law).

There are also empirical studies that focus on a particular type of institutions. The analysis of the role of democracy in explaining economic performance in transition countries is the focus of Fidrmuc(2001). The author analyzes the empirical links between democracy, economic liberalization and economic performance in transition economies. The study finds that, even when controlling for endogeneity of reforms, economic liberalization has a strong positive effect on growth. Democracy is found to facilitate reforms, but it has only a marginal negative direct effect on growth during early stages of transition. The author's conclusion is that the main channel through which democracy affects growth is through its positive direct effect on economic liberalization[29].

The link between corruption and economic performance is the objective of the analysis in Abed and Davoodi(2000). The authors argue that the significant effect of corruption on growth found in previous studies could be driven by the absence of structural reform indicators in the growth regression[30]. They advance the hypothesis that

[29] A similar effect of democracy on economic liberalization had been found in De Melo et al (2001)
[30] Argument which is really valid for Brunetti et al(1997) only.

the link between corruption and growth is of an indirect nature, as corruption erodes economic performance through its effect on institutions. The authors collect data on corruption from several sources, including Wall Street Journal CEER, Transparency International, World Bank, Political Risk Services. The empirical strategy in the study is to first regress growth (during 1994-1998) on macroeconomic indicators, structural reforms and control variables; subsequently the indicators of structural reforms are replaced with the indicator of corruption. When included separately, both structural reforms and corruption prove statistically significant in the growth regression. However, when the variables of reforms and corruption are included together in the equation, then corruption loses its statistical significance for growth, while structural reforms remain strongly significant. When decomposing aggregate growth in contributions for each of the variables included in the analysis, structural reforms are found to be two to three times as important as corruption in accounting for the recorded growth. The authors conclude that the findings do provide evidence on absence of a direct effect of corruption on macroeconomic performance in transition economies.

More revealing evidence on the incidence of corruption on the economic activity of agents in transition economies is provided at the micro level in survey studies. If studies on institutions at the macro level in transition economies are scarce, the situation is much better when it comes to evidence at the firm level. There is a wealth of survey studies introducing data and discussing results based on the perception of managers of local firms on the institutional environment and obstacles to doing business in their (transition) countries[31]. Many of the surveys reveal that managers find government regulations of the business activities among the important factors (if not most important, when not eclipsed by heavy taxation levels) that hinder their economic activity. Of a particular interest for the purpose of the current analysis are the (some of the) results reported in three of the survey studies mentioned in note 31 below.

[31] Some of these studies are: Johnson(1994) on Poland, Hungary, former Czechoslovakia, Bulgaria and Romania; Smallbone, Welter et al(2001) on Ukraine and Belarus; Muent, Pissarides et al(2001), and Hashi(2001) on Albania; Bartlett and Bukvic(2001) for Slovenia; Anderson and Pomfret(2001) for Kyrgyz Republic; Johnson, McMillan et al (2000) on Poland, Slovakia, Romania, Russia and Ukraine; Angelucci, Estrin et al(2001) for Poland, Bulgaria and Romania, Hellman, Jones et al(1998) and Hellman and Schankerman(2000) for all transition economies.

Hellman, Jones et al(2000) analyze the nature of corruption in transition economies, based on the data in the BEEPS database on all transition economies, collected in 1999[32]. In the survey a distinction is made between state capture (reflected by the extent to which firms capture the state by influencing the lawmaking system through unofficial payments made to politicians and public officials), influence (similar to state capture, only it does not rely on monetary rewards) and administrative (petty) corruption (with the usual interpretation of bribery in connection with the (discretionary) implementation of regulations of business activities stipulated by laws). Along a continuum that scales the extent of state capture in transition economies, the authors distinguish two main groups of countries: high-capture countries (Romania, Georgia, Slovakia, Croatia, Bulgaria, Kyrgyzstan, Russia, Ukraine, Moldova and Azerbaijan) and low-capture countries (Albania, Armenia, Belarus, Czech Republic, Estonia, Hungary, Kazakhstan, Lithuania, Poland, Slovenia and Uzbekistan). Among other interesting results in the study, the authors find that incidence of corruption differs along the three main dimensions. State capture appears to benefit, on average, the captor firms in that they reveal higher growth rates of sales and high investment. When controlling for the type of the economy, in terms of the extent of state capture (low versus high), the findings indicate that captor firms benefit a great deal from their interaction with public officials and politicians in the high-capture countries, but to a much lesser extent in the low-capture countries (there is some evidence that capture firms actually record worse sales growth that non-captor firms in these countries). Petty corruption, on the other hand, is found negatively linked to economic performance (in terms of sales and investment) of all firms engaging in such activities, when compared to firms that are less active in bribing the bureaucrats. The study also reveals the possibility of a non-linear relationship between state capture and civil liberties in transition economies. The finding of an inverted U-shaped relationship between the two measures indicate that civil liberties need to reach a basic threshold before being associated with lower levels of state capture.

Hellman and Schankerman(2000) substantiate the results on the nature of the interactions between firms and the state, based on the same data set. Such interactions are considered in terms of state intervention in firms' operational decisions on prices,

[32] See Study 1 for details.

employment, investment, wages, sales, the time spent by managers for dealing with the government (‘time tax’), the frequency and magnitude of bribes paid by firms for various purposes (‘bribe tax’) and state benefits extended to firms (in terms of direct subsidies and implicit benefits in the form of tax and utility arrears). The main findings of the study are that, while at the micro level (within a country), state intervention and corruption appear to be substitutes (that is, firms reporting higher state intervention pay lower bribe taxes and vice versa), at the macro level (across countries) state intervention and corruption go hand in hand. In terms of types of firms, privatized firms are found to be less subject to state intervention, when compared to SOEs, but pay higher bribe tax and benefit less from state subsidies. The authors interpret the results as evidence of the fact that privatization did indeed help the de-politicization of firms. The de novo firms are most affected by corruption (in that they pay highest bribes), but are least subject to state intervention.

The third study at the micro level that I find relevant for the analysis in this chapter is Johnson, McMillan et al(1999). The analysis in the study is based on survey data collected at the firm level in 1997 for Russia, Ukraine, Poland, Slovakia and Romania. The main objective of the paper is the analysis of the links between external financing, property rights protection and investment. The main findings are that the observed weak link between credit and economic performance in the private sector is not necessarily explained by a restricted supply of credit. Managers in private firms in the countries included in the study rely to a large extent on re-investment of profits. However, perceived weak property rights are found to limit the re-investment of profits, despite the high levels of profits recorded in early stages of transition.

Summary of Existing Results

Data considerations reveal there are serious reasons to believe that the official GDP levels reported for the post-communist countries are likely to underestimate the levels of economic activity in those countries through time. Statistical distortions are deemed to be particularly acute for the first years of transition, when the degree of overstated output levels pertaining to the pre-transition period combines with the underestimation of output as a result of the collapse of the channels for data reporting during the initial transitional upheaval. Problems with underestimation of economic activity are also likely to continue beyond the first years of transition due to the developments in the unofficial sector. As estimates on the unofficial economy are available until 1995 for all transition economies, little is that we know about developments in the underground for later stages in transition across the post-communist countries.

Among the factors believed to have influenced the observed developments in economic performance of transition economies, the role of the legacy of communism (as reflected by a variety of indicators) commands a general consensus in the literature. Moreover, we learn that empirical analysis generally supports the hypothesis of an important, but time-decaying effect of initial conditions on economic growth. However, beyond the general conclusion that early negative developments during transition are attributable to initial conditions, there is little more we can say. This is mainly due to the fact that most of the studies employ aggregate indices of initial conditions, such that it is not possible to disentangle the relative importance of specific initial conditions. In the studies that do employ several indicators of initial conditions, a consistent finding is that the dissolution of the CMEA trade block did induce adverse effects on economic performance at that time. There is also some evidence that initial liberalization helped countries cope with early economic imbalances better. A strong adverse effect is also found for war and conflicts.

A consensus also exists on the (confirmed) hypothesis that macroeconomic stabilization is a necessary condition for resuming growth. Inflation measures are systematically found to relate negatively to the indicators of economic performance. Furthermore, there appears to be a non-linear relationship between inflation and growth, in that the latter is adversely affected mostly at high levels of inflation. Once below a threshold (around 13%), the negative effects of inflation on growth disappear.

The theoretical literature on transition focuses mainly on the supply side of the economy. Existing empirical evidence supports the hypothesis of disorganization of supply chains in the aftermath of the demise of the communist regimes, as advanced in Blanchard and Kremer(1997). The lack of credit and financial markets as barriers to economic activities did not find any empirical support to this date. Evidently, absence of empirical support does not necessarily imply that there is no role to be played by financial markets. It only conveys the message that, if there are differences in aggregate economic results among transition countries, they are not explained by observed levels of credit extended to the private sector.

The main divergence between theory and empirical results concerns the role of structural reforms in spurring growth. The OST theory predicts that too fast initial reforms carry the risk of eventually hindering aggregate economic development due to the adverse fiscal effects of large unemployment pools accumulated in the process. The empirical literature tends to support the hypothesis that fast reforms were instrumental to growth, although there is not much of a consensus on the positive role of reforms. There is some evidence of a non-linear effect of structural reforms on economic growth during transition, but problems with estimation methods and the indicators employed cast some doubt on the validity of results. There is some indication that reforms are endogenous. More revealing evidence is provided by studies that consider a differential impact of economic liberalization on the state and the private sectors in the economy. The assumptions that reforms negatively affect the state sector but benefit the private sector are supported by the available data. More specifically, such effects are found for reforms with liberalization of relative prices. Similar effects are found for privatization and financial reforms with a lag. When combined with the results on the effects of initial conditions, the conclusion is that, while initial conditions appear to have driven the initial collapse in output, the economic recovery has been induced by structural reforms. However, the existing empirical literature does not touch the issue of possible interactions between specific reforms, despite the fact that it is well known that price and trade liberalization, and small scale privatization were among the first reforms to be introduced in early stages of transition, while large – scale privatization and financial sector reforms proceeded more slowly (if ever in some countries).

Empirical enquiries on the role of institutions during transition confirm the expectations of a negative association between poor state governance (in terms of cumbersome government regulations, weak judicial system, limited protection of property rights and corruption) and economic growth during transition. The empirical analyses of institutions in transition at the macro level, however, suffer of econometric problems, in that either the possibility of endogeneity of institutions is not considered, or, when it is, then inadequate instruments for institutions are employed.

From survey studies we learn that the private sector is more likely to be affected by poor government regulations, and more involved in corruption activities, than the state firms. Weak property rights are found to impede investment activities in the private sector.

On the interactions between institutions and structural reforms a robust result that appears to be confirmed in several studies is the positive association between democratization of transition countries and their corresponding progress with structural reforms. Given that an aggregate index of economic liberalization is employed, it is not clear which reforms in particular are more affected by positive developments in the political process.

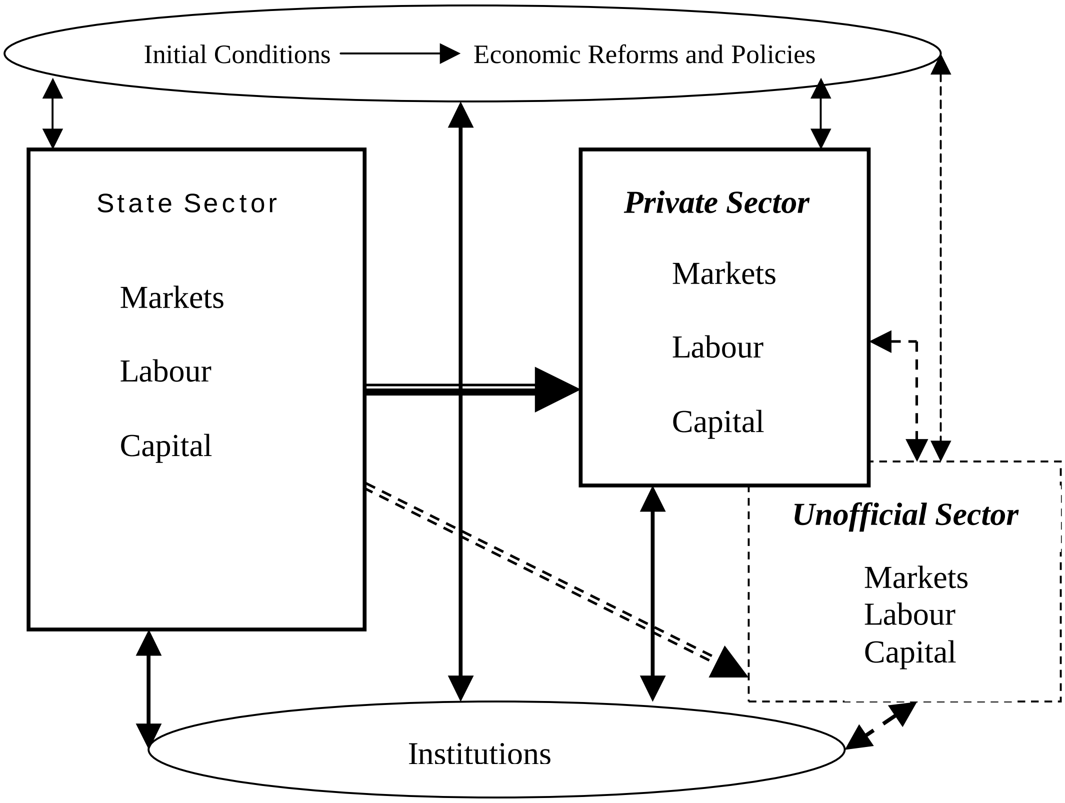
Section IV: Empirical analysis of economic growth in transition economies since the start of transition and until year 2000

The analysis in this study continues the quest of empirical research on the relative roles of initial conditions, implementation of economic reforms and change in political and regulatory institutions to economic developments in the post-communist countries during the transition period until year 2000.

At the conceptual level, I follow the steps of the Optimal Speed of Transition literature in that the analysis relies on the interpretation of aggregate growth for the total economy as the net result (sum) of growth that originates in the private sector, and economic decline (growth) recorded in the state sector. The search for an empirical model of transition relies on the conceptual model illustrated in Figure 1. The transition process from a centrally planned economy to a market system is viewed as a process of systemic and structural transformation, shaped by initial conditions inherited from the recent past and by the reform measures initiated after the demise of the communist leadership. The conceptual model indicates interactions between the economic transformations in the private and the state sector, as well as links (and possible feedback effects) of the implemented reforms and institutional developments associated with the process.

The expansion of the private sector, envisioned as instrumental for a coherent transition to a market system, is the main engine of growth fuelled by the resources released by, and the emerging business opportunities associated with, the transformation in the state sector. The speed and extent of resource allocation between the two sectors are shaped by the adopted economic policies and reforms, but they are also dependent on the initial economic conditions and economic liberalization inherited from the previous political regime. Among early reforms implemented during transition the removal of state control and restrictions over prices, legitimate access to foreign exchange and international trade, triggered changes in relative prices and the re-organization of business relationships of economic agents and markets in the economy. Subsequent reforms with privatization and restructuring of state-owned enterprises, as well as reforms in the financial sector, further enhanced the transfer of resources (labor and capital) between the two sectors.

Figure 1: A conceptual model of transition



The ability of the state – owned enterprises to survive and benefit from the process of structural transformation is assumed to depend not only on the policy measures and structural reforms implemented during transition, but also on the inherited communist legacy.

During transition resource allocation can also go awry, in that resources are attracted by the unofficial economy, if favorable conditions for the development of an official private sector fail to materialize. Inconsistent policies and reform measures, highly repressive tax systems, cumbersome regulations and endemic corruption are only some of the possible reasons why labor and capital released by the state sector could migrate to the underground economy, instead of contributing to improved performance of the official (private) sector.

Political economy considerations are captured in the model by the feedback links from economic development to the institutional environment, and then back to the implementation of reforms.

The empirical model of transition presented in this section helps testing some of the priors embedded in the conceptual model. The explicit distinction between the two sectors allows for differential effects of initial conditions, structural reforms and institutional changes on the economic developments in the private and the state sector. While the main focus is on economic growth in the state and the private sector, the model also specifies the interactions between initial conditions and reforms, with the view that the implementation of structural reforms is path dependent: more favorable initial conditions in terms of previous experience with reforms and the presence of even an embryonic private sector make it easier to initiate the transformation of the economy. Furthermore, early implementation of certain reforms provides a basis for adopting politically difficult policy decisions sooner than later. Endogeneity of reforms is considered, in that there are possible feedback effects from economic development to the reform process, either directly or indirectly through the changes in the institutional environment.

The empirical model constructed in this study only marginally touches on the issue of the developments in the unofficial sector, mainly through the interpretation of results obtained for the officially recorded developments. This is motivated by empirical difficulties of considering the unofficial sector in the current set up of the model. Given that estimates on the underground economy are available only for the first half of the transition period under consideration, there was no possibility to include the unofficial sector in a consistent manner in the model.

While building on previous empirical research efforts, and especially on Hernandez-Cata(1997) and Berg and Borensztein(1999), there are several respects in which I depart from the existing empirical set-ups.

First, instead of controlling for the size of the private sector in the economy in a regression analysis of aggregate growth rates, I base the analysis on the decomposition of aggregate growth rates into growth of GDP generated in the private sector, and the corresponding dynamics in the state sector. Integrating the two resulting series of sector-specific growth rates into the framework of simultaneous – equation models allows for the explicit assessment of differential impact of initial conditions, changes in economic reforms and in the institutional setup on the two sectors.

Second, the methodology of path analysis employed in this study allows for an explicit estimation of both direct and indirect effects of the included explanatory variables on the growth performance in the two sectors. Indirect effects, in particular, come as a result of interactions between initial conditions, on the one hand, and economic reforms and institutions, on the other hand, but they are also a product of interactions between reforms themselves. The existing empirical literature on growth in transition economies occasionally considers the indirect effects of initial conditions on economic growth via their direct impact on economic reforms, but it neglects the interactions among specific reforms. This is partly due to the fact it has become a norm to use a composite indicator of structural adjustment that aggregates information on different types of reforms. However, stylized facts on transition processes in the post-communist countries suggest that policy stances in terms of specific reforms differ among transition countries: while price liberalization has been implemented in most previously centrally planned economies since early stages of transition, there are significant differences in privatization policies and implementation of reforms in the financial sector among countries. I therefore rely on the distinct composite indicators of enterprise sector transformation and reforms in the financial sector, as estimated in the previous chapter of this thesis, in order to disentangle the specific roles of such reforms for the development /decline in the private /state sectors, as well as interactions among reforms themselves.

Third, in terms of initial conditions I employ a limited set of initial conditions including the initial of the private sector, previous experience with economic liberalization and the involvement in trade with CMEA partners. In the previous study in this thesis, where I attempted to estimate an indicator that summarizes various types of structural initial conditions, I found that aggregation is not supported by the sample data. I am therefore left with the option of employing separate measures for specific initial conditions. Given the empirical problems with multicollinearity that are likely to occur as a result, I decided to limit the analysis to the indicators that I perceive as having a higher potential to reflect the relative rigidity of economic systems at the onset of transition and their ability to adjust more rapidly to transitional shocks.

Fourth, in order to capture path dependency in the reform process, as well as the possibility that the effects of reform measures may take time to materialize, I introduce an alternative way of constructing indices of past cumulative reforms, when compared to the existing approach of the issue (as discussed in section III). A view is taken that if there are lagged effects of reforms, they cannot last forever. Therefore, a cumulative index of past reforms is constructed (for each type of reforms) such that it assigns more weight to recent past reforms, and decreasing weights to reforms implemented in the more distant past. Given that the analysis is based on the transition time, and not calendar years, the 'cumulation' problem mentioned for the existing cumulative index (CLI) of economic liberalization does not apply to the measure employed here. There is also a strong possibility that the measures of cumulative reforms employed in this analysis allow for a better control of reversals in reforms, especially if undertaken in early stages.

Fifth, the analysis also contributes to the empirical literature on the role of institutions during transition. Endogeneity of institutional changes is a major concern and tested for accordingly. Interactions between reforms and changes in institutional environment, and the effects of initial conditions on changes in institutions, are also considered.

The structure of this section is the following: sub-section IV.1 starts with the decomposition of aggregate growth rates into growth in the private sector, and the corresponding developments in the state sector. The two resulting series will then be employed as the main dependent variables in the empirical model in sub-section IV.2, where the process of building the empirical simultaneous equations system of transition is described. Sub-section IV.2 also includes a summary and discussions of the estimated results in the final specification of the model. In sub-section IV.3 the reader will find some of what I consider as being the main limitations of the empirical model, relative to the conceptual model presented above.

IV. 1 Decomposition of aggregate growth

Consider the total GDP in the economy at time *t* as the sum of the value added in the private sector, and the corresponding value added generated in the state sector:

$$y(t) = y^{P}(t) + y^{S}(t)$$

where:

$y(t) =$ total value added in the economy at time t

$y^P(t) =$ value added in the private sector at time t

$y^S(t) =$ value added in the state sector at time t

such that:

$$y^P(t) = \alpha(t) \cdot y(t) \text{ and } y^S(t) = (1-\alpha(t)) \cdot y(t),\ 0 < \alpha(t) < 1$$

where:

$\alpha(t) =$ the share of value added in the private sector in total value added in the economy

The aggregate growth, in decimal points, can be written as:

$$\frac{d(\ln y(t))}{dt} = \frac{1}{y(t)}\frac{dy(t)}{dt} = \frac{1}{y(t)}\frac{d(y^P(t)+y^S(t))}{dt} = \frac{1}{y(t)}\frac{dy^P(t)}{dt} + \frac{1}{y(t)}\frac{dy^S(t)}{dt} =$$
$$= \left(\frac{1}{y^P(t)}\frac{dy^P(t)}{dt}\right)\frac{y^P(t)}{y(t)} + \left(\frac{1}{y^S(t)}\frac{dy^S(t)}{dt}\right)\frac{y^S(t)}{y(t)} =$$
$$= \alpha(t)\frac{d(\ln y^P(t))}{dt} + (1-\alpha(t))\frac{d(\ln y^S(t))}{dt}$$

where:

$\frac{d(\ln y^P(t))}{dt} =$ the growth rate, in decimal points, of the private sector

$\frac{d(\ln y^S(t))}{dt} =$ the growth rate, in decimal points, of the state sector

$\alpha(t)\frac{d(\ln y^P(t))}{dt} =$ contribution of private sector growth to aggregate growth at time t

$(1-\alpha(t))\frac{d(\ln y^P(t))}{dt} =$ contribution of state sector growth to aggregate growth at time t.

Note that aggregate growth depends on the relative dynamics of economic performance in the two sectors, and on the relative shares of the private sector and the state sector in total economy at a specific point in time. It is therefore possible that we observe negative aggregate growth even with a rapidly growing private sector, if the current share of the private sector in the total economy is very small and the state sector is rapidly declining.

In order to decompose the observed aggregate growth rates into contributions of the two sectors, we need to translate the growth accounting in continuous terms into a corresponding decomposition in discrete terms. I first approximate the levels of value added in the two sectors by combining the levels of GDP per capita (in PPP terms) in the economy, as reported in WorldBank(2002), with the share of private sector value added in total GDP, as reported in EBRD(2001), as following:

$$\begin{aligned}
&y(t) \to y_t \\
&y^P(t) \to y_t^P = \alpha_t y_t \\
&y^S(t) \to y_t^S = (1-\alpha_t) y_t
\end{aligned}$$

Based on the calculated levels of value added in the total economy, and in the two sectors, I then approximate the growth rates in continuous time with the corresponding calculated growth rates in discrete terms (in percentage points) as following:

$$\frac{d(\ln y(t))}{dt} \to \Delta_{(\%)} y_t = 100 \cdot \left(\ln y_t - \ln y_{t-1}\right)$$

$$\frac{d(\ln y^P(t))}{dt} \to \Delta_{(\%)} y_t^P = 100 \cdot \left(\ln y_t^P - \ln y_{t-1}^P\right)$$

$$\frac{d(\ln y^S(t))}{dt} \to \Delta_{(\%)} y_t^S = 100 \cdot \left(\ln y_t^S - \ln y_{t-1}^S\right)$$

and the corresponding contributions of the two sector to aggregate growth as:

$$\alpha(t) \frac{d(\ln y^P(t))}{dt} \to \left(\frac{\alpha_t + \alpha_{t-1}}{2}\right) \cdot \Delta_{(\%)} y_t^P$$

$$(1-\alpha(t))\frac{d(\ln y^P(t))}{dt} \rightarrow \Delta_{(\%)} y_t - \left(\frac{\alpha_t + \alpha_{t-1}}{2}\right) \cdot \Delta_{(\%)} y_t^P$$

For further reference the term $\left(\frac{\alpha_t + \alpha_{t-1}}{2}\right)$ is denoted as $\alpha_{t/t-1}$.

The resulting cumulative growth rates in the two sectors, for each country during transition time up to year 2000, are reported in Table 1. The calculated annul growth rates in the private and state sectors are reported in Appendix 2.

From Table 1 below, we see there have been impressive developments of the private sector in most transition economies, with the exception of some CIS countries. In the first two columns in the table the size of the private sector (as proxied by the percentage share of private sector value added in total economy) is reported for year 1990 (a pre-transition year for most of the post-communist countries, except Poland and Hungary) and year 2000.

With no exception, in all transition economies we observe cumulative growth of the private sector since the start of transition in each country until year 2000, and an associated cumulative decline in the state sector. Transition has been very active in promoting private sector development especially in the European transition economies (179% average cumulative private sector growth in the CEE[1] for a period of approx. 10 years of transition, and an average of 190% in the SEE region, respectively), as well as in the Baltic countries (with a recorded average cumulative growth of 185% in the private sector). The weakest cumulative private sector performance is observed for the war-torn countries in the Caucasus area (with only 64% private sector growth, on average).

The cumulative results for the state sector growth reveal a strong decline of the state active involvement in the economy in all regions. We can see that the cumulative decline in the state sector output was deeper in the former Soviet republics (on average, across regions) than in the transition economies in CEE and SEE regions.

[1] Note that the reported numbers for the CEE region most likely represent a lower bound of the total private sector growth in the region, as data for initial years for Czech Republic (1991-1992), Hungary (1990), Poland (1990), Slovenia(1991) are not available.

Table 1 Contributions to aggregate growth

Country (period with data available for all series)	PS share(%)		Cum. Growth of Private Sector	Cum. Growth of State Sector
	1990	2000		
	(1)	(2)	(3)	(4)
SEE				
Albania (1991-2000)	5	75	291.77	-112.54
Bulgaria(1991-2000)	9.5	70	198.21	-111.93
Macedonia(1991-2000)	14	55	138.31	-63.28
Romania(1991-2000)	16.5	60	132.33	-70.37
SEE Average	**11.25**	**65**	**190.15**	**-89.53**
CEE				
Croatia(1991-2000)	10	60	191.78	-68.49
Czech Republic (1993-2000)	5	80	123.96	-99.40
Hungary(1991-2000)	19	80	171.09	-112.54
Poland(1991-2000)	27	70	141.79	-42.40
Slovak Republic(1991-2000)	6	75	274.51	-110.50
Slovenia(1992-2000)	11	55	172.51	-21.02
CEE Average	**13**	**70**	**179.27**	**-75.73**
BALTIC				
Estonia(1991-2000)	10	75	225.00	-104.58
Latvia(1991-2000)	10	65	168.56	-113.07
Lithuania(1991-2000)	10	75	162.30	-126.49
BALTIC Average	**10**	**71.67**	**185.29**	**-114.71**
CAUCASUS				
Armenia (1992-2000)	12	60	51.63	-73.65
Azerbaijan (1992-2000)	10	45	105.46	-94.19
Georgia (1992-2000)	15	60	35.83	-178.18
CAUCASUS Average	**12.33**	**55**	**64.31**	**-115.34**
CENTRAL CIS				
Belarus(1992-2000)	6	20	144.43	-11.39
Moldova(1992-2000)	10	50	85.29	-134.43
Russia (1991-2000)	6	70	227.18	-132.71
Ukraine(1992-2000)	10	60	129.25	-131.02
CENTRAL CIS Average	**8**	**50**	**146.54**	**-102.39**
CENTRAL ASIA				
Kazakhstan(1992-2000)	7	60	253.72	-81.27
Kyrgyz Republic(1992-2000)	7	60	116.90	-97.11
Tajikistan (1992-2000)	10	40	57.85	-121.33
Turkmenistan (1992-2000)	10	25	57.92	-51.94
Uzbekistan (1992-2000)	10	45	151.47	-48.18
CENTRAL ASIA Average	**8.8**	**46**	**127.57**	**-79.97**

Table 1 Contributions to aggregate growth (continued)

Country (period with data available for all series)	Contributions to aggregate growth		Cum. Growth of Total Economy
	Private	State	
	(5)	(6)	(7)
SEE			
Albania (1991-2000)	100.64	-79.68	20.96
Bulgaria(1991-2000)	65.70	-67.21	-1.51
Macedonia(1991-2000)	47.81	-46.33	1.49
Romania(1991-2000)	46.59	-43.36	3.23
SEE Average	**65.18**	**-59.14**	**6.04**
CEE			
Croatia(1991-2000)	65.99	-53.39	12.60
Czech Republic (1993-2000)	67.81	-41.93	25.88
Hungary(1991-2000)	85.34	-58.01	27.33
Poland(1991-2000)	72.03	-25.50	46.52
Slovak Republic(1991-2000)	94.07	-72.12	21.94
Slovenia(1992-2000)	58.88	-16.30	42.58
CEE Average	**74.02**	**-44.54**	**29.48**
BALTIC			
Estonia(1991-2000)	97.12	-73.61	23.51
Latvia(1991-2000)	68.91	-87.54	-18.62
Lithuania(1991-2000)	68.43	-86.74	-18.31
BALTIC Average	**78.15**	**-82.63**	**-4.47**
CAUCASUS			
Armenia (1992-2000)	30.64	-48.33	-17.68
Azerbaijan (1992-2000)	42.09	-87.04	-44.94
Georgia (1992-2000)	40.73	-143.53	-102.80
CAUCASUS Average	**37.82**	**-92.97**	**-55.14**
CENTRAL CIS			
Belarus(1992-2000)	18.61	-12.82	5.80
Moldova(1992-2000)	26.46	-102.12	-75.65
Russia (1991-2000)	68.55	-87.05	-18.50
Ukraine(1992-2000)	40.52	-90.45	-49.93
CENTRAL CIS Average	**38.54**	**-73.11**	**-34.57**
CENTRAL ASIA			
Kazakhstan(1992-2000)	68.28	-63.05	5.23
Kyrgyz Republic(1992-2000)	48.29	-70.02	-21.73
Tajikistan (1992-2000)	24.08	-104.86	-80.78
Turkmenistan (1992-2000)	14.24	-47.95	-33.71
Uzbekistan (1992-2000)	40.36	-39.30	1.06
CENTRAL ASIA Average	**39.05**	**-65.04**	**-25.99**

While similar to the European transition performance in terms of the private sector development, the Baltic region proves closer to the formerly Soviet regions with respect to the state sector collapse (with an average cumulative decline of the state sector of –115% in the Baltic region, -115% in Caucasus and –146% in countries of Central CIS). For the countries in Central Asia, the data suggest an average cumulative decline of state activities (-80%) similar to the CEE region (-75%). However, as results in the following section reveal, similar cumulative state sector declines across regions in Europe and the former USSR originate in different reasons.

It is interesting to note that the cumulative aggregate growth for the Baltic countries (of -4.47%), when compared to the CEE countries (29%), is the net result of a stronger average cumulative performance of the Baltic private sector, and a deeper decline of the state sector in the region. This observation is reinforced when we look at the calculated contributions to growth in columns (5) and (6) in Table 1 (second part). Based on the growth accounting exercise introduced above, contributions of the two sectors to aggregate growth are calculated by taking into account the relative sizes of the two sectors in the total economy. Given that the pre-transition share of the private sector in some countries was very small, it is possible that part of the rapid growth in the sector observed at the onset of transition is due to a size effect. For example, we see that the total cumulative growth of 292% of the private sector in Albania translates to a total contribution of the sector to the aggregate growth of 100%, due to the fact that Albania started the transition with a tiny private sector (5%) that developed as the transition unfolded (in year 2000, the proportion of private sector activities in the economy reached 75%). Controlling for the size effects also reveals similar contributions of private sector development to aggregate growth across regions previously part of the USSR (with the exception of Baltic countries). Central CIS, Central Asia and Caucasus countries record, on average, a cumulative contribution of private sector growth to total growth of approximately 38%.

In general, from the cumulative aggregate growth data averaged across regions (column (7) in the table), we see that the private sector development more than compensated for the decline of the state sector only in the CEE and SEE regions. The former Soviet republics are yet to recover the lost output, either because of a strong decline of the state sector (as in the Baltic countries), or the weak performance of the private sector (as in Central Asia), or both (as in the remaining formerly Soviet regions).

The calculated growth rates for the private and state sector reported in Appendix 2 substantiate the picture provided by the average cumulative data in several respects. A continuous decline of the state sector, at least during the first 4-5 years of transition, is observed in all countries, and for a longer period in most transition countries. An exception is Belarus that, after an initial decline that lasted during the first 4 years of transition, sheltered its state sector during the second half of transition. Country growth rates for the private sector suggest that in all former Soviet republics (Baltic countries included), the private sector recorded negative growth in the first year of transition, with the exception of Belarus, Kazakhstan and Kyrgyzstan. For a few following years we note that negative developments in the private sector continued in the war-torn countries in Caucasus, but a (sometimes strong) revival of the private sector in the other former Soviet republics ensued after the initial decline. For the CEE and SEE regions the evidence reveals a growing private sector immediately after the demise of the communist regimes, with the exception of Albania that recorded a decline in private sector activities in 1991. After a decade of transition, most of the post-communist countries reached the stage where both sectors move in the same direction. In year 1999, the state sector was growing in most countries, except Bulgaria, Croatia, Czech Republic, Estonia, Kazakhstan, Lithuania and Slovenia, where the decline of state activities continued. In the following year all of these countries registered positive developments in the state sector as well.

The decomposition of aggregate growth into the two components can also be used to analyze whether there is (at least roughly) a common threshold that needs to be reached by the private sector before we can observe positive aggregate growth. Inorder to see what this hypothesis implies, given the observed developments in the state sector, consider the following inference based on the decomposition of growth rates as following:

$$\Delta_{(\%)} y_t = \alpha_{t/t-1} \Delta_{(\%)} y_t^P + (1-\alpha_{t/t-1}) \Delta_{(\%)} y_t^S$$

Assume that in the relationship above we have: $\Delta_{(\%)} y_t^P > 0$ and $\Delta_{(\%)} y_t^S < 0$. We can then derive the extent to which, given the decline in the state sector and the relative size of the two sectors, the private sector needs to grow such that the aggregate growth is non-negative as given by the inequality:

$$\Delta_{(\%)} y_t^P \geq \frac{1-\alpha_{t/t-1}}{\alpha_{t/t-1}}(-\Delta_{(\%)} y_t^S)$$

with: $\frac{d\left((1-\alpha_{t/t-1})/\alpha_{t/t-1}\right)}{d\alpha_{t/t-1}} < 0$

The inequality above basically formalizes the prior expectation that, given the decline in the state sector, growth generated in the private sector needs to be higher when the relative size of the sector is small. And the deeper the decline in the state sector, the higher the growth in private sector needed to compensate for it. For an average share of 40% of the private sector in total economy, the growth in the private sector needs to be 1.5 times higher than the decline in the state sector in absolute value. However, at initial stages of transition, when the share of the private sector was approximately 10% in many of the post-communist countries, the necessary growth in the private sector should have been 9 times higher than the (negative) growth in the state sector, in absolute terms. When applying this inference to the observed data, I find little preliminary support for the hypothesis of a common threshold of private sector development across regions. In Albania, for example, private sector development more than compensated for the decline in the state sector ever since 1992, when the private sector size was at an average of 7.5% of the total economy. In that year, private sector growth in Albania was 12.4 times higher than the corresponding decline in the state sector (in absolute value). For the other SEE countries, the average private sector size when the aggregate positive growth was observed was of approximately 32.5%; for the CEE countries (with the exception of Czech Republic, where data for initial years are not available) the corresponding average size of the private sector was 36.5%. In the former Soviet regions, positive aggregate growth is reached at an average size of the private sector of 48% in the economy in the Baltic region, and of 30% in the Caucasus region. For the other regions it is difficult to come up with an average as the developments differ significantly among countries.

However, such preliminary observations do not shed much light on why the post-communist countries recorded such different aggregate economic performance during the transition period under consideration. As the already existing literature emphasizes, there is much to be learnt from analyzing the relative importance of the economic legacy of communism as well as subsequent policy developments during the transition period. In the next sub-section I relate the developments in the private and state sectors, as derived above, to initial conditions, changes in macroeconomic conditions, changes in policy measures with economic reforms, as well as changes in the political and regulatory institutions.

IV.2 An empirical model of transition

In what follows the methodology of path analysis is used to gradually build a simultaneous equation system of transition. Because it is difficult to handle such a model with all variables included at once, I structure the process of model building in six main steps.

In **Step_1** a basic set-up focuses on the re-allocation of labor and capital from the state sector to the private sector as triggered by the process of transformations (privatization and restructuring) of enterprises in the state sector. The base model is specified to connect the observed economic performances in the private and state sector, as reflected by the growth rates calculated in the previous sub-section, to initial conditions, the process of enterprise sector transformation (including privatization and incentives to restructure) and changes in employment in the two sectors. The model in Step_1 is then extended, in **Step_2**, by including measures with liberalization of prices, trade and foreign exchange. Direct effects from economic liberalization to growth in the two sectors are complemented with corresponding indirect effects, under the assumption that initial reforms with prices and trade stimulated the transformation of the enterprise sector and the migration of labor from the state owned enterprises to the private sector. Links from initial conditions to reforms are also considered. In **Step_3** effects of reforms in the financial sector on growth in the two sectors, as well as interactions between financial sector liberalization and the other structural reforms already present in the model are tested for. In the following three steps the model is complemented with institutional variables representing developments in the administrative and judicial system, corruption and the political environment as following: in **Step_4** the analysis of institutions commences with the inclusion of an index of property rights that is meant to proxy the changes in the administrative and judicial system; **Step_5** considers changes in political environment, and in **Step_6** the final specification of the model is obtained by including a measure of changes in corruption during the transition process.

With the exception of the measures for initial conditions, the analysis focuses on the effects of *changes* in the measures of economic policies, structural reforms and institutions, as well as on changes in economic performance (as represented by growth rates for each of the two sectors). The maintained hypothesis is that the progress with economic liberalization, structural reforms and institutional developments take a transition economy to a higher level of development but, once the transformation process is completed and institutions built, further growth would be generated by accumulation of resources and technological progress. Consider a very stylized formalization of this argument[2]. With a Cobb-Douglas type of technology, define the output in one sector as given by:

$$y_{t,s} = A_t K_{t,s}^{\delta} L_{t,s}^{\beta}, \ s = state,\ private$$

where the term A_t captures the current state of economic liberalization, structural reforms and institutions in the economy. The growth in the sector (in percentage terms) is then the net result of changes in the three main factors:

$$\Delta_{(\%)} y_{t/t-1} = \Delta_{(\%)} A_{t/t-1} + \delta \cdot \Delta_{(\%)} K_{t/t-1} + \beta \cdot \Delta_{(\%)} L_{t/t-1}$$

where:

$\Delta_{(\%)} y_{t/t-1} =$ growth in (real) value added in the sector

$\Delta_{(\%)} A_{t/t-1} =$ changes in structural reforms and institutions

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[2] For the sake of argument simplicity I abstract from the issue of technological process.

$\Delta_{(\%)}K_{t/t-1}$ = investments in fixed capital

$\Delta_{(\%)}L_{t/t-1}$ = changes in the labor input

In an ideal situation, once the implementation of reforms and the process of institution building are completed, the term $\Delta_{(\%)}A_{t/t-1}$ becomes negligible, such that the main sources of growth reside in the classical accumulation of factors (and in technological progress if we extend the argument further). Therefore, during the transition process, changes in the measures of structural adjustment and institutional developments have a potentially significant role to play in enhancing the economic performance in the post-communist countries.

From the empirical perspective, it is important to recognize that a particular model obtained at each stage is the result of a testing procedure of nested models that takes into account both the statistical significance of the parameter estimates obtained, as well as the overall fit of the model. As it shall be described when a particular model is introduced, the initial, most general, specification follows the logic embedded in the conceptual model of transition described at the beginning of this sections and it is, therefore, less data driven. From this perspective, the overriding objective of the study is not a perfect prediction of growth rates in the two sectors, but the analysis of the relative importance of effects of the specific explanatory factors considered. For presentation purposes intermediate results for *each step* are not reported, although comments on early specifications are inserted in the text. The reported results in each step correspond to what I found to be the most satisfactory empirical construct in terms of the quality of the parameter estimates, as well as the overall fit of the model.

The estimation method used for all the models presented in this section is the SEM variant of full information maximum likelihood (FIML). As described in Study I of this thesis, apart from the empirical advantage in terms of full-system estimation, the SEM variant of FIML allows for an efficient use of the available data points. As I proceed with the analysis, the method proves most useful in the later stages, when the institutional variables are included. When considering the sensitivity of estimated results to outliers, I consistently find problems generated by the observations corresponding to the first year of transition for Albania, Armenia, Belarus and Romania. Although the parameter estimates are not significantly affected (in terms of statistical significance or sign), the presence of outliers distorts the overall fit of the models. The main reason detected for this effect of the outliers is that they induce a significant increase in the multivariate kurtosis of the data. Knowing that data in the first years of transition are of a very poor quality, and given that this problem occurred at each step, with no exception, I have chosen to eventually eliminate the four observations from the data set.

The data series used in this section corresponds to 24 post-communist countries[3], for the period starting with the first year of transition (which is country specific[4]) and until year 2000.

STEP_1: The Base Model

In a **first step** of model building, consider the mechanism of resource reallocation between the state sector and the private sector, as resulting from the process of enterprise sector transformation (triggered by privatization, restructuring and improved competition policy) and the migration of labor between the two sectors. Changes in enterprise sector transformation are calculated based on the corresponding latent factor (NENTREF) estimated in Study I. The latent factor NENTREF in the first study is estimated as a linear combination of observed measures on small – scale and large – scale privatization, competition policy and the hardening of budget constraints. Confirmatory factor analysis, on which the estimation of the factor is based, reveals a high validity of the observed measures employed, such that it induces confidence in the estimated construct. In the current analysis, changes in the estimated scores of NENTREF are represented by the variable **CENTREF**, meant to reflect the dynamics of the implemented policies with privatization and the elimination of the soft budget constraints.

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[3] I excluded Tajikistan from the analysis, as the missing data problem is severe for this country.
[4] See Study 1, Appendix I.

Changes in the hardening of budget constraints and enterprise privatization are expected to be positively associated with the private sector development, and to have a negative direct effect on the growth in the state sector. At the very least, the process of privatization entails an 'accounting' transfer of capital and labor in that, once privatized, an enterprise would then be accounted for as part of the private sector. An additional, and real, positive effect of enterprise sector transformation on the private sector development is to be expected with the imposition of hard budget constraints to the SOEs and to the newly privatized enterprises. As summarized in Havrylyshyn and McGettigan(1999), some of the existing empirical evidence suggests that, on average, the performance of the privatized enterprises is superior to the economic results of the SOEs' activities. The evidence is, however, not fully conclusive as the enhanced economic results of the privatized firms appear to be a function of the privatization method rather than an automatic consequence of the privatization process itself[5]. For the state sector, it is even more difficult to define a prior on the net direct effect of CENTREF on its economic performance: the 'accounting' effect would induce an observed reduction of the state sector growth, but the possible effect of the hardened budget constraints is mixed. To the extent that enterprises restructured rather than collapsed in the aftermath of the elimination of soft budget constraints, the observed effect on their economic results should be positive. The available evidence summarized in the two studies mentioned above suggests, however, that deep restructuring before privatization was an exception (such as in Poland) rather than the rule, which makes it more likely that the effect of CENTREF on the state sector growth is negative, due to the effects of privatization and the closure of SOEs that could not survive the tight budget policies, if implemented.

Lagged effects of the reform measures in the enterprise sector are also included in the model, in the form of a cumulative index of changes in enterprise sector scores over the previous years of transition (**CCENTREF**). When constructing the measure of cumulative reforms I rely on the assumption that effects of changes in reforms carry over the next years but they diminish in time. In order to illustrate the construction of

[5] See Djankov and Murrell(2002) for a survey of empirical results on restructuring and privatization

the variables of cumulative past changes in reforms used in the current analysis, consider ΔR_t as representing the change in a generic index of reforms R (initiated in the first year of transition) at time t, relative to the previous period (t-1). If we denote the first year of transition as Year1, then the cumulative index of previous changes in reforms is calculated based on the following scheme:

R_1	ΔR_2	ΔR_3	ΔR_4	$\cdots$	ΔR_{t-1}	ΔR_t
Year1	*Year2*	*Year3*	*Year4*	…	*Year(t-1)*	*Year(t)*

The contemporaneous change in reforms at time t is given by ΔR_t, while the cumulative level of past changes in reforms (since the beginning of transition) is calculated as:

$$C\Delta R_t = \frac{R_1}{t-1} + \frac{\Delta R_2}{t-2} + \frac{\Delta R_3}{t-3} + \frac{\Delta R_4}{t-4} + ... + \frac{\Delta R_{t-1}}{1} = \frac{R_1}{t-1} + \sum_{j=2}^{t-1} \frac{\Delta R_j}{t-j}$$

Note that different weights are assigned to past changes in reforms, with the more recent changes assumed to have a relatively higher impact. The effects of reform changes initiated at the beginning of transition are assumed to dissipate through time, as transition unfolds. This is consistent with the view that, if the reform process has been completed in early stages of transition, the contemporaneous growth in later stages would be less affected by reform changes implemented in the distant past. However, from the levels perspective of economic development, an advanced reformer would produce a higher level of output, relative to economies with a slow reform progress. From this respect, I depart from the traditional way of including cumulative reform changes, based on the index constructed in De Melo, Denizer et al(1996), that assigns equal weights to all incremental past steps of the reform process. The measure CCENTREF reflects more the recent past changes in reforms, with less emphasis on reforms implemented in the distant past. It thus have the potential to reflect reversals of reforms more adequately, when comparisons across time and between countries are made but, as with the De Melo, Denizer et al(1996) index, it does not solve the problem fully. The current version of cumulative reforms does not aim to reflect the speed of reforms by itself. In this respect, I approach the issue of speed of reforms in an alternative way, as inferences on the speed of reforms are drawn when corroborating the effects estimated for cumulative past changes with (specific) reforms with contemporaneous changes in (other) reforms, and also with the knowledge on the timing of specific reforms.

Labor reallocation from the state sector to the private sector is included in the analysis in the form of (percentage) changes in employment in the private sector (**CHEMPRIV**) and in the state sector (**CHEMSTAT**). Both variables on percentage changes in employment in the two sectors are constructed based on the annual levels of employment in the state and the private sectors, as reported in the IMF country studies[6]. The series are then corroborated and complemented, whenever possible, with the EBRD data on the share of private sector employment in total employment, as reported in EBRD(2001).

There are several conceivable ways in which observed changes in employment in the two sectors can be related to the contemporaneous growth of the state and the private activities. The 'accounting' effect discussed for the changes in enterprise reforms also applies to changes in employment, in that the employees of a state – owned enterprise would be accounted for as employees in the private sector, once the enterprise is privatized. Such an effect would be observed if the newly privatized enterprises did not significantly dismiss labor immediately after privatization. In order to capture the 'accounting' effect on employment, indirect paths from variables of enterprise sector transformation to growth in the two sectors, via changes in employment, are specified. Furthermore, from the evidence summarized in Boeri(2000), we learn that labor separation from the state sector also happened on a voluntary basis, rather than through layoffs. A direct path from CHEMSTAT to CHEMPRIV is specified in order to separate the effect of privatization on changes in employment from the observed increases in private sector employment as a result of voluntary quits in the state sector. Finally, changes in state sector employment are also linked directly to the measure of growth in the private sector, in order to account for the possibility of labor re-allocation that is not officially accounted for in private employment data. The 'residual' effect of changes in private sector employment on private sector growth, obtained after

[6] See the online IMF statistical appendices for transition economies, various issues.

controlling for the influences of privatization and voluntary transfers from the state sector, is meant to capture the influence of market driven changes in official private employment.

The model in this step also includes measures of initial conditions. In this respect, I focus on individual indicators that represent structural economic imbalances inherited from the pre-transition period. Consistent with the results reported in the empirical literature on transition, a common assumption on the role of initial conditions embedded in the model is that their effects on subsequent developments in the economy are stronger in the first years of transition, and that they weaken as transition unfolds. Therefore, for each indicator of initial conditions I construct a corresponding measure of decaying effects as following[7]:

$$IC_t = \frac{IC}{t^2}$$

where:
IC = one of the three indicators of initial conditions discussed below
t = the current transition year

A first indicator of initial conditions, **INSHARE**, is based on a measure of the share of the private sector in total economy in the year immediately preceding the first year of transition. Annual indicators of private sector shares in total economy for transition economies, for the period 1989-2001, are reported in EBRD(2001) and they represent the IMF estimates for the period 1989-1993, and EBRD estimates for the following years. There are two main purposes for including a measure of the initial private sector share. First, I attempt to control for size effects on private sector growth. As explained in sub-section IV.1, it is possible that the observed initial high growth rates of the private sector in some of the post-communist countries reflect more the initial absence, or a very small size, of the private sector, rather than being driven by the implemented economic reforms. I assume, however, that if there is a size effect on growth, then its influence on subsequent growth in the private sector diminishes in time, as the private sector grows and the economy restructures. Second, I explore the

[7] Alternative measures of decaying effects along a linear or cubic path have also been tested, but the quadratic measure above seemed to perform best.

possibility that the existence of a larger private sector at the start of transition helped initiating reforms and institutional changes earlier in transition.

A second indicator of initial conditions, **INLIB**, represents the extent to which economic liberalization had been implemented during the communist regime[8]. As explained in the first study, countries such as Hungary and former Yugoslavia and Poland experimented with reforms long before transition started. Pre-transition economic liberalization had also been experimented with in Poland and in the former USSR during the 1980s. The inclusion of the variable INLIB in the model has a dual purpose. In line with arguments introduced in the models of disorganization in the economy state enterprises in countries that had experienced reforms during the communist regime are expected to be able to cope with the initial transition-related disruptions better. More autonomy assigned by the communist regimes to the SOEs meant they were less dependent on the central planner for establishing relationships with customers and suppliers, when compared to countries where central planning was pervasive. Furthermore, in countries such as Hungary, decentralization of economic activity also meant that enterprise managers had weaker incentives (if at all) to over-report output, thus contributing to higher observed initial growth rates of the state sector. It is therefore possible that an observed smaller decline in output is actually partly due to better quality data. Unfortunately, there is no way I can distinguish between the two effects.

A similar argument on the SOEs ability to cope with economic liberalization at the onset of transition is advanced in relation to the dependency on CMEA trade, **CMEA**, introduced as a third indicator for inherited structural imbalances. The extent of CMEA involvement, expressed as the share of a country trade with its CMEA partners in total GDP, is expected to be negatively associated with the economic developments in the state sector. As with the indicator INSHARE, the effects of INLIB and CMEA are assumed to weaken over time.

Additional variables meant to partly explain the variance in economic performances in the two sectors include a dummy variable for War and Conflicts, and a measure of annual inflation. The latter is meant to proxy the stabilization policies. The

[8] The indicator is introduced in Study 1, Section II.1 in this thesis.

variable of inflation, **INF**, is constructed such that it reflects the hypothesis of a kinked effect of inflation on growth. In accordance with the results reported in Christoffersen and Doyle(1998), the indicator INF is constructed based on the following relationship:

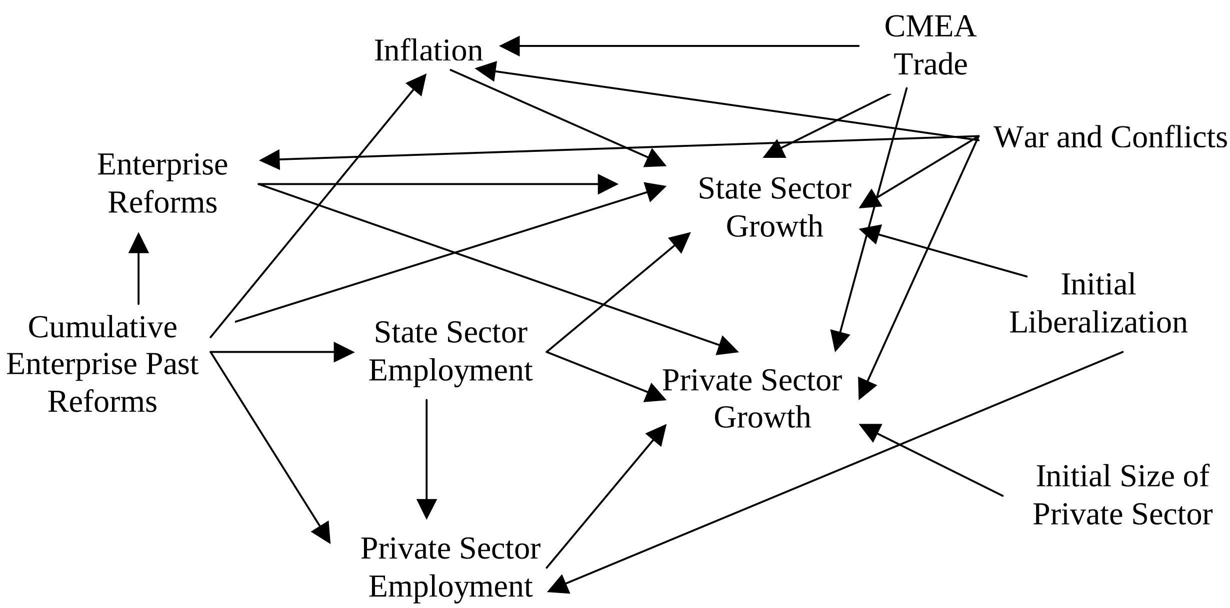
$$INF_t = \begin{cases} \ln(AnInf_t) & if \quad AnInf_t > 13\% \\ 0 & otherwise \end{cases}$$

where:

$AnInf_t =$ the annual rate of inflation at time t

The final specification obtained for the base model in this first step of the analysis is schematically represented in the diagram in Figure 2.

Figure 2: The model in Step_1



The exogenous variables in the model are the three indicators of initial conditions, and War and Conflicts. The only predetermined variable considered at this stage is the Cumulative Enterprise Past Reforms. Note that, as discussed above, all the variables actually represent percentage changes in the indicators included in the diagram (with the exception of the exogenous variables).

The standardized estimated path weights, together with the associated critical ratios, are reported in Table 2 below for all equations corresponding to the endogenous variables in the system. The variable GRPRIV and GRSTAT represent the growth rates of GDP per capita in PPP terms in the two sectors (private and state). For easy reference, a summary of the names, meaning and sources of the variables employed in the analysis is included in Appendix 1. Descriptive statistics, correlations between the observed variables in the system, and the extent of missing data are reported in Appendix 3. For the sake of simplicity in the main text, the model equations and the non-standardized parameter estimates (with the corresponding standard errors) are also included in the appendix.

Table 2 Standardized parameter estimates of direct effects in Step_1

	GRPRIV	GRSTATE	CHEMPRIV	CHEMSTAT	CENTREF	INF
	(1)	(2)	(3)	(4)	(5)	(6)
War and Conflicts	-0.200 (-3.334)	-0.298 (-5.089)			-0.079 (-1.150)	0.134 (2.221)
INSHARE	0.095 (0.589)					
INLIB		0.136 (2.190)	0.233 (3.339)			
CMEA	-0.232 (-2.362)	-0.251 (-3.671)				0.259 (3.874)
CHEMPRIV	0.226 (2.921)					
CHEMSTAT	-0.190 (-2.438)	0.161 (2.433)	-0.553 (-8.354)			
CENTREF	0.353 (6.194)	-0.386 (-6.962)				
CCENTREF		-0.200 (-2.950)	-0.218 (-3.080)	-0.186 (-2.345)	-0.190 (-2.775)	-0.254 (-3.772)
INF		-0.197 (-3.210)				
R-square	*0.325*	*0.346*	*0.383*	*0.034*	*0.034*	*0.250*

Model Fit Indices:
$\chi^2_{(df=22)}$=79.680 (p-value=0.000) Max. Sample Size (NxT): 227
RMSEA = 0.108 (p-value=0.000)
(see the appendix for more fit indices)

Note: Dependent variables in columns, and the explanatory variables in rows

The present model specification has been arrived at by hierarchical reduction of an initial, less restricted, model to more parsimonious, nested models. The procedure is based on both significance tests of individual paths in the model, as well as test on χ^2-differences of the nested models. Information in Table 2 reads as following: the columns represent the endogenous variables in the system, while the rows headings denote the explanatory variables. For example the cell (1,1) in the table, corresponding to the intersection of the first column (headed GRPRIV) with the first row (headed 'War and Conflicts'), includes the estimate of the direct effect associated with 'War and Conflicts' in the equation for GRPRIV. For an easy reading of the statistical significance of the parameter estimates, the corresponding critical ratios are reported in the parentheses. A critical ratio outside the interval $[-1.96, 1.96]$ reveals statistical significance of the effect at the 0.05 level. The parameter estimates obtained largely confirm the priors on the expected direct effects discussed earlier.

When considering the equations (1) and (2), for the developments in the two sectors (GRPRIV and GRSTAT), worse economic performance is found to be associated with War and Conflicts, and the dependence on CMEA trade. While the direct effect estimated for the CMEA dependence on the state sector meets the hypothesis advanced in transition literature, the corresponding significant direct effect on private sector growth comes in as a surprise, in that it suggests that the breakup of CMEA possibly affected not only the activity of SOEs, but also the emerging private sector activities. When comparing the two effects, the impact of CMEA dissolution appears to be higher for the state sector, than for the private sector. In terms of initial conditions, activity in the state sector is estimated as positively associated with initial level of liberalization (INLIB). As initially postulated, the more initial experience with reforms a country has, the lower the (transition-related) collapse of the state sector. Changes in employment are significantly related to growth rates in the two sectors, and in the expected directions. Positive developments in the private sector are associated with increases in private sector employment, and reductions in the state sector employment. The persistent statistical significance of the direct effect of changes in state sector employment on GRPRIV, even when controlling for the effects of privatization and restructuring, as well as for the mediation effect of increases in private sector employment, suggests the possibility that the migration of labor from the state sector to the private sector may not be completely captured by the observed changes in official private sector employment. A possible explanation for this effect is the existence of an unofficial labor market. Anecdotic evidence on transition economies suggests that, due to high levels of labor taxation, private firms do not fully declare the actual level of employment. Furthermore, detailed analyses of labor reallocation during transition (Boeri and Martins(2000), Boeri and Terrell(2002)) reveal important flows from state sector employment directly out of the labor force. As it is difficult to believe that people in transition can survive without working, this result corroborates with the anecdotic evidence on unofficial private employment.

Contemporaneous implementation of reforms in the enterprise sector is estimated as positively related to private sector growth, and negatively associated with state sector developments. Given that in most countries the growth rates for the state sector are negative, the corresponding direct effect of enterprise sector transformation suggests that the observed output collapse in the state sector is indeed partly associated with privatization and restructuring. The effect of changes with reforms in the enterprise sector on private sector development is estimated to be positive and statistically significant. Cumulative past changes in enterprise reforms have a negative and statistically significant direct effect on the state sector performance, but no statistically significant effect is found on the private sector.

Finally, the usual negative effect of inflation is estimated on economic activity. However, the model suggests that, while having adverse effects on the activity in the state sector, high levels of inflation do not appear to have affected the expansion of the private sector.

The remaining equations in the model help us understand the indirect effects that the explanatory variables have on the private, and respectively on the state, sector activities. We see that, apart from its estimated direct effect, there is also an indirect effect of War and Conflicts on the state sector through its influence on inflation (eq. (6)). Similarly, significant indirect effects are found for the cumulative changes in reforms on the state sector via the effects mediated by changes in state sector employment (eq. (4)) and by inflation (eq(6)). Together with the corresponding direct effects, the estimated results reveal that privatization and hardening of budget constraints also have indirect contemporaneous and lagged effects on the state sector. It is interesting though that contemporaneous reforms in the enterprise sector are not significantly related to contemporaneous changes in employment. Significant effects are found only for lagged reforms, as represented by the cumulative index CCENTREF, suggesting delayed effects in terms of labor releases in the state sector as a result of privatization and restructuring (eq. (3) and (4)).

A direct effect is estimated from changes in employment in the state sector to changes in private sector employment, thus indicating labor re-allocation between the two sectors. No effect is found from changes in enterprise sector reforms to the measure of employment in the private sector at this stage in the analysis.

The negative 'effect' of CCENTREF on CENTREF does not really tell us much more than the fact that, if a country implemented more aggressive reforms in the recent past, then the contemporaneous observed changes in the same reforms would be small. It could be partly interpreted as reflecting 'waves' of the privatization process, but the interpretation cannot go too far as there is a limited scope to which reforms can be fully implemented.

The overall poor model fit, together with an estimated statistically significant covariance between the residuals in the GRPRIV and GRSTAT equations, suggests there are potentially important factors missing from the analysis. Given I could not improve the model fit without relying on rather ad-hoc assumptions on the error structure in the model, I therefore proceed with the next step of the analysis, by including measures of price and trade liberalization as additional explanatory factors in the model.

Step_2 Adding Price, Trade and Foreign Exchange Liberalization

In a second stage, the model is extended by adding measures of changes in reforms with price liberalization, trade liberalization and unrestricted legitimate access to foreign currencies. For this purpose I rely on the two EBRD indices of price liberalization, and of foreign exchange and trade liberalization respectively. In order to ensure scale comparability with the other indicators in the model, I normalize the two EBRD indicators in $[0,1]$, and then multiply the resulting scores by 100. This transformation allows for the direct interpretation of changes in the two reform measures in terms of percentages. A score of 0 for the index of price liberalization represents cases where the government controls most prices, while the maximum value of 100 is assigned to countries where comprehensive price liberalization has been adopted, together with ‘efficiency -enhancing regulation of utility prices’ (EBRD(2001)). The minimum value of 0 for the index of trade and foreign exchange liberalization corresponds to situations of pervasive import and/or export controls, and very limited official access to foreign exchange. When most trade tariffs have been removed and WTO compliance is formally the norm in trade activities, the maximum value of 100 is assigned.

The two transformed EBRD indices on economic liberalization are used to construct four measures of changes in economic liberalization. Contemporaneous changes in economic liberalization, denoted **CPRICE** and **CTRADE**, are calculated as the differences in score for the current year t, relative to the previous year. Cumulative past changes in economic liberalization, since the start of transition, are captured by **CCPRICE** and **CCTRADE** constructed according to the scheme presented in Step_1.

Contemporaneous and lagged changes liberalization of prices and trade regulations are expected to affect the economic activity in both sectors, state and private. Much in the spirit of the model in Blanchard and Kremer(1997), disorganization effects of price liberalization on the state sector would be reflected in a negative path coefficient from the measures of changes in price liberalization (both contemporaneous and lagged) to the growth of the state sector. While economic liberalization imposed significant pressures on the activity of the SOEs, the private sector is expected to benefit in the aftermath of price and trade liberalization, if only due to ensuing increased business opportunities. A derivative effect of economic liberalization is also expected in relation to the decisions to privatize and restructure the enterprise sector. As long as SOEs where sheltered from market competition through controlled prices and/or limiting regulation of international trade, it is to be expected that incentives to privatize and/or restructure were kept low. With economic liberalization, at least some of the existing SOEs could hardly cope with the associated increasing efficiency – related pressures, such that the only viable options were privatization and/or restructuring, or closure.

Table 3 illustrates the standardized path weights, and their corresponding critical ratios, representing the direct effects found to be statistically significant in the model. Data description in terms of descriptive statistics, degree of missing data and correlations with the other variables included in the model for the measures employed to represent changes in economic liberalization are included in Appendix 4. The equations of the model specification discussed in this Step, together with the non-standardized parameter estimates and their corresponding standard errors, are also included in the appendix.

The parameter estimates obtained in this Step largely confirm the preliminary estimates found in Step_1, with one exception. First, note that the measure of cumulative past changes in trade regulations is absent from the list of explanatory variable. I decided to eventually exclude it altogether as no statistically significant effect was found in any stage of the analysis.

In equation (1) for private sector growth, similar significant effects, and in the same direction, for initial conditions (INSHARE and CMEA), War and conflicts, changes in employment (state and private) and contemporaneous changes in enterprise transformation are found as in Step_1. Among the measures of economic liberalization newly introduced, a statistically significant and positive effect is estimated from contemporaneous changes in price liberalization. No statistically significant direct effects from the other two measures of economic liberalization are detected.

Developments in the state sector (eq (2)) are significantly, and negatively, related with contemporaneous changes in price liberalization. The previously found effects on the state sector developments remain statistically significant in the model.

Contemporaneous and lagged changes in price liberalization are also negatively and significantly associated with changes in employment in the state sector (eq (4)), but no corresponding effects are found in relation to changes in private sector employment. An improvement in the fit of equation(4) is obtained after introducing the effects of price liberalization.

Table 3 Standardized parameter estimates of direct effects in Step_2

	GRPRIV	GRSTATE	CHEMPRIV	CHEMSTAT	CENTREF	INF	CPRICE	CTRADE
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
War and Conflicts	-0.232 (-4.217)	-0.270 (-4.785)			-0.231 (-4.229)			
INSHARE							0.213 (4.826)	
INLIB		0.257 (3.433)	0.301 (4.577)				0.546 (11.293)	0.491 (8.450)
CMEA	-0.240 (-3.814)	-0.199 (-2.875)				0.351 (5.462)		
CHEMPRIV	0.169 (2.141)							
CHEMSTAT	-0.192 (-2.594)	0.145 (2.135)	-0.459 (-7.150)					
CENTREF	0.273 (4.546)	-0.328 (-5.615)	0.171 (2.579)					
CCENTREF		-0.233 (-3.411)		-0.265 (-3.349)	-0.150 (-2.617)	-0.342 (-5.382)		
INF		-0.208 (-3.439)						
CPRICE	0.221 (3.210)	-0.273 (-3.398)		-0.408 (-4.939)	0.332 (4.488)			
CCPRICE				-0.306 (-3.840)	0.502 (8.573)	0.342 (5.899)	-0.226 (-5.808)	
CTRADE					0.318 (4.825)			
R-square	*0.396*	*0.397*	*0.426*	*0.200*	*0.432*	*0.336*	*0.582*	*0.241*

Model Fit Indices

$\chi^2_{(df=42)}$=89.103 (p-value=0.000) Max. Sample Size(NxT) = 227

RMSEA = 0.070 (p-value=0.050)

(see the appendix for more model fit indices)

Note: Dependent variables in columns, and the explanatory variables in rows

An interesting difference between estimated coefficients in the equation (3) for private sector employment consists of the fact that, with the introduction of measures of economic liberalization, the direct (negative) effect of cumulative reforms in the enterprise sector found in Step 1 *vanishes* in Step2, while being replaced by a positive and statistically significant direct effect from contemporaneous changes in enterprise transformation. The latter effect is more in line with the prior that enterprise sector transformation induces increases in employment in the private sector (as a result of both the ‘accounting’ effect, and also enterprise restructuring in the aftermath of the imposition of hard budget constraints).

The current model specification helps explaining the implemented changes in reforms with the enterprise sector to a much larger extent than the previous model. Statistically significant effects found between each of the three measures of (contemporaneous and lagged) changes in liberalization of prices and of contemporaneous changes in price liberalization indicate that countries that implemented more aggressive reforms with prices and trade are also more likely to undertake reforms with privatization and tight enterprise budget policies. Estimates in equations (7) and (8) for contemporaneous changes in price, trade and foreign exchange liberalization, on the other hand, reveal that more favorable initial conditions (in terms of a larger initial private sector and a higher degree of initial liberalization) made it more likely for the post-communist countries to engage in substantial liberalization of prices, trade and foreign exchange earlier in the process of transition.

In equation (6) for inflation the effect of War and Conflicts on inflation is rendered statistically insignificant by the introduction of the effect from cumulative changes in price liberalization. Recent elimination of price controls appears to induce higher contemporaneous levels of inflation.

Apart from differences already discussed above, the introduction of measures of changes in economic liberalization in the model also has the effect of changing the magnitude of some of the previously found direct effects. In equation (1) for example, note that the initially found direct effect of CENTREF on GRPRIV is depressed from the (non-standardized) level of 0.848 to 0.679, once the direct effect of changes in price liberalization is accounted for. Similarly, the effect of War and Conflicts in equation (5) on changes in enterprise reforms becomes statistically significant, and of a larger magnitude (the new non-standardized estimate is –7.609, compared to –2.556 found in Step_1) as a result of adding the effects of reforms with prices and trade.

In terms of the overall fit of the model, I find the current model specification as performing better than the previous model, especially as reflected by the index of RMSEA (0.070), which indicates a good fit for the model. Improvements in the model fit are also signaled by the other overall model fit indices reported in the appendix.

In the next step of the analysis I analyze the changes in parameter estimates, as well as new possible effects, obtained as a result of adding measures of changes in reforms in the financial sector to the model.

Step_3 Adding Financial Sector Reforms

Another type of indicators of economic reforms[9] implemented during transition focuses on the changes in regulations in the financial sector. The two measures of contemporaneous (**CFINANCE**) and cumulative past changes (**CCFINANCE**) in financial sector reforms are constructed based on the latent factor of financial sector reforms (NFINANCE) estimated in the first study in this thesis. As discussed in Study 1, the latent factor of financial sector reforms combines information on liberalization of interest rates, government ownership of banks, competitive conditions and restrictions imposed on foreign entry in the banking sector, the extent of directed credits, diversity of financial services provided by banks, regulations and prudential supervision instituted in the banking sector, and the reforms of securities markets and non-bank financial institutions (such as insurance companies, investment funds, pension funds etc). Based on confirmatory factor analysis, I found a high degree of validity of the observed measures used for estimating the latent factor of financial sector reforms, which justifies its use in the current analysis. As with the case of reforms previously introduced in the model, I employ the information comprised in the latent factor NFINANCE in the form of contemporaneous changes in the estimated scores, and a measure of cumulative past changes in financial sector regulations.

[9] The measure of reforms in the financial sector also has an institutional nature to a large extent, as regulations and supervision in the banking sector are more of economic institutions than reforms.

While there is very little empirical work that relates developments in the financial sector to growth in transition economies, there is a considerable amount of descriptive studies that reveal the developments in the financial systems, and more specifically the banking sector, in the post-communist countries during the transition period[10]. What the literature conveys is that most of transition countries inherited a one-tier bank system from the central planning, and started the journey of transition with financial systems that were underdeveloped and heavily dominated by state-owned financial institutions. As transition unfolded, absence of restructuring of the state – owned enterprises found its counterpart in pervasive non-performing loans in the banks, that were being used by the government as alternative means for advancing disguised subsidies to the SOEs. A political decision to improve regulations in the financial system and allow for building up a competitive environment is expected to reduce and /or eliminate adverse bank incentives to support the failing SOEs, and thus stimulate the process of enterprise sector transformation by further hardening the budget constraints for the state-owned productive units. A positive influence of financial sector reforms on private sector developments is also to be expected, to the extent that bank restructuring and development of stock markets enabled better financial intermediation in the economy.

As an alternative measure used to capture the role of the financial system in enabling growth in private sector an attempt has been made to use the traditional indicator of the share of credit to the private sector in total GDP, but no significant results have been obtained. This is in line with alternative attempts mentioned in other empirical studies in transition[11].

The estimated results corresponding to the model specification obtained in the current step are inserted in Table 4 below.

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[10] See EBRD(1998) for a comparative descriptive analysis of developments in the financial sector of transition economies. Extensive discussions on restructuring the banking sector and developments with stock markets are to be found in Scholtens(2000), Rockinger and Urga(2000), Hermes and Lensink(2000), Doukas, Murinde et al(1998), Dittus(1994), Claessens, Djankov et al(2000), Bonin, Miszei et al(1998) and Anderson and Kegels(1998).

[11] The absence of a significant relationship between credit measures and growth in the economy is most probably one of the reasons why the empirical literature on growth during transition is silent on the role of financial systems.

Table 4 Standardized parameter estimates of direct effects in Step_3

	GRPRIV	GRSTATE	CHEMPRIV	CHEMSTAT	CENTREF	INF	CPRICE	CTRADE	CFINANCE
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
War and Conflicts	-0.221 (-4.050)	-0.257 (-4.606)			-0.149 (-2.681)				-0.252 (-3.916)
INSHARE							0.213 (4.825)		
INLIB		0.272 (3.680)	0.301 (4.566)				0.546 (11.291)	0.491 (8.450)	
CMEA	-0.248 (-4.009)	-0.202 (-2.957)				0.351 (5.462)			
CHEMPRIV	0.168 (2.171)								
CHEMSTAT	-0.173 (-2.370)	0.146 (2.176)	-0.456 (-7.104)						
CENTREF	0.185 (2.774)	-0.268 (-4.195)	0.171 (2.564)						
CCENTREF		-0.076 (-2.370)		-0.266 (-3.339)	-0.339 (-4.086)	-0.342 (-5.89)			
INF		-0.207 (-3.423)							0.202 (3.163)
CPRCE	0.176 (2.551)	-0.317 (-3.836)		-0.407 (-4.901)	0.153 (1.866)				0.568 (8.144)
CCPRICE				-0.289 (-3.611)	0.252 (3.380)	0.342 (5.385)	-0.226 (-5.819)		0.474 (6.878)
CTRADE					0.327 (5.221)				
CFINANCE	0.203 (2.805)				0.263 (3.779)				
CCFINANCE		-0.216 (-2.131)			0.317 (3.312)				
R-square	*0.420*	*0.419*	*0.423*	*0.193*	*0.507*	*0.336*	*0.583*	*0.241*	*0.406*
Model Fit Indices: $\chi^2_{(df=57)}$=111.228 (p-value=0.000), RMSEA = 0.065 (p-value=0.085); Max. Sample Size(NxT) = 227									

Appendix 5 includes descriptive statistics for the two indicators on financial system reforms, correlations between them and the other variables included in the analysis, and the extent of missing data. Model equations, non-standardized parameter estimates, and their corresponding standard errors, are also to be found in the appendix.

In equation(1), I find a statistically significant direct effect from contemporaneous changes in financial reforms on growth in the private sector. Moreover, the introduction of the financial indicator has the effect of changing the relative importance of the already existing direct effects, as found in previous steps. If in Step_1, the largest effect on private expansion was found for contemporaneous changes in enterprise reforms, in the current model specification we see that part of that effect was actually capturing the positive influence of financial reforms.

When both variables CENTREF and CFINANCE are introduced simultaneously, we see that they are both statistically significant in explaining variations in private sector developments, with a relatively higher role attributed to financial sector reforms. The same applies to the direct effect estimated for contemporaneous changes in price liberalization. All the other previously found direct effects in equation(1) are largely the same.

State sector growth appears to be directly affected by lagged changes in reforms with the financial sector, suggesting a lagged effect of restructuring of the banking sector on the developments in the state productive sector. The effect is statistically significant and negative, as expected. When accounting for the effects of financial reforms, I find that the previously found direct effect of cumulative changes in past reforms in the enterprise sector is reduced to a very low level, although still statistically significant. The relative roles of the explanatory variables in equation (2) also change, in that price liberalization appears to affect activities of the state – owned units to a larger extent than the contemporaneous changes in enterprise reforms. When comparing the latter effect with the effect of financial reforms, I find that, although both statistically significant and of relatively large magnitudes, enterprise reforms display a larger contemporaneous effect relative to the financial reforms (in absolute terms).

Financial sector transformation also appears to have significant indirect effects on the two sectors, via the effects found on the contemporaneous changes in enterprise reforms. In equation (5), the estimated results indicate that a country that reforms its financial sector is also more likely to record a deeper enterprise sector transformation. Enterprise restructuring and privatization is positively influenced by both contemporaneous and lagged (cumulative) regulatory changes in the financial sector. The introduction of the two indicators of financial reforms in equation (5) has important consequences on the previously found effects: contemporaneous changes in enterprise reforms appear to be driven by past cumulative changes in those reforms to a larger extent than previously estimates, while the effect of contemporaneous changes in price liberalization is rendered statistically insignificant.

In equation (9), that has the contemporaneous changes in financial regulations as the dependent variable, a significant direct effect of changes in price liberalization (both contemporaneous and lagged) is estimated, thus suggesting that the previously found direct effect of contemporaneous changes in price liberalization on enterprise reforms is actually mediated by its effects on financial reforms. Financial reforms in equation(9) are also significantly linked to War and Conflicts, indicating that there has been little scope for such reforms during turbulent times. An interesting effect is detected between inflation and financial reforms, with the path being directed from inflation to CFINANCE. When testing for a link between the two indicators, I considered two alternative hypotheses: either improvements in financial regulations contribute to reductions in inflation levels, and/or, an alternative political economy argument, higher levels of inflation persuaded the government to put order in the financial sector. It is the second hypothesis that I find more consistent with the data in the current set-up of the model, in that the only significant direct effect was estimated from inflation to financial reforms.

For the model specification in Step_3, a slight but steady improvement in the overall model fit is estimated. The estimate obtained for the RMSEA index is 0.065, corresponding to a very good fit, and the probability of a close fit is 0.085. Additional overall fit indices reported in the appendix also support a good fit for the model.

If in the initial three steps of the analysis the focus is on the role of initial conditions and economic reforms in explaining economic developments in the state and the private sectors, during the following three steps in model building I additionally analyze the role of administrative and political institutions during the transition from central planning to a market system. The analysis of institutions proves more difficult in that there is little guidance provided by theoretical models (if any), and there are strong reasons to believe that 'causality' between institutions and economic development could run both ways. If the economists tend to emphasize the role of institutions in explaining differences in levels of economic developments across countries[12], an alternative hypothesis is found with political science, in that better institutions (and particular political institutions of democratic systems) are driven by superior economic development. In relation to developments in transition economies, additional arguments on the role of institutional environment can be conceived in that, if supported by a system with better institutions, governments in transition may be more inclined and find it easier to reform the economy. Therefore, the search for a model specification in next three steps started by testing the hypotheses of direct feedbacks between economic development indicators (GRPRIV and GRSTAT) and the respective variables that are meant to represent (or proxy) changes in administrative and political institutions. Results are presented only for the model specifications found to be most robust in the process of model building.

Step_4 Introducing the Judicial System and Protection of Property Rights

Developments in the judicial systems in the post-communist countries during the period under consideration are represented in the model by the indicator **CJUSTICE**, constructed based on the Heritage Foundation index of Property Rights Protection. The corresponding Heritage Foundation annual index combines information on government intervention and corruption in the judicial system, delays in receiving judicial decisions, the existence and use of a commercial code in defining contracts, government expropriation of private property, and legal guarantees and protection for private property. The original HF indicator is normalized in $[0,1]$, and then multiplied by 100, in order to allow for the interpretation of changes directly in percentage terms.

[12] See Hibbs(2000) for a discussion on the 'politicization of growth theory'.

According to the Heritage Foundation definition of the indicator, *lower* values of the index indicate *better* protection of private property. The resulting measure of property rights protection and quality of the judicial systems takes the minimum value of 0 for countries with efficient contract enforcement by courts and strong private property protection provided by the government. The maximum value of 100 is assigned to countries where private property is either not legally allowed, or not protected (due to chaos, war, endemic corruption in the judicial system). Consistent with the general view taken in the current analysis, the corresponding measure of annual changes in the degree of property rights protection and the quality of the judicial system (CJUSTICE) is then constructed.

The estimates obtained for the model specification arrived at in step_4 are presented in Table 5.

Note that negative values for changes in the property rights protection measure represent improvements in property rights protection and the quality of the judicial system. Descriptive statistics for CJUSTICE, and its correlations the other variables in the system are included in Appendix 6. In the appendix I also report the model equations and the non-standardized parameter estimates, together with their corresponding estimated standard errors.

As displayed in Table 5, the introduction of the measure of changes in the judicial system and property rights protection in equation(1) weakens the statistical significance of the direct effect of contemporaneous changes in price liberalization on growth in the private sector. The direct effect of contemporaneous changes in the functioning of courts and legal protection of private property appears to be weak, although with the expected sign. The effect is statistically significant at the level of 0.10%, and it suggests that improvements in the judicial systems and contract enforcement are positively correlated with economic growth of the private sector, although not in a very robust manner. When testing for the competing hypothesis that it is actually the development of the private sector that drives improvements in judicial institutions, no significant evidence was found to support the hypothesis. No other path from CJUSTICE to other variables in the model has been found statistically significant.

Table 5 Standardized parameter estimates of direct effects in Step_4

	GRPRIV	GRSTATE	CHEMPRIV	CHEMSTAT	CENTREF
	(1)	(2)	(3)	(4)	(5)
War and Conflicts	-0.235 (-4.300)	-0.251 (-4.536)			-0.147 (-2.648)
INSHARE					
INLIB		0.266 (3.57)	0.296 (4.545)		
CMEA	-0.265 (-4.249)	-0.193 (-2.841)			
CHEMPRIV	0.152 (1.963)				
CHEMSTAT	-0.189 (-2.610)	0.160 (2.426)	-0.460 (-7.376)		
CENTREF	0.181 (2.712)	-0.251 (-4.152)	0.179 (2.785)		
CCENTREF				-0.269 (-3.379)	-0.337 (-4.074)
INF		-0.197 (-3.330)			
CPRCE	0.145 (1.958)	-0.313 (-3.788)		-0.409 (-4.943)	0.153 (1.872)
CCPRICE				-0.286 (-3.582)	0.251 (3.364)
CTRADE					0.328 (5.229)
CFINANCE	0.194 (2.702)				0.263 (3.784)
CCFINANCE		-0.270 (-3.918)			0.315 (3.288)
CJUSTICE	-0.120 (-1.713)				
R-square	*0.430*	*0.419*	*0.429*	*0.194*	*0.507*

Note: Dependent variables in columns, and the explanatory variables in rows

Table 5 Standardized parameter estimates of direct effects in Step_4 (continued)

	INF	CPRICE	CTRADE	CFINANCE	CJUSTICE
	(6)	(7)	(8)	(9)	(10)
War and Conflicts				-0.254 (-3.928)	
INSHARE		0.213 (4.825)			
INLIB		0.546 (11.289)	0.491 (8.448)		-0.644 (-10.461)
CMEA	0.351 (5.461)				
CHEMPRIV					
CHEMSTAT					
CENTREF					
CCENTREF	-0.342 (-5.89)				0.173 (2.865)
INF				0.201 (3.132)	
CPRCE				0.563 (8.055)	
CCPRICE	0.342 (5.386)	-0.226 (-5.823)		0.478 (6.905)	
CTRADE					
CFINANCE					
CCFINANCE					
CJUSTICE					
R-square	*0.336*	*0.583*	*0.241*	*0.404*	*0.530*
Model Fit Indices: $\chi^2_{(df=70)}$=122.392 (p-value=0.000) RMSEA = 0.058 (p-value=0.222) *(see the appendix for other fit indices)* Max. Sample Size(NxT) = 227					

Note: Dependent variables in columns, and the explanatory variables in rows

In equation (10), with CJUSTICE as a dependent variable, I obtain significant paths from initial liberalization and cumulative past changes with reforms in the enterprise sector. The data therefore supports the hypothesis that countries with a higher initial level of economic liberalization are more likely to record positive developments in their judicial system. However, when looking at the data points for CJUSTICE across time and countries I notice it is more often the case that the indicator tells us that some transition economies registered negative developments in their judicial systems, in terms of poor contract enforcement and endemic corruption, and less corresponding improvements (that is, it is more often the case that the non-zero values for CJUSTICE are positive, rather than negative). Therefore, consistent with the evidence, the interpretation of the effect should actually emphasize the negative developments associated with worsening conditions in the judicial systems. Countries with a higher initial level of economic liberalization, and a strong transition history in terms of reforming the enterprise sector, are therefore less likely to record negative developments in their judicial system.

Despite the weak significance of CJUSTICE in equation (1), an improvement in the overall fit is obtained, as reflected by the probability value associated with the RMSEA index. The estimated value of the index is 0.058, suggesting a next to excellent overall fit, and the corresponding p-value is 0.222.

In this step I also experimented with the introduction of the twin Heritage Foundation indicator on government regulations of business activities. The two indicators are almost indistinguishable in terms of changes through time and across countries, and therefore produced almost identical results. Due to the strong collinearity between the indicators of property rights protection and government regulations, the inclusion of both of them was not an option, and therefore I have decided to drop the measure of government regulations from the analysis.

Step_5 Introducing Changes in Political Environment

As discussed in Section III, a consensus is growing in the literature that a democratic political system is necessary for transition to succeed, if only because of its effects on the reform process. A strong positive link is found between economic reforms implemented during transition and the degree of political freedom, as measured by indices of political rights and civil liberties. As no robust relationship between democracy and economic growth during transition has been found, and given the lack of consensus on the effect of economic liberalization on aggregate growth in the post-communist countries, little is known about the link between democracy and economic development during transition.

The variables employed to represent changes in the political environment are constructed based on the corresponding latent factor (NPOLITIC) estimated in the first study of this thesis. Using the method of confirmatory factor analysis, the latent factor of political environment is estimated based on indicators of institutionalized democracy and institutionalized autocracy, as reported in Polity IV database, and two alternative indicators on political rights and civil liberties, reported by Freedom House. The resulting construct proves to be a reliable measure of a democratic political environment, with highest values being assigned to countries with a significantly democratic political regime, and little (if any) autocratic features. For the purpose of the current analysis, I construct two measures of changes in the political environment in transition economies: **CPOLITIC**, representing contemporaneous annual changes in the democratic, civil and/or autocratic traits of the polity, and **CCPOLITIC**, which stands for cumulative past changes in the political environment. CCPOLITIC is constructed in a similar manner as the other cumulative measures of past changes reported earlier.

At this stage of the analysis, there are two main hypotheses on the effects of changes in the political environment on economic growth that I consider. First, following political economy (and science) arguments[13], I consider the possibility that positive economic development induce the necessary political support for creating and maintaining a democratic society. While such a hypothesis is justified in view of developments in the private sector, given that economies in transition were initially

[13] See Lipset(1959), Jackman(1973), Olson(2000)

dominated by the state sector, it is also conceivable that negative developments in the sector would induce political preferences for an autocratic regime that could have a stronger control on transitional developments[14]. The competing hypothesis[15] considered focuses on the possible influences of changes in the political system on economic developments in the two sectors. From this perspective, I expect that a more democratic political regime would support private sector development to a larger extent, and at the same time tolerate a rapid demise of the state sector. Consistent with the already existing consensus in the empirical literature, I also test for possible paths between the variables of changes in the political environment and the various measures of changes with reforms[16]. The results corresponding to the model specification found to perform best after including the two measures of changes in the political environment are reported in Table 6. The model equations, descriptive statistics, as well as the estimated non-standardized coefficients are reported in Appendix 7.

The estimated results come as a surprise in that the data seem to favor a combination of the hypotheses formulated above. A statistically significant link is found from the developments in the private sector to contemporaneous changes in the political environment, while with respect to the state sector, a statistically significant direct path originates in changes in the political environment and runs to the measure of economic developments in the sector.

A puzzling effect is estimated in equation (1) for private sector development in that, while no direct influence of contemporaneous change in political environment is found, a negative effect of lagged changes in political environment on private sector growth appears to be statistically significant. Given that the cumulative measure of changes in the political system assigns more weight to recent past changes in the polity traits, it is difficult to justify the effect on temporal grounds, meaning that a stabilization of growth rates of the private sector to lower, more sustainable, levels is recorded in the aftermath of political and economic transformation of the society and the economy.

[14] Given the pain inflicted by transition on the population in at least some transition countries, occasional nostalgias for the old regime would be expressed, especially by the older people.
[15] See Przeworski and Limondi(1993), Barro (1994), Minier(1998), Rodrik(1997) on debates and alternative results.
[16] See Haggard and Webb(1993) for a review of results on the relationship between reforms and the political system, based on other countries' experiences.

Table 6 Standardized parameter estimates of direct effects in Step_5

	GRPRIV	GRSTATE	CHEMPRIV	CHEMSTAT	CENTREF
	(1)	(2)	(3)	(4)	(5)
War and Conflicts	-0.217 (-4.140)	-0.265 (-4.902)			-0.137 (-2.484)
INSHARE					
INLIB		0.302 (4.127)	0.300 (4.643)		
CMEA	-0.290 (-4.744)	-0.156 (-2.282)			
CHEMPRIV	0.121 (1.645)				
CHEMSTAT	-0.229 (-3.285)	0.140 (2.146)	-0.461 (-7.402)		
CENTREF	0.182 (2.791)	-0.208 (-3.405)	0.175 (2.731)		
CCENTREF				-0.257 (-3.288)	-0.293 (-4.034)
INF		-0.193 (-3.353)			
CPRCE	0.068 (0.885)	-0.270 (-3.300)		-0.386 (-4.764)	0.120 (1.464)
CCPRICE				-0.279 (-3.565)	0.246 (3.225)
CTRADE					0.296 (4.671)
CFINANCE	0.300 (4.092)				0.252 (3.512)
CCFINANCE		-0.298 (-4.407)			0.289 (3.326)
CJUSTICE	-0.078 (-1.057)				
CPOLITIC		-0.139 (-1.967)			
CCPOLITIC	-0.171 (-3.076)				
GRPRIV					
R-square	*0.494*	*0.445*	*0.432*	*0.197*	*0.505*

Note: Dependent variables in columns, and the explanatory variables in rows

Table 6 Standardized parameter estimates of direct effects in Step_5 (continued)

	INF	CPRICE	CTRADE	CFINANCE	CJUSTICE	CPOLITIC
	(6)	(7)	(8)	(9)	(10)	(11)
War and Conflicts				-0.236 (-3.950)		
INSHARE		0.196 (3.983)				0.468 (8.094)
INLIB		0.500 (10.086)	0.360 (5.696)		-0.627 (-10.763)	0.156 (2.674)
CMEA	0.353 (5.488)					
CHEMPRIV						
CHEMSTAT						
CENTREF						
CCENTREF	-0.336 (-5.294)				0.161 (3.008)	
INF				0.21 (3.481)		
CPRCE				0.513 (6.858)		
CCPRICE	0.339 (5.872)	-0.266 (-5.992)		0.424 (6.704)		
CTRADE						
CFINANCE						
CCFINANCE						
CJUSTICE						
CPOLITIC		0.150 (2.508)	0.293 (4.246)	0.151 (1.935)	-0.178 (-2.998)	
CCPOLITIC		0.156 (3.152)	0.170 (2.937)			-0.195 (-3.925)
GRPRIV						0.302 (5.461)
R-square	*0.335*	*0.62*	*0.324*	*0.482*	*0.652*	*0.527*

Model Fit Indices: $\chi^2_{(df=86)}$=158.940 (p-value=0.000), RMSEA = 0.061 (p-value=0.106); Max. Sample Size(NxT) = 227
(see the appendix for other fit indices)

A more interesting possibility is that, conditional on the fact that changes in the political environment correspond to election years, then, after initial ‘honey months’ of the newly elected political leadership, vested interest groups arise in the polity, and possibly political corruption, such that they eventually impede the development of the private sector. This is indeed more of a speculation around the estimated effect, as more substantial evidence would require complementing the model with a (‘pure’) measure of political corruption and vested interest groups.

In equation(2), contemporaneous changes in the degree of democratization of the political system appear to be associated with more severe declines in the state sector. A possible reason behind this direct effect is that a newly elected and more democratic political leadership is more inclined towards aggressive restructuring of the economy, thus willing to take the responsibility of severe disruptions in the state sector.

Statistically significant effects of changes in the polity traits are estimated in relation to the measures of contemporaneous changes in price liberalization and trade liberalization. The effects are also reinforced by the influence that past changes in polity appear to exert on economic liberalization. The results in this step are therefore in line with the already existing consensus of a benefic effect of democratization of the polity on reforms with prices and trade. The beneficial effects of a more democratic political leadership and institutions also extend to the implemented reforms in the financial system (eq (9)), and in the judicial system (eq 10), although the effect estimated on changes in financial sector reforms has a borderline statistical significance.

The estimates in equation (11) indicate that the political choice for democratic institutions and leadership in the post-communist countries has been driven by favorable initial conditions and the development of the private sector during transition. In terms of initial conditions, significant changes in the polity towards democratization are associated with a higher initial level of economic liberalization, and the presence of an initially more sizeable private sector. The influence of the private sector development is reinforced by the significant effect found between the contemporaneous growth in the private sector and contemporaneous changes in the polity. Corroborated with the fact that effects from the polity changes to growth in the private sector proved to be highly volatile during the search process for a stable model specification, I interpret the reported effects as supporting more the political science argument that development (and more specifically, a developed private sector) induces the political support for a democratic regime. These results partly corroborate with the evidence in Fidrmuc(2000), were we learn that entrepreneurs were among the groups supporting the reform oriented political leadership.

Given the feedback of contemporaneous changes in political environment on private sector development via the effects on changes in reforms, the model in this step is non-recursive. Non-recursivity usually makes estimation more difficult, in that, given the interdependencies between variables, a feedback effect gets transmitted throughout the system. In the model specification corresponding to the results in Table 4, feedback effects from growth in the private sector are induced also on the variables affected by changes in economic reforms. As presented in Section I in this chapter, the methodology of path analysis for non-recursive systems developed a measure of system stability when feedback effects are considered. Some of the feedback loops induced by the direct path from private sector growth to contemporaneous changes in the political environment are the following:

1:4 GRPRIV→CPOLITIC→CTRADE→CENTREF→CHEMSTAT→CHEMPRIV

5:8 GRPRIV→CPOLITIC→CPRICE→CENTREF→CHEMSTAT→CHEMPRIV

9:11 GRPRIV→CPOLITIC→CPRICE→CHEMSTAT→CHEMPRIV

12:16 GRPRIV→CPOL→CPRICE→CFINANC→CENTREF→CHEMSTAT→CHEMPRIV

The estimated stability index for the system, including all the induced feedback loops, is 0.118 (lower than the critical value of 1), thus suggesting the system is stable[17].

Non-recursivity induces a slight depreciation of the overall model fit, as the estimated value for the RMSEA fit index of 0.061 (p-value = 0.106) indicates, but it still suggests that the available data support the specified model.

Step_6 Introducing Perception of Corruption

In the last step of model building, I consider complementing the model with an indicator of corruption, as a proxy for the quality of bureaucracy and the degree of corruption in the political arena. For this purpose I employ the index of Perception of Corruption, reported by Transparency International, that comprises information on the perception of business people, risk analysts and the general public on the extent of both administrative and political corruption in the country. I first normalize and inverse the scale of the Transparency International indicator such that I obtain scores in $[0,1]$. The scores are then multiplied by 100, in order to ensure the compatibility (in magnitude terms) with the other similar indicators included in the analysis. The interpretation of the resulting indicator is the following: a value of 0 is assigned to countries perceived as almost corruption-free, and the maximum value of 100 to countries where corruption in bureaucracy and politics is perceived to be endemic. As in the previous steps, I consider the changes in corruption, rather than levels, by taking differences in scores for each pair of successive years. The resulting variable is denoted **CORR**. Across the six steps of the model building process, I find that this measure of corruption most difficult to fit in the model. This is due the fact that the indicator employed for the perception of corruption in the system is far from perfect in many respects. Compared to the other variables in the model, there is a high degree of missing data in the series (there are only 120 observations, compared to a maximum possible of 227) that makes the corresponding estimates less robust in the analysis. Furthermore, as mentioned in Paldam(2000), the TI series on corruption is less suitable for the analysis of annual changes in corruption, given that perceptions have a tendency to change slower through

[17] For more information of stability of non-recursive simultaneous systems, see Section I.

time. Therefore, the reported results on corruption are to be interpreted with caution, when compared to the other results reported.

As in the case of political environment, there are two main competing hypotheses on how corruption relates to economic development[18]. A first possible argument is that corruption impedes activity in the official economy and forces legal businesses to go underground. A competing hypothesis is that a higher level of development helps eradicating corruption, as more resources are available for building institutions that contain corruption. In the process of searching for a model specification, I test the two hypotheses both simultaneously, and then separately. The model specification found to be most robust in terms of the quality of estimates and stability of the system is reflected by the results reported in Table 7. Model equations and the non-standardized parameter estimates are reported in Appendix 8.

Two main direct effects of corruption are estimated as statistically significant in the model. The first direct effect of corruption is on changes in private sector employment, suggesting that negative developments in private sector employment are associated with increases in corruption. As suggested in the various studies on corruption, one of the effects it has on the economy is to distort the allocation of resources. In the current analysis, distortions come in the form of negative effects on labor allocation to the official private sector. No direct effect of corruption is detected as statistically significant on the private sector growth in a robust manner.

The second statistically significant effect of corruption is estimated on the implementation of reforms with trade liberalization. Increased levels of corruption are associated with negative developments in trade policy. As it was to be expected that a higher degree of licenses and permits required in relation to international trade activity would generate higher level of corruptions, paths in both direction between the two variables have been tested for.

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[18] For extensive discussions and reviews of theoretical and empirical literature on corruption see Bardhan(1997), Rose-Ackerman(1999) and Jain(2001), as well as the reference of Hibbs(2000) mentioned before for empirical issues on the role of institutions in growth analysis.

Table 7 Standardized parameter estimates of direct effects in Step_6

	GRPRIV	GRSTATE	CHEMPRIV	CHEMSTAT	CENTREF
	(1)	(2)	(3)	(4)	(5)
War and Conflicts	-0.216 (-4.170)	-0.270 (-4.980)			-0.144 (-2.164)
INSHARE					
INLIB		0.301 (4.088)	0.244 (3.784)		
CMEA	-0.284 (-4.862)	-0.160 (-2.324)			
CHEMPRIV	0.065 (0.85)				
CHEMSTAT	-0.26 (-3.750)	0.141 (2.15)	-0.449 (-7.607)		
CENTREF	0.165 (2.519)	-0.226 (-3.696)	0.158 (2.587)		
CCENTREF				-0.257 (-3.299)	-0.31 (-4.290)
INF		-0.189 (-3.244)			
CPRCE		-0.253 (-3.126)		-0.391 (-4.854)	
CCPRICE				-0.279 (-3.542)	0.202 (3.116)
CTRADE					0.330 (5.904)
CFINANCE	0.34 (4.665)				0.305 (4.939)
CCFINANCE		-0.293 (-4.331)			0.306 (3.546)
CJUSTICE	-0.120 (-1.808)				
CPOLITIC		-0.144 (-2.022)			
CCPOLITIC	-0.162 (-2.950)				
GRPRIV					
GRSTATE					
CORR			-0.274 (-3.877)		
R-square	*0.502*	*0.441*	*0.477*	*0.200*	*0.507*

Table 7 Standardized parameter estimates of direct effects in Step_6 (continued)

	INF	CPRICE	CTRADE	CFINANCE	CJUSTICE	CPOLITIC	CORR
	(6)	(7)	(8)	(9)	(10)	(11)	(12)
War and Conflicts				-0.217 (-3.802)			
INSHARE		0.178 (3.624)				0.467 (8.051)	
INLIB		0.503 (10.203)	0.315 (5.094)		-0.657 (-12.290)	0.16 (2.748)	
CMEA	0.356 (5.604)						
CHEMPRIV							
CHEMSTAT							
CENTREF							
CCENTREF	-0.333 (-5.325)				0.161 (3.335)		
INF				0.200 (3.455)			
CPRCE				0.553 (7.766)			
CCPRICE	0.333 (5.842)	-0.262 (-5.830)		0.402 (6.671)			
CTRADE							
CFINANCE							
CCFINANCE							
CJUSTICE							0.276 (3.44)
CPOLITIC		0.170 (2.957)	0.227 (4.212)	0.165 (2.207)	-0.177 (-3.318)		
CCPOLITIC		0.156 (3.159)	0.190 (3.417)			-0.193 (-3.889)	
GRPRIV						0.293 (5.274)	-0.289 (-3.448)
GRSTATE							-0.260 (-3.258)
CORR			-0.278 (-4.669)				
R-square	*0.334*	*0.622*	*0.406*	*0.521*	*0.699*	*0.525*	*0.197*
Model Fit Indices: $\chi^2_{(df=70)}$=160.528 (p-value=0.000), RMSEA = 0.051 (p-value=0.437)							

When controlling for initial conditions, the only effect that stays statistically significant corresponds to the path from corruption to trade reforms, thus hinting to political economy arguments for the implementation of reforms with international trade. No other robust effect was found from corruption to any of the variables in the system.

The model weakly explains differences in changes in corruption, with statistically significant effects estimated from the two measures of growth in the private and the state sector. It appears that negative economic developments in the two sectors invite higher levels of corruption in the economy. Both effects are statistically significant, and of similar magnitudes. A third direct effect on changes in perceptions of corruption is found from the changes in the judicial system and corruption in courts. As both indicators relate to corruption, and it is not clear to which extent the Transparency International indicator captures corruption in the judicial system, attempts to estimate alternative specifications of the link between the two variables have been made. Neither the effect from CORR to CJUSTICE, nor an estimated covariance between the two indicators, proved statistically significant. I therefore conclude that it is more than the possible common information comprised in the two indicators that drives the significant effect from CORR to CJUSTICE. However, as indicated by the R-square estimated for equation (12), we see there is much more of differences in corruption that is left to explain[19].

Note that additional feedback loops are induced in the model due to the direct effects from growth in the two sectors on corruption, and then the effects of corruption on private sector employment (which feeds back into private sector growth) and on trade liberalization (with the feedback being further propagated in the system via enterprise sector transformation). The stability index is estimated at the level of 0.202, still far lower the theoretical cutoff value of 1 for system stability. The overall fit of the model also appears to be very good, as reflected by the estimated RMSEA value of 0.051, and the corresponding probability value for close fit of 0.437.

Statistically significant residual covariances are found for the error terms in equations (7) and (8), for price liberalization and trade liberalization, thus suggesting

[19] Treisman(2002) finds that different levels of corruption in transition economies can be explained mostly by differences in initial conditions

there are still common factors that could explain the variance in the two measures of economic liberalization. Additional statistically significant correlations are estimated for residuals in equation (3), for private sector employment, and equation (10), for the property rights measure, and between residuals in equation (11), having corruption as the dependent variable, and equation (6), with inflation as the dependent variable. The covariance between the residual terms in the equations (1) and (2), corresponding to growth in the private sector and state sector, is rendered statistically insignificant at the 0.05 level, although it stays statistically significant at the 0.10 level.

When comparing the current model specification with the earlier variants in the previous steps, I find that most of the initially found effects are robust (especially in terms of sign and statistical significance) to further extensions of the model. The main findings in terms of the direct effects estimated as statistically significant in the current specification are summarized as following:

1) Private Sector Development

In terms of a direct impact, initial private sector growth appears to be significantly affected by the inherited dependency on trade with CMEA partners. Dissolution of the CMEA trade block appears to impede private sector development in early stages of transition. Further impediments to a rapid building of the private sector are estimated for the countries involved in military conflicts (such as the Caucasus countries and Croatia), or severe domestic conflicts (such as Albania in 1997, in the aftermath of the pyramid schemes collapse).

From the perspective of economic developments during transition, strong private sector growth is linked to changes in employment in the state sector, indicating that re-allocation of labor from the ‘old’ units to the new private businesses. However, the direct effect from changes in private sector employment to private sector growth is less robust, and it eventually disappears across successive model specifications. In Step_6, the path from CHEMPRIV to GRPRIV is rendered statistically insignificant. The dominance of the CHEMSTAT effect on GRPRIV could be interpreted as preliminary evidence for the fact that much of the labor released from the state sector went out of the labor force, and subsequently obtained employment in the private sector on an unofficial basis. Problems with the registration of private businesses, especially the small firms with fewer employees, also help explaining why we do not observe a strong link between private sector growth and changes in private sector employment.

The policy measures that are found to directly affect growth in the private sector are the reforms in the enterprise sector (such as privatization and the imposition of hard budget constraints), and the reforms in the financial sector. In both cases, the contemporaneous (rather than lagged) changes with reforms prove statistically significant. Improved regulations in banking and non-bank financial institutions appear to have a much stronger effect on private sector growth, when compared to the other direct effects estimated in equation(1). As mentioned in Step_3, when measures of financial development were introduced in the model, no statistically significant effect of credit to the private sector was found, and yet reforms in the financial sector appear to benefit most the expansion of the sector. From alternative survey studies on private sector activities, we learn that private firms usually finance investment based on retained profits, rather than relying on credits from banks. It therefore appears that the function of re-allocation of capital of the financial system is not yet significant in transition economies, but changes in the financial system benefit the development of the private sector possibly through other functions than the provision of credit, such as the intermediation of transactions, trade financing, reduce uncertainty related to business partners. Alternatively, it is possible that the available data on the volume of credits to the private sector do not reflect the actual extent of the relationships between financial institutions and the private firms.

Among the institutional variables, relatively more efficient contract enforcement and less corruption in the judicial system are found to positively relate to private sector expansion. The effect is, however, relatively weaker in terms of statistical significant (it is statistically significant at 0.10 level in most model specifications). The weak effect of property rights protection partly corroborates with the results reported in Johnson, McMillan et al(1999), where we learn that private firms in some transition economies rely on relational contract enforcement to a large extent. As the study is focused only on a small number of countries, we can only speculate that the same applies in other transition countries as well. A puzzling negative effect on private sector development is consistently estimated for the measure of cumulative changes in the political environment. While no contemporaneous effect of changes in polity on private sector growth is found, the changes in the recent past appear to have a negative effect. A possible justification of this effect resides in the formation of vested interest groups that, after the initial euphoria of elections, would pressure the political leadership in pursuing policies that benefit the elite in the system. The current analysis, however, cannot shed more light on this effect, as it does not include any measure of interest group formation (and presence) in the polity.

2) State Sector Decline

Among the three indicators of initial conditions, I find that CMEA dependency participates in explaining the deep decline recorded in the state sector, at least during the initial years of transition. The state sector collapse was less severe in countries that entered the transition period with previous experiences with economic liberalization (such as the case of some countries in Central Europe). In absolute terms, the direct effect of initial economic liberalization is found to dominate the opposite effect of CMEA trade dependency.

A positive association is found between negative changes in state sector employment and the decline in the sector, indicating yet another factor that potentially explains the negative developments in the state productive activities. Despite the fact that the SOEs were notoriously over-staffed, the massive re-allocation of labor from the state sector to alternative uses (either the official private sector, or the unofficial sector) does appear to affect the activity of state sector enterprises.

Statistically significant direct effects of reforms on the state sector are estimated for the enterprise sector transformation (thus confirming the initial prior of at least an ‘accounting’ effect of the privatization process on the observed decline in the state sector), and for contemporaneous changes in price liberalization. The direct effect of price liberalization appears to be larger in magnitude than the corresponding effect of enterprise sector reforms, and both effects act in the same direction. A distinct negative effect is also estimated for high levels of inflation, in line with the existing consensus that lack of macroeconomic stabilization exerted a negative influence on the developments in the economy. The current analysis substantiates the effect in that it indicates that high levels of inflation mainly affected activities in the state sector, at times when the state sector dominated the economy, while no significant adverse effect is found on the activity in the private sector.

Reforms in the financial sector have a statistically significant negative effect on the activity in the state sector, though with some delay. No significant effect of contemporaneous changes in financial sector reforms on the state sector is estimated. The effect of cumulative recent past changes in reforms in the financial system is larger in magnitude (in absolute terms) that the direct effect found for the enterprise sector transformation, and price liberalization.

Contemporaneous changes in political institutions towards the democratization of the society are estimated to have a negative, direct effect on state sector activities. As mentioned above, I interpret this effect as evidence that a more democratic leadership is more willing to assume the responsibility of 'creative destruction' in the economy. The estimated result in this study partially parallels the result in Fidrmuc(2001), where a negative contemporaneous effect of the democracy measure on aggregate growth is found. Considering that changes in positive changes polity mainly happened during initial stages of transition, it is likely that the negative effect of democracy on aggregate growth is due to the heavy dominance of the state sector in the economy at the onset of transition. As the private sector takes the lead, it becomes increasingly difficult to support the hypothesis of a contemporaneous negative effect of democracy on economic development in the post-communist countries.

3) Indirect Effects of Initial Conditions

The direct effects of initial conditions on the expansion of the private sector, and the decline in the state sector, are reinforced by the effects initial conditions have on the implementation of reforms and building of institutions. Countries that started transition with some degree of initial economic liberalization, and also with a larger private sector in the economy, appear to be more likely to adopt measures of price and trade liberalization earlier in transition. They also record significant positive changes in the political arena, towards the creation of a democratic system.

More favorable initial conditions, however, are not found to directly affect decisions on reforms in the enterprise sector and the financial system. Such reforms appear to be more difficult to implement, in that they require prior reforms (in terms of prices and trade liberalization) and a political consensus on deeper restructuring of the economy. Reforms with enterprises and the financial sector are also more difficult to implement during periods of war and internal conflicts.

4) Reforms and Institutions

It is generally the case that statistically significant direct effects have been found from institutions to the contemporaneous changes in reforms. Both contemporaneous and lagged changes in the political system (towards democratization) are found to positively relate to contemporaneous changes in policy measures with economic liberalization and the improved regulations in the financial system. Estimates on the direct effects of corruption indicate that increases in corruption are associated with reductions in private sector employment, and also with less liberalization of international trade.

Interactions among institutions themselves are also found, in that cumulated recent changes towards a more democratic system are associated with less adverse developments in the judicial system, in terms of protection of property rights and corruption in courts. Depreciation of the judicial system, on the other hand, is found to contribute to increased perception of corruption in the country.

5) Economic Development and Institutions

The data and model specifications analyzed in this study appear to support the hypothesis that favorable changes in political institutions are partly driven by the expansion of the private sector. A statistically significant and relatively stable effect is estimated from growth in the private sector to contemporaneous (positive) changes in political institutions, indicating that the political support for a democratic society originates in a relatively more developed private sector. This effect also corroborates with the previously mentioned results indicating that countries that inherited a larger private sector from the communist period, were also more likely to record early positive changes in their political institutions. No effect is found from the adverse developments in the state sector to contemporaneous changes in the political system.

A second group of feedback effects in the system originates in the direct effects estimated from the measures of contemporaneous economic developments in the two sectors, state and private, to changes in (perception of) corruption. Increased corruption appears to be triggered by adverse developments in both sectors. That is, a worsening economic performance at the aggregate level fosters rent-seeking activities and corruption.

Total and Indirect Effects

The interactions among initial conditions, policy measures with reforms, and changes in economic and political institutions suggest that, despite the lack of significant direct effects on economic development in some cases, there are potentially strong indirect effects from those variables to economic growth in the private and the state sectors. In Table 8 I report the standardized values of the estimated direct, indirect and total effects on the two variables of growth, GRPRIV and GRSTATE.

Estimates in Table 8 indicate that indirect effects can be very strong, in particular for initial conditions and the reform measures. Despite the fact that no direct significant effect could be estimated from the initial level of economic liberalization on private sector growth, we see that the corresponding total effect of initial liberalization on private sector expansion is among the largest estimated total effects. This type of result therefore indicates that results based on reduced-form type of regression analyses do not reveal much on the mechanisms at work. As with initial liberalization, we see that favorable initial economic conditions do not automatically induce growth, but they help the process to a large extent via the favorable climate induced for the implementation of reforms. The total effect estimated for initial share of private sector indicates that the initial expectation on a size effect on private sector growth, in the sense that countries with a larger initial private sector would record lower growth rates in the sector, did not materialize. While no direct effect is estimated, I find the opposite result, indicating that a larger initial private sector was actually beneficial to further expansion of the sector, through the effects it had on the implementation of economic reforms and initial favorable changes in the political institutions.

Table 8 Direct, Indirect and Total Effects on Economic Development

	Private Sector Growth			State Sector Growth		
	Direct	Indirect	Total	Direct	Indirect	Total
War and Conflicts	-0.216	-0.127	-0.343	-0.270	0.068	-0.203
Initial Share of Private Sector		0.140	0.140		-0.181	-0.181
Initial Economic Liberalization		0.330	0.330	0.301	-0.264	0.037
CMEA Dissolution	-0.284	0.011	-0.274	-0.160	-0.051	-0.210
Private Employment (changes)	0.065	0.004	0.068		-0.005	-0.005
State Employment (changes)	-0.260	-0.045	-0.305	0.141	0.022	0.163
Enterprise Reforms (changes)	0.165	0.018	0.183	-0.226	-0.012	-0.238
Cumulative Enterprise Reforms (lagged changes)		-0.027	-0.027		0.104	0.104
Inflation		0.081	0.081	-0.189	-0.019	-0.208
Price Liberalization (changes)		0.347	0.347	-0.253	-0.117	-0.370
Cumulative Price Liberalization (past changes)		0.225	0.225		-0.105	-0.105
Trade Liberalization (changes)		0.060	0.060		-0.079	-0.079
Financial Sector Reforms (changes)	0.340	0.076	0.416		-0.099	-0.099
Cumulative Financial Sector Reforms (lagged changes)		0.053	0.053	-0.293	-0.071	-0.364
Judicial System and Private Property Protection (changes)[20]	-0.120	-0.017	-0.137		0.016	0.016
Political Institutions (changes)		0.167	0.167	-0.144	-0.103	-0.247
Cumulative Changes in the Political Institutions (lagged)	-0.162	0.024	-0.139		-0.012	-0.012
Perception of Corruption (changes)		-0.036	-0.036		0.023	0.023

Similarly strong indirect effects are estimated for the policy measures with price and trade liberalization in that, even if no direct effects on private sector activities proved statistically significant, sizeable indirect effects, via their influence on enterprise sector and financial system restructuring, are unraveled by the decomposition of effects.

The specified model indirectly supports the hypothesis that contemporaneous changes in the political environment foster private sector development, due to the direct

[20] Note the corresponding level indicator has an inverse scale, in that low values indicate a high quality of the judicial system and private property protection by the government.

effects of changes in politics on the progress with reforms. Corruption, on the other hand, does not appear to have large feedback effects on developments in the two sectors.

IV.3 Some Limitations of the Analysis

What I perceive as being one of the major limitations of the analysis in this study is that fact that it does not distinguish between growth in the private sector generated by newly established firms (the *de novo* firms) and developments in the sector as a result of activities of privatized firms. That privatization is not the main factor that that is behind the growth rates calculated for private sector is revealed by the model. However the estimated results have a very limited ability to reveal the role of the start-up firms in transition.

When comparing the conceptual model of transition introduced in the beginning of this section with the empirical model specified in the previous subsection, one can see there are two main elements missing from the empirical analysis. First, the model does not control for investments, either domestic or foreign, as a possible explanatory variables for growth in transition economies. Attempts have been made to include measures of total investments, private investments and/or foreign direct investments in transition economies with no success. From this perspective, the lack of explanatory power of the investment variables parallels similar results reported in other empirical studies on growth in transition. The hypothesis usually advanced to possibly explain the lack of significance of investment variables is that growth in transition has not been driven by investments. I would rather favor a more conservative hypothesis, in that we really do not know the extent to which investments helped growth during transition. It has been largely acknowledged that data on investment, and particularly private investment, in transition economies are of a poor quality. Moreover, survey studies on private firms in transition economies indicate that firms do invest, though based on their retained profits. Little is known on the extent to which such investments are captured in statistics at the aggregate level. On data issues, we learnt about the poor coverage of private sector activities by the central statistic offices, at least in initial stages of transition. It is therefore to be expected that quality of data on investment in the private sector is at least as low as for the general level of economic activity in the sector. As regards the influence of foreign direct investment, specific country experiences suggest that, especially in the oil – rich countries, foreign direct investment occasionally boosted aggregate growth. Absence of foreign direct investment effects from the model in this study can at best be interpreted that, on average across countries and time, other factors have been relatively more important to growth during transition, which does not necessarily imply a trivial role of foreign direct investment in particular cases.

A second missing factor that I believe has a good potential to shed more light on developments during transition is the evolution of the unofficial sector, in parallel with the official private sector expansion. The main reason for not explicitly considering the role of the unofficial sector, and its interactions with developments in the official state and private sectors, is data availability. Data series on size of the unofficial economy are available until year 1995, which limits the scope of a similar analysis to a large extent. The main empirical concern from this respect is that the number of available data points would be insufficient to empirically support a model of this magnitude. Preliminary indications on interactions between the official private sector and the unofficial sector are provided by the estimated effects on changes in employment, both in the private and the state sector. Changes in the private sector employment are very weakly linked to growth in the private sector, which could suggest improvements in productivity, but it could also indicate significant unofficial employment in the sector. Furthermore, a statistically significant effect of changes in corruption is found on private sector employment, which reinforces the idea of reallocation of labor between the two sectors. The current set-up of the model, however, does not enable further analysis of such interactions.

Closely related to the issue of the unofficial economy are the issues of taxation and government regulation (in terms of permits, licenses etc) of the business activities. As mentioned, effects[21] estimated for changes in government regulations (based on the corresponding Heritage Foundation index) were almost identical with the effects detected for the measure of changes in property rights protection. The two data series are very similar across countries and time, such that strong collinearity did not allow for the inclusion of both variables in the analysis. As for taxes, I did not find yet a

[21] Not reported.

satisfactory way of measuring the incidence of taxation in the economy. Attempts to employ the Heritage Foundation index on fiscal burden have been made with no success. However, the index represents more the statutory levels of taxation than the incidence of taxation, which I believe would be more relevant in an empirical analysis.

As the discussions in the next chapter in the thesis suggests, the role of taxes and regulations can be best captured when considering their simultaneous effects on both the official and the unofficial sector, rather than include them in an isolated manner in a model that focuses on developments in the official economy only.

Section V: Conclusions

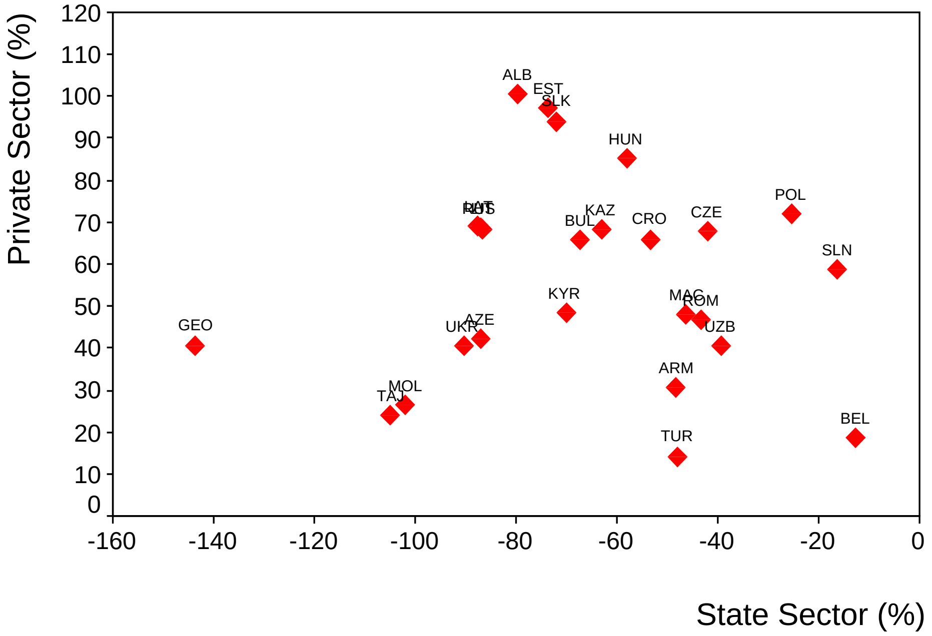
In a preliminary stage of the analysis I consider three main sources of data that can be employed for the study of economic growth during transition. When comparing data series on growth of real GDP, as collected by the IMF and the World Bank, with a corresponding series of growth of GDP in PPP terms I find that there are marked differences in terms of the magnitude of growth rates among the three series. I include this discussion in Section II of the paper in order to share with the reader the fact that employing alternative data series in a regression may result in parameter estimates of significantly different magnitudes. However, rank correlation coefficients estimated for each possible pair of the three series indicate that, despite differences in magnitudes, they provide relatively similar rankings across transition countries. The data series I employ in the analysis is the PPP series of growth of GDP per capita, as I find it more appropriate for comparisons of economic growth across countries.

Based on the empirical observation that aggregate growth rates for transition economies are the net result of positive growth in the private sector and negative growth in state sector most of the time, I decompose aggregate growth into the contribution of growth rates in the state sector and the contribution of the growth in the private sector to the observed aggregate economic performance. The decomposition of aggregate growth into growth of the two sectors is introduced in Section IV.1 and it reveals interesting differences among countries. As also illustrated in Figure I below, we can see that even among the best achievers in transition the net cumulative aggregate growth originate in different sources.

In Poland and Slovenia, where highest cumulative aggregate growth is observed, economic success relies on a strong expansion of the private sector, but also on a limited decline in the state sector. Hungary, Estonia, Albania and Slovak Republic, on the other hand, recorded a much stronger development of their private sectors, relative to the two countries mentioned above, but also a deeper decline in the state sector. Countries such as Russia, Lithuania, Latvia, Bulgaria, Kazakhstan, and Croatia recorded similar cumulative levels of private sector expansion as Poland, but their aggregate growth has been severely affected by the complementing declines in the state sector.

Figure 1

Contributions to Cumulative Aggregate Growth



Those countries would have needed to focus more on encouraging the private sector development at times when the state sector was collapsing, The weakest progress in terms of aggregate economic performance is observed for Georgia, where a collapse of the state sector activities has not been even remotely compensated by developments in the private sector.

Countries of Belarus and Turkmenistan have been largely recognized as outliers in terms of developments during transition as, while they hardly recorded progress with reforms and institution building, they also did not register a marked aggregate economic collapse, when compared at least to other CIS countries. From the graph above we see that their results can be explained by the fact that absence of reforms actually sheltered their state sector activities, while there is very little development in the private sector. It is therefore difficult to characterize the two countries as transition economies, given they did not depart from the old system to a significant extent.

The main body of the empirical analysis in this study consists of the process of building an empirical simultaneous equation model that could help us understand the relative roles of specific factors of transition in explaining the growth developments in the two sectors. I focus on the effects of factors that relate to initial conditions, economic reforms and the process of institution building during transition. The variables that reflect initial conditions include: initial share of the private sector in total economic activities, dependence on CMEA trade and previous experience with economic reforms relevant from a market economy perspective. In terms of reforms implemented during transition I consider contemporaneous and past cumulative annual changes with price liberalization, international trade liberalization, reforms in the enterprise sector and reforms in the financial sector. The (separate) dimensions employed in order to reflect the process of institution building include changes in the political environment (both contemporaneous and cumulative past changes), changes in the extent to which the government protects private property and in the quality of the judicial system, and changes in (international observers') perceptions of corruption in transition economies.

For all these factors, direct, indirect and total effects are estimated by employing the method of path analysis introduced in Section I of the study.

Empirical findings in this study concur with some of the existing empirical results to a large extent, and they also confirm hypotheses that had not been previously tested. The distinction between direct and indirect effects of reforms and institution building proves most useful in that it facilitates unraveling the mechanism behind the empirically significant effects found in a set-up of multivariate regression.

When interpreted in the light of knowledge we have on the timing of reforms, the results reveal that aggressive reforms implemented early in transition did indeed contribute to a, sometimes severe, output collapse of state sector activities in the post-communist countries, but they also created a solid foundation for further development in terms of further reforms and private sector expansion.

In relation to the output collapse observed in initial stages of transition early reforms with price liberalization had a direct adverse impact on the state sector, both contemporaneous and with a lag. When combined with the result that indicates that countries that entered transition with previous experience on economic liberalization were in a better position to cope with the initial transitional turmoil, we can interpret the results as providing indirect support of the economic disorganization hypothesis, albeit not directly in terms of complexity of production processes. Disorganization effects are inferred based on the economic autonomy that the SOEs benefited of during the communist regime: the less connected via a central planner during the previous regime, the better the chances they would survive the shocks induced by economic liberalization during transition. Results on the direct negative effect of CMEA dissolution on the state sector activities point to a similar conclusion: the more dependent a country was on its trade partners within the socialist block, the less chances it had to quickly adapt to requirements of a competitive market system. However, the break-up of the socialist trade block is estimated to have had adverse effects not only on the state sector, but also on the activity of the (initially) embryonic private sectors in the post-communist countries. It is possible that the latter effect is of a spurious nature, in that the strong connection between the measure on CMEA trade and the growth in the private sector during the first years of transition actually captures the influence of another factor, not included in the analysis, which is closely correlated with the indicator CMEA. It is difficult, however, to come up with such a factor at this stage of the analysis. The deep collapse of aggregate economic activity in some countries is also significantly related to military conflicts and domestic unrest, a result that is in line with perhaps one of the most robust results found in the empirical literature of transition. Adverse developments in the state sector are further linked to the very high levels of inflation recorded at least during the initial years in transition in most of the post-communist countries.

Additional pressure on the activities in the state sector has been put by the reforms implemented in the enterprise and in the financial sectors. The recovery of growth during transition therefore relied on the ability of the private sector in compensating for the continuing shrinking in the volume of economic activities in the state sector.

The role of reforms in creating a solid basis for future economic development is reflected by the direct effects estimated for specific measures of economic reforms on developments in the private sector, but also by interactions among reforms. A sizeable direct effect of reforms in the financial sector is detected in connection with private sector expansion. The result breaks the silence of empirical analysis of growth in transition economies on the role of the financial sector. When testing for the significance of the credit extended by banks to the private sector I reach a similar conclusion on lack of statistical significance as in previous empirical attempts. Corroborated with results reported in survey studies, it does appear indeed that private sector development did not rely primarily on external financing extended by banks. However, restructuring in the financial sector in the current model proves to have a strong direct influence on private sector activity. The interpretation of the effect advanced in this study is that a restructured financial system directly helped private sector expansion mainly through intermediation of transactions and other functions (than the provision of credit) that financial institutions perform. Providing credit is only one of the functions of the financial system. Banks and financial institutions are instrumental for firms' activities for cash management, trade financing and in propagating information on potential business partners. However, further light on this effect could only be shed in empirical studies at the micro level that analyze the specific interactions between private firms and financial institutions in transition.

The process of enterprise sector transformation (in terms of privatization and the elimination of soft budget constraints to SOEs) is also found to have a significant direct effect on developments in the private sector, although of a smaller magnitude than reforms in the financial sector. As noted, the effect could have an 'accounting' interpretation, in that privatization entailed a 'transfer on paper' of economic results from the state sector to the private sector. Note that in terms of total effects, the negative effect of contemporaneous changes in enterprise reforms on the state sector is larger, in absolute value, than the corresponding total positive effect on private sector activity. The effect does suggest that privatization by itself does not automatically entail improved economic performance. A better understanding of the effects of privatization would be provided by a systematic analysis of differences in aggregate economic performance induced by specific methods of privatization employed.

Finally, an interesting direct effect found on private sector expansion is represented by the direct path estimated from changes in employment in the state sector. While the effect of changes in employment in the private sector does not survive alternative specifications of the model, the effect related to employment in the state sector proves robust. When combined with alternative evidence that we have on labor supply dynamics during transition, the result points toward a strong possibility that observed changes in private sector employment may not accurately measure the actual dynamics of total employment in the sector, thus hinting towards issues of unofficial economy.

The instrumental role of early economic liberalization is also indicated by interactions found among the measures of reforms themselves. Among other effects, I find that in countries where more price liberalization and restructuring of financial systems had been implemented early in transition, transformation of the enterprise sector and re-allocation of labor were likely to be adopted sooner than later, with the net result of a more rapid expansion of the private sector.

The emphasis put on the private sector development in the conclusions of the analysis is not only supported by the net effect that private sector growth has on aggregate growth observed during transition, but also by the beneficial feedback effects detected from a strong emerging entrepreneurial class on the process of institution building. I find that existence and expansion of private sector relate to changes in the political systems of transition economies towards democratization, limited autocratic behavior of political leadership, better civil rights and reduced corruption. In this respect the available data appears to support the hypothesis that the emerging entrepreneurial class generates stronger support for a more democratic system. However, past recent (positive) changes in levels of democracy seem to be associated with decreases in growth rates in the private sector. A possible interpretation of the effect is that, after an initial euphoria immediately after election, the democratic government becomes more subjects to pressures exerted by interest groups. However, given the set-up of the specified model, the current analysis has a very limited ability to further support this interpretation. Benefic changes in the polity feed further back into the system via the effects on the reforms process.

The results on corruption in this analysis are viewed as preliminary due to the data problems discussed in the text. A depreciation of economic results in both private and state sector is found to relate to increases in perceptions of corruption. Effects detected from corruption to other variables in the system are limited only to the measure of trade liberalization, and changes in private sector development. The latter effect is particularly interesting in that it suggests that increased corruption distorts the allocation of labor in the official private sector.

Interactions among institutions are also detected in the study, in that democratization in the society is found to significantly relate to less adverse developments in terms of the quality of the judicial system and protection of property rights. Increases in perceptions of corruption, on the other hand, appear to parallel such adverse developments.

One of the advantages of the method of path analysis I employ is that it allows for the estimation of various types of effects in non-recursive systems: direct effects, indirect effects and total effects. I find that even if initial private sector share and initial economic liberalization do not directly relate to growth in private sector, they prove to have sizeable indirect effects on the activities in the sector via the direct effects estimated on changes in reforms and changes in the institutional environment. This is also the case with the indicator of contemporaneous and past cumulative changes in price liberalization.

The estimation results also cast some light on difficulties usually encountered in a multivariate regression analysis in fitting the indicators of political institutions in a growth equation. I find that, while there is a direct effect from growth in the private sector to changes in the political environment, there is also a sizeable indirect (positive) effect of contemporaneous changes in the political environment on economic activities in the private sector. This indirect effect is mediated by the indicators of reforms.

Estimation results at the equation and at the model levels indicate that, despite the relatively rich structure of effects detected in the empirical model, the extent to which the initial conditions, reforms and institutional developments (as considered in the analysis) explain the variance in the economic developments calculated for the two sectors is not very high. Although I believe that the objective of perfect predictions on growth in the two sectors would be unrealistic, I note that the variance explained in the two growth rates series is of approximately 50%. This result makes sense in light of the fact that the study does not control for the severe data problems discussed in Section III. Moreover, there are likely to be important specific country factors that affected short-term deviations in growth rates. Consequently, much is left to explain about developments during transition and studies across countries need companion empirical research at country levels.

Furthermore, while the primary objective in the study is not to mainly capture the determinants of the process of reforms and institution building, the empirical model I construct indicates that the estimated effects combine to explain more than 50% of the variance in the changes with reforms, political environment and protection of property rights. The analysis therefore suggests that, while the process of reforms and democratization are endogenous to some extent, there is also scope for political will in inducing these changes. The model, however, proves very weak in enlightening us on the potential causes of perceptions of corruption.

I also believe there are some serious limitations of the empirical analysis in this study. As mentioned in the previous section, the analysis does not have the ability to distinguish between growth generated in the private sector by newly established firms (the *de novo* firms) and the activity of privatized enterprises. Such a distinction would have proved most useful for a more precise interpretation of the effects of reforms on growth in the private sector, but it could not be considered in the analysis due to data limitations. There are also two other important aspects missing from the analysis: investments and the dynamics of the unofficial sector. While not included in the analysis, I do believe they have a great explanatory potential, based on alternative survey evidence available. With respect to the unofficial economy in particular, it is often believed that what we perceive as economic growth in transition countries may actually represent the surfacing of previously underground economic activities to the officially observed sector. This hypothesis is explored from a theoretical perspective in the next chapter in the thesis.

APPENDIX I

Variable	Description	Source
CCENTREF	Cumulative Past Changes in Enterprise Reforms	based on CENTREF; see Section IV.2
CCFINANCE	Cumulative Past Changes in Financial Sector Reforms	based on CFINANCE; see Section IV.2
CCPOLITIC	Cumulative Past Changes in Political Environment	based on CPOLITIC; see Section IV.2
CCPRICE	Cumulative Past Changes in Price Liberalization	based on CPRICE; see Section IV.2
CCTRADE	Cumulative Past Changes in Trade Liberalization	based on CTRADE; see Section IV.2
CENTREF	Changes in Enterprise Reforms	based on NENTREF
CFINANCE	Changes in Financial Sector Reforms	based on NFINANCE
CHEMPRIV	Changes in Employments in the Private Sector	based on raw data from IMF, EBRD
CHEMSTAT	Changes in Employments in the State Sector	based on raw data from IMF, EBRD
CJUSTICE	Changes in Property Rights Protection and the Judiciary	based on Heritage Foundation data; see Section IV.2
CLI	Cumulative Liberalization Index	De Melo, Denizer et al(1996)
CMEA	Share of CMEA trade in GDP (1990)	see Study 1
CORR	Changes in Perception of Corruption	based on Transparency International data
CPOLITIC	Changes in Political Environment	based on NPOLITIC
CPRICE	Changes in Price Liberalization	based on the corresponding EBRD index (see Study 1)
CTRADE	Changes in Trade and Forex Liberalization	based on the corresponding EBRD index (see Study 1)
GRPRIV	Growth in the Private Sector	see Section IV.1
GRSTAT	Growth in the State Sector	see Section IV.1
INF	Inflation	see Section IV.2
INLIB	Initial Level of Economic Liberalization	see Study 1
INSHARE	Initial Share of Private Sector in Total Economy	year 1990; EBRD(2001)
NENTREF	Enterprise Sector Transformation	latent factor estimated in Study 1
NFINANCE	Efinancial Sector Reforms	latent factor estimated in Study 1
NPOLITIC	Political Environment	latent factor estimated in Study 1
War and Conflicts	Military Conflicts and Domestic Unrest	dummy variable

APPENDIX II

Table 1 Private sector growth (value added per capita, PPP)

	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
ALB	-26.28	69.13	146.22	30.59	26.56	30.90	-8.22	5.98	8.97	7.92
ARM		-19.22	-4.77	-1.90	21.42	16.61	12.15	13.53	6.01	7.80
AZE		-41.27	-19.83	55.28	12.34	2.76	51.03	18.27	9.19	17.69
BEL		62.65	-6.43	30.20	-7.56	3.96	39.92	7.64	5.78	8.27
BUL	71.56	10.41	34.86	17.67	29.96	1.12	1.10	10.12	12.02	9.39
CRO	47.69	14.69	11.07	22.97	25.18	31.67	17.30	3.47	12.08	5.66
CZE			42.58	40.42	16.57	13.34	-0.74	-1.68	8.08	5.38
EST	-5.53	74.12	41.42	33.26	24.33	14.01	14.61	3.67	9.74	15.38
GEO		-47.09	-18.28	-49.94	47.24	59.42	13.41	11.07	12.16	7.84
HUN	35.32	28.82	23.46	14.86	14.33	17.32	11.30	17.76	0.12	7.81
KAZ		70.08	-9.33	58.83	18.35	49.78	35.32	-1.07	16.38	15.36
KYR		16.43	8.05	-0.73	25.87	28.62	26.60	0.08	5.58	6.40
LAT	-8.22	53.43	5.41	32.78	35.31	13.62	8.67	11.90	6.51	9.17
LIT	-17.86	49.05	40.03	45.76	15.00	14.15	7.72	4.56	-1.59	5.48
MAC	1.72	-1.08	77.37	-1.54	13.59	23.88	1.11	10.92	6.34	6.02
MOL		-30.55	41.15	-5.78	42.85	19.89	14.15	3.67	-12.35	12.26
POL	32.14	15.87	15.30	16.80	18.02	5.90	14.22	3.80	6.19	13.55
ROM	30.66	-3.32	37.16	19.01	22.30	25.49	2.41	-5.38	0.23	3.78
RUS	-21.07	153.31	37.51	9.83	8.86	6.65	16.73	-3.54	9.96	8.95
SLK	78.76	65.54	38.19	26.76	17.34	22.44	12.79	3.21	4.84	4.65
SLN		26.99	28.01	22.50	47.92	4.67	15.44	3.16	16.96	6.86
TAJ		-32.55	-16.83	18.34	-8.42	10.69	-2.93	42.55	7.72	39.28
TUR		-7.26	-13.24	18.04	-5.62	19.97	4.82	5.06	15.68	20.46
UKR		-4.71	29.24	72.53	3.73	1.46	6.98	-1.24	3.59	17.66
UZB		-6.46	37.45	23.24	40.93	29.82	13.19	1.07	6.11	6.12

Table 2 State sector growth (per capita, PPP)

	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
ALB	-26.28	-5.59	-32.96	-9.96	-13.99	-38.42	-8.22	5.98	8.97	7.92
ARM		-42.05	-26.13	-1.90	0.94	-3.45	-7.91	-6.95	6.01	7.80
AZE		-41.27	-19.83	-25.81	-16.42	2.76	-18.29	-2.21	9.19	17.69
BEL		-12.07	-6.43	-16.07	-7.56	3.96	5.09	7.64	5.78	8.27
BUL	-15.22	-18.36	-13.10	-3.69	-10.58	-18.94	-19.38	-11.24	-10.81	9.39
CRO	-33.40	-14.08	-14.06	0.15	3.82	-8.88	-2.76	3.47	-8.40	5.66
CZE			-22.08	-41.55	-6.25	-11.79	-0.74	-1.68	-20.69	5.38
EST	-5.53	-35.74	-27.89	-27.36	-17.51	-8.82	14.61	3.67	-15.39	15.38
GEO		-47.09	-53.11	-49.94	-6.66	-25.30	-6.66	-9.41	12.16	7.84
HUN	-24.95	-15.37	-17.09	-5.21	-6.15	-26.86	-13.83	-45.84	34.95	7.81
KAZ		-4.64	-9.33	-22.26	-10.42	-19.53	-25.29	-1.07	-4.10	15.36
KYR		-18.40	-20.72	-25.86	-18.31	-11.93	-13.94	0.08	5.58	6.40
LAT	-8.22	-56.43	-19.72	-11.41	-25.31	-6.86	8.67	-9.46	6.51	9.17
LIT	-2.20	-32.05	-36.69	-56.69	-6.35	-8.68	7.72	4.56	-1.59	5.48
MAC	-6.35	-1.08	-34.19	-1.54	-7.77	-16.67	1.11	-9.15	6.34	6.02
MOL		-30.55	-5.11	-40.61	-11.05	-24.29	-6.33	-16.40	7.71	-7.81
POL	-26.78	-4.61	-4.77	-3.26	-2.46	5.90	-7.14	3.80	6.19	-9.28
ROM	-21.63	-3.32	-10.80	-2.35	1.82	-14.65	-18.07	-5.38	0.23	3.78
RUS	-1.78	-31.27	-31.81	-30.72	-11.21	-13.83	-27.45	-3.54	9.96	8.95
SLK	-22.93	-23.19	-26.47	-13.37	-3.14	-21.75	-12.35	3.21	4.84	4.65
SLN		-7.84	-0.76	-2.63	-16.74	4.67	-4.63	3.16	-3.11	6.86
TAJ		-32.55	-16.83	-27.92	-8.42	-24.14	-2.93	-11.35	7.72	-4.90
TUR		-7.26	-13.24	-28.22	-5.62	-14.86	-23.95	5.06	15.68	20.46
UKR		-4.71	-17.02	-60.38	-16.75	-18.60	-13.09	-1.24	3.59	-2.82
UZB		-6.46	-8.81	-11.59	-12.97	-14.37	-7.29	1.07	6.11	6.12

APPENDIX III

Step_1 The Base Model

Descriptive Statistics

	N	Mean	Std. Deviation	Kurtosis
GRPRIV	223	15.8654	22.3185	6.847
GRSTAT	223	-9.4069	15.1746	.990
CHEMPRIV	146	9.9310	15.6334	6.133
CHEMSTATE	146	-9.6398	12.8108	11.857
CENTREF	226	6.3628	9.0279	1.117
CCENTREF	227	10.1261	6.7406	-.714
CMEA	226	2.6659	5.9976	13.025
INLIB	226	.9964	2.4072	41.579
INSHARE	227	1.5588	3.4890	24.845
INF	227	2.9407	2.6258	-1.271
Valid N (listwise)	145			

The equations of the Model in Step_1

$$\begin{bmatrix} GRPRIV_t \\ GRSTATE_t \\ CHEMPRIV_t \\ CHEMSTATE_t \\ CENTREF_t \\ INF_t \end{bmatrix} = \begin{bmatrix} 0 & 0 & \beta_{13} & \beta_{14} & \beta_{15} & 0 \\ 0 & 0 & 0 & \beta_{24} & \beta_{25} & \beta_{26} \\ 0 & 0 & 0 & \beta_{34} & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \end{bmatrix} \cdot \begin{bmatrix} GRPRIV_t \\ GRSTATE_t \\ CHEMPRIV_t \\ CHEMSTATE_t \\ CENTREF_t \\ INF_t \end{bmatrix} +$$

$$+ \begin{bmatrix} \gamma_{11} & \gamma_{12} & 0 & \gamma_{14} & 0 \\ \gamma_{21} & 0 & \gamma_{23} & \gamma_{24} & \gamma_{25} \\ 0 & 0 & \gamma_{33} & 0 & \gamma_{35} \\ 0 & 0 & 0 & 0 & \gamma_{45} \\ \gamma_{51} & 0 & 0 & 0 & \gamma_{55} \\ 0 & 0 & 0 & \gamma_{64} & \gamma_{65} \end{bmatrix} \cdot \begin{bmatrix} WAR_t \\ INSHARE_t \\ INLIB_t \\ CMEA_t \\ CCENTREF_t \end{bmatrix} + \begin{bmatrix} \zeta_{1t} \\ \zeta_{2t} \\ \zeta_{3t} \\ \zeta_{4t} \\ \zeta_{5t} \\ \zeta_{6t} \end{bmatrix}$$

The covariance structure of the error terms:

$$\Phi = \begin{bmatrix} \phi_{11} & \phi_{12} & 0 & 0 & 0 & 0 \\ \phi_{21} & \phi_{22} & 0 & 0 & 0 & 0 \\ 0 & 0 & \phi_{33} & 0 & 0 & 0 \\ 0 & 0 & 0 & \phi_{44} & 0 & 0 \\ 0 & 0 & 0 & 0 & \phi_{55} & 0 \\ 0 & 0 & 0 & 0 & 0 & \phi_{66} \end{bmatrix}$$

Spearman Correlation Coefficients and Two-Tailed Significance Tests

		WAR	GRPRIV	GRSTAT	CHEM PRIV	CHEM STATE	CENTREF
WAR	*Corr*	1.000	-0.223	-0.234	0.081	-0.052	0.003
	Sig. (2-t)	.	0.001	0.000	0.333	0.535	0.966
	N	227	223	223	146	146	226
GRPRIV	*Corr*	-0.223	1.000	-0.344	0.287	-0.350	0.412
	Sig. (2-t)	0.001	.	0.000	0.000	0.000	0.000
	N	223	223	223	146	146	223
GRSTAT	*Corr*	-0.234	-0.344	1.000	-0.293	0.284	-0.468
	Sig. (2-t)	0.000	0.000	.	0.000	0.001	0.000
	N	223	223	223	146	146	223
CHEMPRIV	*Corr*	0.081	0.287	-0.293	1.000	-0.417	0.292
	Sig. (2-t)	0.333	0.000	0.000	.	0.000	0.000
	N	146	146	146	146	146	146
CHEMSTATE	*Corr*	-0.052	-0.350	0.284	-0.417	1.000	-0.289
	Sig. (2-t)	0.535	0.000	0.001	0.000	.	0.000
	N	146	146	146	146	146	146
CENTREF	*Corr*	0.003	0.412	-0.468	0.292	-0.289	1.000
	Sig. (2-t)	0.966	0.000	0.000	0.000	0.000	.
	N	226	223	223	146	146	226
CCENTREF	*Corr*	-0.280	0.154	0.038	-0.128	-0.126	-0.102
	Sig. (2-t)	0.000	0.022	0.568	0.123	0.129	0.126
	N	227	223	223	146	146	226
CMEA	*Corr*	0.180	0.118	-0.493	0.462	-0.127	0.298
	Sig. (2-t)	0.007	0.080	0.000	0.000	0.127	0.000
	N	226	222	222	145	145	225
INLIB	*Corr*	0.336	0.048	-0.338	0.307	-0.001	0.269
	Sig. (2-t)	0.000	0.473	0.000	0.000	0.987	0.000
	N	226	222	222	145	145	225
INSHARE	*Corr*	0.301	0.164	-0.535	0.448	-0.252	0.441
	Sig. (2-t)	0.000	0.014	0.000	0.000	0.002	0.000
	N	227	223	223	146	146	226
INF	*Corr*	0.258	0.086	-0.440	0.504	-0.082	0.287
	Sig. (2-t)	0.000	0.200	0.000	0.000	0.327	0.000
	N	227	223	223	146	146	226

Spearman Correlation Coefficients and Two-Tailed Significance Tests (continued)

		CENTREF	CCENTREF	CMEA	INLIB	INSHARE	INF
WAR	*Corr*	0.003	-0.280	0.180	0.336	0.301	0.258
	Sig. (2-t)	0.966	0.000	0.007	0.000	0.000	0.000
	N	226	227	226	226	227	227
GRPRIV	*Corr*	0.412	0.154	0.118	0.048	0.164	0.086
	Sig. (2-t)	0.000	0.022	0.080	0.473	0.014	0.200
	N	223	223	222	222	223	223
GRSTAT	*Corr*	-0.468	0.038	-0.493	-0.338	-0.535	-0.440
	Sig. (2-t)	0.000	0.568	0.000	0.000	0.000	0.000
	N	223	223	222	222	223	223
CHEMPRIV	*Corr*	0.292	-0.128	0.462	0.307	0.448	0.504
	Sig. (2-t)	0.000	0.123	0.000	0.000	0.000	0.000
	N	146	146	145	145	146	146
CHEMSTATE	*Corr*	-0.289	-0.126	-0.127	-0.001	-0.252	-0.082
	Sig. (2-t)	0.000	0.129	0.127	0.987	0.002	0.327
	N	146	146	145	145	146	146
CENTREF	*Corr*	1.000	-0.102	0.298	0.269	0.441	0.287
	Sig. (2-t)	.	0.126	0.000	0.000	0.000	0.000
	N	226	226	225	225	226	226
CCENTREF	*Corr*	-0.102	1.000	-0.428	-0.267	-0.359	-0.435
	Sig. (2-t)	0.126	.	0.000	0.000	0.000	0.000
	N	226	227	226	226	227	227
CMEA	*Corr*	0.298	-0.428	1.000	0.455	0.767	0.640
	Sig. (2-t)	0.000	0.000	.	0.000	0.000	0.000
	N	225	226	226	226	226	226
INLIB	*Corr*	0.269	-0.267	0.455	1.000	0.627	0.464
	Sig. (2-t)	0.000	0.000	0.000	.	0.000	0.000
	N	225	226	226	226	226	226
INSHARE	*Corr*	0.441	-0.359	0.767	0.627	1.000	0.652
	Sig. (2-t)	0.000	0.000	0.000	0.000	.	0.000
	N	226	227	226	226	227	227
INF	*Corr*	0.287	-0.435	0.640	0.464	0.652	1.000
	Sig. (2-t)	0.000	0.000	0.000	0.000	0.000	.
	N	226	227	226	226	227	227

Non-Standardized parameter estimates of direct effects (and standard errors) in Step_1

	GRPRIV	GRSTATE	CHEMPRIV	CHEMSTAT	CENTREF	INF
	(1)	(2)	(3)	(4)	(5)	(6)
War and Conflicts	-15.568 (4.670)	-15.929 (3.130)			-2.556 (2.223)	1.226 (0.570)
INSHARE	0.363 (0.617)					
INLIB		0.837 (0.382)	1.560 (0.467)			
CMEA	-0.836 (0.354)	-0.662 (0.169)				0.113 (0.029)
CHEMPRIV	0.303 (2.104)					
CHEMSTAT	-0.316 (0.130)	0.185 (0.076)	-0.687 (0.082)			
CENTREF	0.848 (0.137)	-0.636 (0.091)				
CCENTREF		-0.441 (0.149)	-0.521 (0.169)	-0.358 (0.153)	-0.254 (0.092)	-0.099 (0.027)
INF		-1.117 (0.348)				
R-square	*0.325*	*0.346*	*0.383*	*0.034*	*0.034*	*0.250*
Model Fit Indices: $\chi^2_{(df=22)}$=79.680 (p-value=0.000) RMSEA = 0.108 (p-value=0.000) NFI=0.956 CFI=0.967 NPAR=55 AIC=189.680 Hoelter(.01)=115						

Note: Dependent variables in columns, and the explanatory variables in rows

APPENDIX IV

Step_2 Adding Price, Trade and Foreign Exchange Liberalization

Descriptive Statistics

	N	Mean	Std. Deviation	Kurtosis
CPRICE	226	5.8022	15.7640	4.933
CCPRICE	225	11.2219	7.6859	.323
CTRADE	226	8.4336	19.0117	4.074
CCTRADE	227	13.8329	10.6480	-.604
Valid N (listwise)	224			

The equations of the Model in Step_2

$$\begin{bmatrix} GRPRIV_t \\ GRSTATE_t \\ CHEMPRIV_t \\ CHEMSTATE_t \\ CENTREF_t \\ INF_t \\ CPRICE_t \\ CTRADE_t \end{bmatrix} = \begin{bmatrix} 0 & 0 & \beta_{13} & \beta_{14} & \beta_{15} & 0 & \beta_{17} & 0 \\ 0 & 0 & 0 & \beta_{24} & \beta_{25} & \beta_{26} & \beta_{27} & 0 \\ 0 & 0 & 0 & \beta_{34} & \beta_{35} & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & \beta_{47} & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & \beta_{57} & \beta_{58} \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \end{bmatrix} \cdot \begin{bmatrix} GRPRIV_t \\ GRSTATE_t \\ CHEMPRIV_t \\ CHEMSTATE_t \\ CENTREF_t \\ INF_t \\ CPRICE_t \\ CTRADE_t \end{bmatrix} +$$

$$+ \begin{bmatrix} \gamma_{11} & 0 & 0 & \gamma_{14} & 0 & 0 \\ \gamma_{21} & 0 & \gamma_{23} & \gamma_{24} & \gamma_{25} & 0 \\ 0 & 0 & \gamma_{33} & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & \gamma_{45} & \gamma_{46} \\ \gamma_{51} & 0 & 0 & 0 & \gamma_{55} & \gamma_{56} \\ 0 & 0 & 0 & \gamma_{64} & \gamma_{65} & \gamma_{66} \\ 0 & \gamma_{72} & \gamma_{73} & 0 & 0 & \gamma_{76} \\ 0 & 0 & \gamma_{83} & 0 & 0 & 0 \end{bmatrix} \cdot \begin{bmatrix} WAR_t \\ INSHARE_t \\ INLIB_t \\ CMEA_t \\ CCENTREF_t \\ CCPRICE_t \end{bmatrix} + \begin{bmatrix} \zeta_{1t} \\ \zeta_{2t} \\ \zeta_{3t} \\ \zeta_{4t} \\ \zeta_{5t} \\ \zeta_{6t} \\ \zeta_{7t} \\ \zeta_{8t} \end{bmatrix}$$

The covariance structure of the error terms:

$$\Phi = \begin{bmatrix} \phi_{11} & \phi_{12} & 0 & 0 & 0 & 0 & 0 & 0 \\ \phi_{21} & \phi_{22} & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & \phi_{33} & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & \phi_{44} & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & \phi_{55} & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & \phi_{66} & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & \phi_{77} & \phi_{78} \\ 0 & 0 & 0 & 0 & 0 & 0 & \phi_{87} & \phi_{88} \end{bmatrix}$$

Spearman Correlation Coefficients and Two-Tailed Significance Tests

		CPRICE	CCPRICE	CTRADE	CCTRADE
GRPRIV	*Corr*	0.018	0.320	0.186	0.291
	Sig. (2-t)	0.784	0.000	0.005	0.000
	N	223	221	223	223
GRSTAT	*Corr*	-0.311	-0.338	-0.175	-0.099
	Sig. (2-t)	0.000	0.000	0.009	0.142
	N	223	221	223	223
CHEMPRIV	*Corr*	0.198	0.319	0.319	0.041
	Sig. (2-t)	0.017	0.000	0.000	0.620
	N	146	146	146	146
CHEMSTATE	*Corr*	-0.188	-0.242	-0.281	-0.284
	Sig. (2-t)	0.023	0.003	0.001	0.001
	N	146	146	146	146
CPRICE	*Corr*	1.000	-0.315	0.345	-0.339
	Sig. (2-t)	.	0.000	0.000	0.000
	N	226	224	226	226
CCPRICE	*Corr*	-0.315	1.000	0.029	0.529
	Sig. (2-t)	0.000	.	0.663	0.000
	N	224	225	224	225
CTRADE	*Corr*	0.345	0.029	1.000	-0.247
	Sig. (2-t)	0.000	0.663	.	0.000
	N	226	224	226	226
CCTRADE	*Corr*	-0.339	0.529	-0.247	1.000
	Sig. (2-t)	0.000	0.000	0.000	.
	N	226	225	226	227
CENTREF	*Corr*	0.211	0.387	0.401	0.144
	Sig. (2-t)	0.001	0.000	0.000	0.031
	N	226	224	226	226

Spearman Correlation Coefficients and Two-Tailed Significance Tests (continued)

		CPRICE	CCPRICE	CTRADE	CCTRADE
CCENTREF	*Corr*	-0.427	0.319	-0.164	0.684
	Sig. (2-t)	0.000	0.000	0.013	0.000
	N	226	225	226	227
CMEA	*Corr*	0.393	0.152	0.277	-0.265
	Sig. (2-t)	0.000	0.023	0.000	0.000
	N	225	224	225	226
INLIB	*Corr*	0.325	0.119	0.144	-0.120
	Sig. (2-t)	0.000	0.074	0.031	0.072
	N	225	224	225	226
INSHARE	*Corr*	0.470	0.254	0.336	-0.076
	Sig. (2-t)	0.000	0.000	0.000	0.252
	N	226	225	226	227
INF	*Corr*	0.285	0.190	0.180	-0.220
	Sig. (2-t)	0.000	0.004	0.007	0.001
	N	226	225	226	227

Non-Standardized parameter estimates of direct effects (and standard errors) in Step_2

	GRPRIV	GRSTATE	CHEMPRIV	CHEMSTAT	CENTREF	INF	CPRICE	CTRADE
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
War and Conflicts	-18.955 (4.459)	-14.642 (3.060)			-7.609 (1.799)			
INSHARE							1.052 (0.218)	
INLIB		1.605 (0.468)	2.084 (0.455)				3.897 (0.345)	4.078 (0.483)
CMEA	-0.907 (0.238)	-0.499 (0.173)				0.153 (0.028)		
CHEMPRIV	0.230 (0.108)							
CHEMSTAT	-0.327 (0.126)	0.163 (0.077)	-0.575 (0.080)					
CENTREF	0.679 (0.149)	-0.541 (0.096)	0.313 (0.121)					
CCENTREF		-0. 521 (0.153)		-0.525 (0.157)	-0.203 (0.078)	-0.133 (0.025)		
INF		-1.196 (0.348)						
CPRICE	0.291 (0.091)	-0.240 (0.071)		-0.316 (0.064)	0.176 (0.039)			
CCPRICE				-0.530 (0.138)	0.597 (0.070)	0.117 (0.020)	-0.505 (0.087)	
CTRADE					0.145 (0.030)			
Model Fit Indices $\chi^2_{(df=22)}$=89.103 (p-value=0.000), RMSEA = 0.070 (p-value=0.050), NFI=0.966, CFI=0.981, NPAR=77, AIC=243, Hoelter(.01)=168								

APPENDIX V

Step_3 Adding Financial Sector Reforms

Descriptive Statistics

	N	Mean	Std. Deviation	Kurtosis
CFINANCE	154	6.6039	12.5737	5.000
CCFINANCE	152	9.2918	6.5149	-.069
Valid N (listwise)	131			

The equations of the Model in Step_3

$$
\begin{bmatrix} GRPRIV_t \\ GRSTATE_t \\ CHEMPRIV_t \\ CHEMSTATE_t \\ CENTREF_t \\ INF_t \\ CPRICE_t \\ CTRADE_t \\ CFINANCE_t \end{bmatrix}
=
\begin{bmatrix}
0 & 0 & \beta_{13} & \beta_{14} & \beta_{15} & 0 & \beta_{17} & 0 & \beta_{19} \\
0 & 0 & 0 & \beta_{24} & \beta_{25} & \beta_{26} & \beta_{27} & 0 & 0 \\
0 & 0 & 0 & \beta_{34} & \beta_{35} & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & \beta_{47} & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & \beta_{57} & \beta_{58} & \beta_{59} \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & \beta_{96} & \beta_{97} & 0 & 0
\end{bmatrix}
\cdot
\begin{bmatrix} GRPRIV_t \\ GRSTATE_t \\ CHEMPRIV_t \\ CHEMSTATE_t \\ CENTREF_t \\ INF_t \\ CPRICE_t \\ CTRADE_t \\ CFINANCE_t \end{bmatrix}
+
$$

$$
+
\begin{bmatrix}
\gamma_{11} & 0 & 0 & \gamma_{14} & 0 & 0 & 0 \\
\gamma_{21} & 0 & \gamma_{23} & \gamma_{24} & \gamma_{25} & 0 & \gamma_{27} \\
0 & 0 & \gamma_{33} & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & \gamma_{45} & \gamma_{46} & 0 \\
\gamma_{51} & 0 & 0 & 0 & \gamma_{55} & \gamma_{56} & \gamma_{57} \\
0 & 0 & 0 & \gamma_{64} & \gamma_{65} & \gamma_{66} & 0 \\
0 & \gamma_{72} & \gamma_{73} & 0 & 0 & \gamma_{76} & 0 \\
0 & 0 & \gamma_{83} & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & \gamma_{96} & 0
\end{bmatrix}
\cdot
\begin{bmatrix} WAR_t \\ INSHARE_t \\ INLIB_t \\ CMEA_t \\ CCENTREF_t \\ CCPRICE_t \\ CCFINANCE_t \end{bmatrix}
+
\begin{bmatrix} \zeta_{1t} \\ \zeta_{2t} \\ \zeta_{3t} \\ \zeta_{4t} \\ \zeta_{5t} \\ \zeta_{6t} \\ \zeta_{7t} \\ \zeta_{8t} \\ \zeta_{9t} \end{bmatrix}
$$

The covariance structure of the error terms

$$\Phi = \begin{bmatrix} \phi_{11} & \phi_{12} & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ \phi_{21} & \phi_{22} & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & \phi_{33} & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & \phi_{44} & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & \phi_{55} & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & \phi_{66} & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & \phi_{77} & \phi_{78} & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & \phi_{87} & \phi_{88} & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & \phi_{99} \end{bmatrix}$$

Spearman Correlation Coefficients and Two-Tailed Significance Tests

		CFINANCE	CCFINANCE
GRPRIV	*Corr*	0.318	0.288
	Sig. (2-t)	0.000	0.000
	N	154	149
GRSTAT	*Corr*	-0.281	-0.113
	Sig. (2-t)	0.000	0.169
	N	154	149
CHEMPRIV	*Corr*	0.107	-0.181
	Sig. (2-t)	0.246	0.060
	N	119	108
CHEMSTATE	*Corr*	-0.304	-0.010
	Sig. (2-t)	0.001	0.915
	N	119	108
CPRICE	*Corr*	0.221	-0.385
	Sig. (2-t)	0.006	0.000
	N	154	151
CCPRICE	*Corr*	0.318	0.602
	Sig. (2-t)	0.000	0.000
	N	154	152
CTRADE	*Corr*	0.203	-0.204
	Sig. (2-t)	0.011	0.012
	N	154	151

Spearman Correlation Coefficients and Two-Tailed Significance Tests (continued)

		CFINANCE	CCFINANCE
CCTRADE	*Corr*	0.242	0.696
	Sig. (2-t)	0.002	0.000
	N	154	152
CENTREF	*Corr*	0.268	0.067
	Sig. (2-t)	0.001	0.415
	N	154	151
CCENTREF	*Corr*	0.128	0.762
	Sig. (2-t)	0.113	0.000
	N	154	152
CFINANCE	*Corr*	1.000	0.062
	Sig. (2-t)	.	0.484
	N	154	131
CCFINANCE	*Corr*	0.062	1.000
	Sig. (2-t)	0.484	.
	N	131	152
CMEA	*Corr*	0.292	-0.355
	Sig. (2-t)	0.000	0.000
	N	154	151
INLIB	*Corr*	0.291	-0.078
	Sig. (2-t)	0.000	0.341
	N	154	151
INSHARE	*Corr*	0.420	-0.127
	Sig. (2-t)	0.000	0.119
	N	154	152
INF	*Corr*	0.238	-0.259
	Sig. (2-t)	0.003	0.001
	N	154	152

Non-standardized parameter estimates of direct effects (and standard errors) in Step_3

	GRPRIV	GRSTATE	CHEMPRIV	CHEMSTAT	CENTREF	INF	CPRICE	CTRADE	CFINANCE
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
War and Conflicts	-18.027 (4.451)	-14.041 (3.048)			-4.893 (1.825)				-12.864 (3.285)
INSHARE							0.213 (4.825)		
INLIB		1.711 (0.465)	2.081 (0.456)				0.546 (11.291)	4.078 (0.483)	
CMEA	-0.937 (0.234)	-0.509 (0.172)				0.153 (0.028)			
CHEMPRIV	0.229 (0.106)								
CHEMSTAT	-0.296 (0.125)	0.166 (0.077)	-0.573 (0.081)						
CENTREF	0.460 (0.166)	-0.445 (0.106)	0.311 (0.121)						
CCENTREF		-0.170 (0.223)		-0.523 (0.157)	-0.459 (0.112)	-0.133 (-0.025)			
INF		-1.194 (0.349)							1.0091 (0.345)
CPRCE	0.232 (0.091)	-0.279 (0.073)		-0.314 (0.064)	0.153 (1.866)				0.467 (0.057)
CCPRICE				-0.499 (0.138)	0.299 (0.089)	0.117 (0.020)	-0.226 (-5.819)		0.873 (0.127)
CTRADE					0.081 (0.044)				
CFINANCE	0.326 (0.116)				0.170 (0.045)				
CCFINANCE		-0.503 (0.236)			0.445 (0.134)				
Model Fit Indices: $\chi^2_{(df=57)}$=111.228 (p-value=0.000), RMSEA = 0.065 (p-value=0.085), NFI=0.964, CFI=0.982, NPAR=95, AIC=301.228, Hoelter(.01)=173									

APPENDIX VI

Step_4 Introducing the Judicial System and Protection of Property Rights

Descriptive Statistics

	N	Mean	Std. Deviation	Kurtosis
CPOLITIC	198	6.1263	17.5967	8.680
CCPOLITIC	202	11.2211	9.6073	.600
CORR	120	3.8333	9.5937	.356
CJUSTICE	142	1.2324	5.2233	4.603
Valid N (listwise)	92			

The equations of the Model in Step_4

$$\begin{bmatrix} GRPRIV_t \\ GRSTATE_t \\ CHEMPRIV_t \\ CHEMSTATE_t \\ CENTREF_t \\ INF_t \\ CPRICE_t \\ CTRADE_t \\ CFINANCE_t \\ CJUSTICE_t \end{bmatrix} = \begin{bmatrix} 0 & 0 & \beta_{13} & \beta_{14} & \beta_{15} & 0 & \beta_{17} & 0 & \beta_{19} & \beta_{1:10} \\ 0 & 0 & 0 & \beta_{24} & \beta_{25} & \beta_{26} & \beta_{27} & 0 & 0 & 0 \\ 0 & 0 & 0 & \beta_{34} & \beta_{35} & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & \beta_{47} & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & \beta_{57} & \beta_{58} & \beta_{59} & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & \beta_{96} & \beta_{97} & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \end{bmatrix} \cdot \begin{bmatrix} GRPRIV_t \\ GRSTATE_t \\ CHEMPRIV_t \\ CHEMSTATE_t \\ CENTREF_t \\ INF_t \\ CPRICE_t \\ CTRADE_t \\ CFINANCE_t \\ CJUSTICE_t \end{bmatrix} +$$

$$+ \begin{bmatrix} \gamma_{11} & 0 & 0 & \gamma_{14} & 0 & 0 & 0 \\ \gamma_{21} & 0 & \gamma_{23} & \gamma_{24} & 0 & 0 & \gamma_{27} \\ 0 & 0 & \gamma_{31} & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & \gamma_{45} & \gamma_{46} & 0 \\ \gamma_{51} & 0 & 0 & 0 & \gamma_{55} & \gamma_{56} & \gamma_{57} \\ 0 & 0 & 0 & \gamma_{64} & \gamma_{65} & \gamma_{66} & 0 \\ 0 & \gamma_{72} & \gamma_{73} & 0 & 0 & \gamma_{76} & 0 \\ 0 & 0 & \gamma_{83} & 0 & 0 & 0 & 0 \\ \gamma_{91} & 0 & 0 & 0 & 0 & \gamma_{96} & 0 \\ 0 & 0 & \gamma_{10:3} & 0 & \gamma_{10:5} & 0 & 0 \end{bmatrix} \cdot \begin{bmatrix} WAR_t \\ INSHARE_t \\ INLIB_t \\ CMEA_t \\ CCENTREF_t \\ CCPRICE_t \\ CCFINANCE_t \end{bmatrix} + \begin{bmatrix} \zeta_{1t} \\ \zeta_{2t} \\ \zeta_{3t} \\ \zeta_{4t} \\ \zeta_{5t} \\ \zeta_{6t} \\ \zeta_{7t} \\ \zeta_{8t} \\ \zeta_{9t} \\ \zeta_{10t} \end{bmatrix}$$

The covariance structure of the error terms

$$\Phi = \begin{bmatrix} \phi_{11} & \phi_{12} & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ \phi_{21} & \phi_{22} & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & \phi_{33} & 0 & 0 & 0 & 0 & 0 & 0 & \phi_{3:10} \\ 0 & 0 & 0 & \phi_{44} & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & \phi_{55} & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & \phi_{66} & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & \phi_{77} & \phi_{78} & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & \phi_{87} & \phi_{88} & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & \phi_{99} & 0 \\ 0 & 0 & \phi_{10:3} & 0 & 0 & 0 & 0 & 0 & 0 & \phi_{10:10} \end{bmatrix}$$

Spearman Correlation Coefficients and Two-Tailed Significance Tests

		CPOLITIC	CCPOLITIC	CORR	CJUSTICE
GRPRIV	*Corr*	0.133	0.167	-0.113	-0.053
	Sig. (2-t)	0.064	0.013	0.219	0.528
	N	194	200	120	142
GRSTAT	*Corr*	-0.158	-0.233	0.008	0.069
	Sig. (2-t)	0.028	0.000	0.929	0.414
	N	194	198	120	142
CHEMPRIV	*Corr*	0.179	0.060	-0.233	0.127
	Sig. (2-t)	0.043	0.475	0.028	0.191
	N	129	145	89	107
CHEMSTATE	*Corr*	-0.275	-0.240	0.029	0.138
	Sig. (2-t)	0.002	0.004	0.790	0.156
	N	129	145	89	107
CPRICE	*Corr*	0.265	-0.111	0.012	-0.021
	Sig. (2-t)	0.000	0.098	0.899	0.806
	N	197	201	120	142
CCPRICE	*Corr*	-0.058	0.525	-0.178	-0.012
	Sig. (2-t)	0.418	0.000	0.051	0.889
	N	196	202	120	142
CTRADE	*Corr*	0.259	0.034	-0.137	0.018
	Sig. (2-t)	0.000	0.612	0.135	0.831
	N	197	202	120	142
CENTREF	*Corr*	0.170	0.300	0.028	-0.106
	Sig. (2-t)	0.017	0.000	0.761	0.210
	N	197	200	120	142

Spearman Correlation Coefficients and Two-Tailed Significance Tests (continued)

		CPOLITIC	CCPOLITIC	CORR	CJUSTICE
CCENTREF	*Corr*	-0.120	0.423	-0.128	0.119
	Sig. (2-t)	0.091	0.000	0.164	0.159
	N	198	202	120	142
CFINANCE	*Corr*	0.194	0.316	-0.195	-0.015
	Sig. (2-t)	0.026	0.000	0.036	0.865
	N	131	154	116	139
CCFINANCE	*Corr*	-0.206	0.722	0.078	0.154
	Sig. (2-t)	0.021	0.000	0.414	0.078
	N	124	152	111	132
CPOLITIC	*Corr*	1.000	-0.056	-0.068	-0.047
	Sig. (2-t)	.	0.431	0.501	0.610
	N	198	197	100	118
CCPOLITIC	*Corr*	-0.056	1.000	0.190	0.125
	Sig. (2-t)	0.431	.	0.037	0.139
	N	197	202	120	142
CMEA	*Corr*	0.208	0.015	-0.222	0.070
	Sig. (2-t)	0.003	0.827	0.015	0.410
	N	198	201	120	142
INLIB	*Corr*	0.184	-0.020	-0.087	-0.168
	Sig. (2-t)	0.009	0.762	0.347	0.045
	N	198	201	120	142
INSHARE	*Corr*	0.357	0.133	-0.098	-0.121
	Sig. (2-t)	0.000	0.045	0.285	0.153
	N	198	202	120	142
CORR	*Corr*	-0.068	0.190	1.000	0.000
	Sig. (2-t)	0.501	0.037	.	0.999
	N	100	120	120	112
CJUSTICE	*Corr*	-0.047	0.125	0.000	1.000
	Sig. (2-t)	0.610	0.139	0.999	.
	N	118	142	112	142
INF	*Corr*	0.038	0.007	-0.114	0.065
	Sig. (2-t)	0.597	0.921	0.213	0.444
	N	198	202	120	142

Non-standardized parameter estimates of direct effects (and standard errors) in Step_4

	GRPRIV	GRSTATE	CHEMPRIV	CHEMSTAT	CENTREF
	(1)	(2)	(3)	(4)	(5)
War and Conflicts	-19.307 (4.490)	-13.645 (3.008)			-4.839 (1.828)
INSHARE					
INLIB		1.665 (0.466)	2.070 (0.455)		
CMEA	-1.003 (0.236)	-0.486 (0.171)			
CHEMPRIV	0.205 (0.105)				
CHEMSTAT	-0.325 (0.124)	0.182 (0.075)	-0.583 (0.079)		
CENTREF	0.451 (0.166)	-0.416 (0.100)	0.331 (0.119)		
CCENTREF				-0.529 (0.157)	-0.456 (0.112)
INF		-1.132 (0.340)			
CPRCE	0.193 (0.098)	-0.275 (0.073)		-0.316 (0.064)	0.081 (0.043)
CCPRICE				-0.495 (0.138)	0.299 (0.089)
CTRADE					0.150 (0.029)
CFINANCE	0.314 (0.116)				0.170 (0.045)
CCFINANCE		-0.628 (0.160)			0.441 (0.134)
CJUSTICE	-0.362 (0.211)				
R-square	*0.43*	*0.419*	*0.429*	*0.194*	*0.507*

Non-standardized parameter estimates of direct effects (and standard errors) in Step_4 (continued)

	INF	CPRICE	CTRADE	CFINANCE	CJUSTICE
	(6)	(7)	(8)	(9)	(10)
War and Conflicts				-12.902 (3.285)	
INSHARE		1.052 (0.218)			
INLIB		3.896 (0.345)	4.078 (0.483)		-2.018 (0.193)
CMEA	0.153 (0.028)				
CHEMPRIV					
CHEMSTAT					
CENTREF					
CCENTREF	-0.133 (0.025)				0.194 (0.068)
INF				1.080 (0.345)	
CPRCE				0.462 (0.057)	
CCPRICE	0.117 (0.020)	-0.506 (0.087)		0.877 (0.127)	
CTRADE					
CFINANCE					
CCFINANCE					
CJUSTICE					
R-square	*0.336*	*0.583*	*0.241*	*0.404*	*0.530*
Model Fit Indices: $\chi^2_{(df=70)}$=122.392 (p-value=0.000) RMSEA = 0.058 (p-value=0.222) NFI=0.961, CFI=0.982, NPAR=100 AIC=322.392 Hoelter(.01)=186					

APPENDIX VII

Step_5 Introducing the Political Environment

Note: See Appendix VI for descriptive statistics and Spearman correlation coefficients

Model specification in Step_5

$$
\begin{bmatrix} GRPRIV_t \\ GRSTATE_t \\ CHEMPRIV_t \\ CHEMSTATE_t \\ CENTREF_t \\ INF_t \\ CPRICE_t \\ CTRADE_t \\ CFINANCE_t \\ CJUSTICE_t \\ CPOLITIC_t \end{bmatrix}
=
\begin{bmatrix}
0 & 0 & \beta_{13} & \beta_{14} & \beta_{15} & 0 & \beta_{17} & 0 & \beta_{19} & \beta_{1:10} & 0 \\
0 & 0 & 0 & \beta_{24} & \beta_{25} & \beta_{26} & \beta_{27} & 0 & 0 & 0 & \beta_{2:11} \\
0 & 0 & 0 & \beta_{34} & \beta_{35} & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & \beta_{47} & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & \beta_{57} & \beta_{58} & \beta_{59} & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & \beta_{7:11} \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & \beta_{8:11} \\
0 & 0 & 0 & 0 & 0 & \beta_{96} & \beta_{97} & 0 & 0 & 0 & \beta_{9:11} \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & \beta_{10:11} \\
\beta_{11:1} & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0
\end{bmatrix}
\cdot
\begin{bmatrix} GRPRIV_t \\ GRSTATE_t \\ CHEMPRIV_t \\ CHEMSTATE_t \\ CENTREF_t \\ INF_t \\ CPRICE_t \\ CTRADE_t \\ CFINANCE_t \\ CJUSTICE_t \\ CPOLITIC_t \end{bmatrix}
$$

$$
+
\begin{bmatrix}
\gamma_{11} & 0 & 0 & \gamma_{14} & 0 & 0 & 0 & \gamma_{18} \\
\gamma_{21} & 0 & \gamma_{23} & \gamma_{24} & 0 & 0 & \gamma_{27} & 0 \\
0 & 0 & \gamma_{31} & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & \gamma_{45} & \gamma_{46} & 0 & 0 \\
\gamma_{51} & 0 & 0 & 0 & \gamma_{55} & \gamma_{56} & \gamma_{57} & 0 \\
0 & 0 & 0 & \gamma_{64} & \gamma_{65} & \gamma_{66} & 0 & 0 \\
0 & \gamma_{72} & \gamma_{73} & 0 & 0 & \gamma_{76} & 0 & 0 \\
0 & 0 & \gamma_{83} & 0 & 0 & 0 & 0 & \gamma_{88} \\
\gamma_{91} & 0 & 0 & 0 & 0 & \gamma_{96} & 0 & 0 \\
0 & 0 & \gamma_{10:3} & 0 & \gamma_{10:5} & 0 & 0 & 0 \\
0 & \gamma_{11:2} & \gamma_{11:3} & 0 & 0 & 0 & 0 & \gamma_{11:8}
\end{bmatrix}
\cdot
\begin{bmatrix} WAR_t \\ INSHARE_t \\ INLIB_t \\ CMEA_t \\ CCENTREF_t \\ CCPRICE_t \\ CCFINANCE_t \\ CCPOLITIC_t \end{bmatrix}
+
\begin{bmatrix} \zeta_{1t} \\ \zeta_{2t} \\ \zeta_{3t} \\ \zeta_{4t} \\ \zeta_{5t} \\ \zeta_{6t} \\ \zeta_{7t} \\ \zeta_{8t} \\ \zeta_{9t} \\ \zeta_{10t} \\ \zeta_{11t} \end{bmatrix}
$$

The covariance structure of the error terms

$$\Phi = \begin{bmatrix} \phi_{11} & \phi_{12} & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ \phi_{21} & \phi_{22} & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & \phi_{33} & 0 & 0 & 0 & 0 & 0 & 0 & \phi_{3:10} & 0 \\ 0 & 0 & 0 & \phi_{44} & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & \phi_{55} & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & \phi_{66} & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & \phi_{77} & \phi_{78} & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & \phi_{87} & \phi_{88} & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & \phi_{99} & 0 & 0 \\ 0 & 0 & \phi_{10:3} & 0 & 0 & 0 & 0 & 0 & 0 & \phi_{10:10} & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & \phi_{11:11} \end{bmatrix}$$

Stability index for the following variable is 0.188

CPOLITIC
CJUSTICE
CFINANCE
CTRADE
CPRICE
CENTREF
CHEMSTAT
CHEMPRIV
GRPRIV

Non-standardized parameter estimates of direct effects (and standard errors) in Step_5

	GRPRIV	GRSTATE	CHEMPRIV	CHEMSTAT	CENTREF
	(1)	(2)	(3)	(4)	(5)
War and Conflicts	-17.958 (4.338)	-14.472 (2.952)			-4.499 (1.811)
INSHARE					
INLIB		1.898 (0.460)	2.102 (0.453)		
CMEA	-1.110 (0.234)	-0.395 (0.173)			
CHEMPRIV	0.165 (0.100)				
CHEMSTAT	-0.394 (0.120)	0.158 (0.074)	-0.582 (0.079)		
CENTREF	0.460 (0.165)	-0.346 (0.102)	0.324 (0.119)		
CCENTREF				-0.511 0.155)	-0.396 (0.098)
INF		-1.117 (0.333)			
CPRCE	0.091 (0.103)	-0.239 (0.072)		-0.300 (0.063)	0.064 (0.043)
CCPRICE				-0.487 (0.137)	0.292 (0.091)
CTRADE					0.136 (0.029)
CFINANCE	0.454 (0.111)				0.151 (0.043)
CCFINANCE		-0.671 (0.152)			0.391 (0.117)
CJUSTICE	-0.206 (0.195)				
CPOLITIC		-0.122 (0.062)			
CCPOLITIC	-0.409 (0.133)				
GRPRIV					
R-square	*0.494*	*0.445*	*0.432*	*0.197*	*0.505*

Non-standardized parameter estimates of direct effects (and standard errors) in Step_5 (continued)

	INF	CPRICE	CTRADE	CFINANCE	CJUSTICE	CPOLITIC
	(6)	(7)	(8)	(9)	(10)	(11)
War and Conflicts				-12.906 (3.267)		
INSHARE		0.966 (0.243)				2.334 (0.288)
INLIB		3.564 (0.353)	2.966 (0.521)		-2.262 (0.210)	1.125 (0.421)
CMEA	0.154 (0.028)					
CHEMPRIV						
CHEMSTAT						
CENTREF						
CCENTREF	-0.131 (0.025)				0.207 (0.069)	
INF				1.217 (0.350)		
CPRCE				0.453 (0.066)		
CCPRICE	0.116 (0.020)	-0.596 (0.101)		0.839 (0.125)		
CTRADE						
CFINANCE						
CCFINANCE						
CJUSTICE						
CPOLITIC		0.148 (0.059)	0.335 (0.079)	0.132 (0.068)	-0.089 (0.030)	
CCPOLITIC		0.278 (0.088)	0.350 (0.119)			-0.352 (0.090)
GRPRIV						0.228 (0.042)
R-square	*0.335*	*0.62*	*0.324*	*0.482*	*0.652*	*0.527*
Model Fit Indices: $\chi^2_{(df=86)}$=158.940 (p-value=0.000) , RMSEA = 0.061 (p-value=0.106) NFI=0.957, CFI=0.979, NPAR=123, AIC=404.94, Hoelter (.01)=170						

APPENDIX VIII

Step_6 Introducing Perception of Corruption

Note: See Appendix VI for descriptive statistics and Spearman correlation coefficients

Model specification in Step_6

$$
\begin{bmatrix} GRPRIV_t \\ GRSTATE_t \\ CHEMPRIV_t \\ CHEMSTATE_t \\ CENTREF_t \\ INF_t \\ CPRICE_t \\ CTRADE_t \\ CFINANCE_t \\ CJUSTICE_t \\ CPOLITIC_t \\ CORR_t \end{bmatrix}
=
\begin{bmatrix}
0 & 0 & \beta_{13} & \beta_{14} & \beta_{15} & 0 & 0 & 0 & \beta_{19} & \beta_{1:10} & 0 & 0 \\
0 & 0 & 0 & \beta_{24} & \beta_{25} & \beta_{26} & 0 & 0 & 0 & 0 & \beta_{2:11} & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & \beta_{3:12} \\
0 & 0 & 0 & 0 & 0 & 0 & \beta_{47} & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & \beta_{57} & \beta_{58} & \beta_{59} & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & \beta_{7:11} & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & \beta_{8:11} & \beta_{8:12} \\
0 & 0 & 0 & 0 & 0 & \beta_{96} & \beta_{97} & 0 & 0 & 0 & \beta_{9:11} & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & \beta_{10:11} & 0 \\
\beta_{11:1} & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
\beta_{12:1} & \beta_{12:2} & 0 & 0 & 0 & 0 & 0 & 0 & 0 & \beta_{12:10} & 0 & 0
\end{bmatrix}
\cdot
\begin{bmatrix} GRPRIV_t \\ GRSTATE_t \\ CHEMPRIV_t \\ CHEMSTATE_t \\ CENTREF_t \\ INF_t \\ CPRICE_t \\ CTRADE_t \\ CFINANCE_t \\ CJUSTICE_t \\ CPOLITIC_t \\ CORR_t \end{bmatrix}
+
\begin{bmatrix}
\gamma_{11} & 0 & 0 & \gamma_{14} & 0 & 0 & 0 & \gamma_{18} \\
\gamma_{21} & 0 & \gamma_{23} & \gamma_{24} & 0 & 0 & \gamma_{27} & 0 \\
0 & 0 & \gamma_{33} & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & \gamma_{45} & \gamma_{46} & 0 & 0 \\
\gamma_{51} & 0 & 0 & 0 & \gamma_{55} & \gamma_{56} & \gamma_{57} & 0 \\
0 & 0 & 0 & \gamma_{64} & \gamma_{65} & \gamma_{66} & 0 & 0 \\
0 & \gamma_{72} & \gamma_{73} & 0 & 0 & \gamma_{76} & 0 & \gamma_{78} \\
0 & 0 & \gamma_{83} & 0 & 0 & 0 & 0 & \gamma_{88} \\
\gamma_{91} & 0 & 0 & 0 & 0 & \gamma_{96} & 0 & 0 \\
0 & 0 & \gamma_{10:3} & 0 & \gamma_{10:5} & 0 & 0 & 0 \\
0 & \gamma_{11:2} & \gamma_{11:3} & 0 & 0 & 0 & 0 & \gamma_{11:8} \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0
\end{bmatrix}
\cdot
\begin{bmatrix} WAR_t \\ INSHARE_t \\ INLIB_t \\ CMEA_t \\ CCENTREF_t \\ CCPRICE_t \\ CCFINANCE_t \\ CCPOLITIC_t \end{bmatrix}
+
\begin{bmatrix} \zeta_{1t} \\ \zeta_{2t} \\ \zeta_{3t} \\ \zeta_{4t} \\ \zeta_{5t} \\ \zeta_{6t} \\ \zeta_{7t} \\ \zeta_{8t} \\ \zeta_{9t} \\ \zeta_{10t} \\ \zeta_{11t} \\ \zeta_{12t} \end{bmatrix}
$$

The covariance structure of the error terms

$$\Phi = \begin{bmatrix} \phi_{11} & \phi_{12} & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ \phi_{21} & \phi_{22} & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & \phi_{33} & 0 & 0 & 0 & 0 & 0 & 0 & \phi_{3:10} & 0 & 0 \\ 0 & 0 & 0 & \phi_{44} & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & \phi_{55} & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & \phi_{66} & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & \phi_{77} & \phi_{78} & 0 & 0 & 0 & \phi_{6:12} \\ 0 & 0 & 0 & 0 & 0 & 0 & \phi_{87} & \phi_{88} & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & \phi_{99} & 0 & 0 & 0 \\ 0 & 0 & \phi_{10:3} & 0 & 0 & 0 & 0 & 0 & 0 & \phi_{10:10} & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & \phi_{11:11} & 0 \\ 0 & 0 & 0 & 0 & 0 & \phi_{12:6} & 0 & 0 & 0 & 0 & 0 & \phi_{12:12} \end{bmatrix}$$

Stability index for the following variables is 0.202
CORR CPOLITIC CJUSTICE CFINANCE CTRADE CPRICE GRSTATE CENTREF CHEMSTAT CHEMPRIV GRPRIV

Non-standardized parameter estimates of direct effects (and standard errors) in Step_6

	GRPRIV	GRSTATE	CHEMPRIV	CHEMSTAT	CENTREF
	(1)	(2)	(3)	(4)	(5)
War and Conflicts	-17.939 (4.302)	-14.703 (2.953)			-3.751 (1.773)
INSHARE					
INLIB		1.888 (0.462)	1.707 (0.451)		
CMEA	-1.088 (0.224)	-0.401 (0.173)			
CHEMPRIV	0.088 (0.104)				
CHEMSTAT	-0.447 (0.119)	0.158 (0.074)	-0.564 (0.074)		
CENTREF	0.416 (0.165)	-0.374 (0.101)	0.292 (0.113)		
CCENTREF				-0.512 (0.155)	-0.420 (0.098)
INF		-1.089 (0.336)			
CPRCE		-0.223 (0.071)		-0.305 (0.063)	
CCPRICE				-0.483 (0.136)	0.240 (0.077)
CTRADE					0.152 (0.026)
CFINANCE	0.493 (0.106)				0.175 (0.035)
CCFINANCE		-0.658 (0.152)			0.414 (0.117)
CJUSTICE	-0.294 (0.163)				
CPOLITIC		-0.125 (0.062)			
CCPOLITIC	-0.388 (0.131)				
GRPRIV					
GRSTATE					
CORR			-0.417 (0.108)		
R-square	*0.502*	*0.441*	*0.477*	*0.200*	*0.507*

Non-standardized parameter estimates of direct effects (and standard errors) in Step_5 (continued)

	INF	CPRICE	CTRADE	CFINANCE	CJUSTICE	CPOLITIC	CORR
	(6)	(7)	(8)	(9)	(10)	(11)	(12)
War and Conflicts				-12.409 (3.263)			
INSHARE		0.875 (0.241)				2.327 (0.289)	
INLIB		3.583 (0.351)	2.591 (0.509)		-2.563 (0.209)	1.157 (0.421)	
CMEA	0.156 (0.028)						
CHEMPRIV							
CHEMSTAT							
CENTREF							
CCENTREF	-0.130 (0.024)				0.224 (0.067)		
INF				1.206 (0.349)			
CPRCE				0.511 (0.066)			
CCPRICE	0.114 (0.019)	-0.586 (0.100)		0.831 (0.125)			
CTRADE							
CFINANCE							
CCFINANCE							
CJUSTICE							0.325 (0.094)
CPOLITIC		0.168 0.057)	0.316 (0.075)	0.150 (0.068)	-0.096 (0.029)		
CCPOLITIC		0.278 (0.088)	0.390 (0.114)			-0.349 (0.090)	
GRPRIV						0.221 (0.042)	-0.139 (0.040)
GRSTATE							-0.191 (0.059)
CORR			-0.498 (0.106)				
R-square	*0.334*	*0.622*	*0.406*	*0.521*	*0.699*	*0.525*	*0.197*
Model Fit Indices: $\chi^2_{(df=101)}$=160.528 (p-value=0.000), RMSEA = 0.051 (p-value=0.437) NFI=0.957, CFI=0.983, NPAR=129, AIC=418, Hoelter(.01)=193							

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STUDY 3

Hidden Activities and Bureaucratic Corruption

Abstract

There are two main hypotheses that can support the empirical observation that the volume of the shadow activities is positively correlated with the levels of corruption in transition economies. The first hypothesis presumes that excessive government regulations and the associated bureaucratic corruption complement taxation as factors that push private firms away from the official sector and into the unofficial economy. This hypothesis is formalized in the theoretical model of Friedman, Johnson et al.(2000). The second hypothesis stands on the belief that, as a result of their illegal activities, private firms that engage in unofficial activities also need to engage in corrupting public officials. This is the cornerstone of the theoretical analysis in this study, where I build a model that links the quality of institutions to tax evasion and to bureaucratic corruption. In a partial equilibrium set-up, I find that the effect of taxation on the extent of firms' participation in the unofficial sector is best interpreted if considered in connection with two other aspects: the benefits that firms extract from their legal activities, and the factors that facilitate activities in the shadow sector. In a business environment characterized by a well—functioning financial system, and with high quality of public goods such as contract enforcement and protection of property, firms may be willing to tolerate higher levels of taxes without necessarily migrate to the underground sector. Firms' incentives to be present in the official sector also relate to low incentives that the bureaucrats may have to engage in corrupt deals with non-compliant firms. However, in economic environments with weak institutions and/or with poorly motivated bureaucrats even low levels of taxes may prove high enough to strengthen the temptation to undertake shadow activities. I find that, when circumstances are such that activities in the underground are profitable, a government that experiences vanishing tax revenues should concentrate on enticing non-compliant firms to be active in the official sector, rather than attempt to squeeze more taxes from the existing official activities. Policy implications related to incentives that the bureaucrats may have to engage in corrupt deals with non-compliant firms are also analyzed.

Keywords: unofficial economy, tax evasion, bureaucratic corruption, transition, institutions

Hidden Activities and Bureaucratic Corruption

INTRODUCTION

From the previous study in this thesis we learn that an empirical model that includes initial conditions and measures of the process of reforms and institutions (as explanatory variables) accounts for approximately half of the variance in the calculated rates of growth in the private sector across transition economies and through time. A possible reason behind this result is partly attributable to data deficiencies discussed in the study. Especially during the first years of transition, the statistical offices in transition economies varied to a large extent in their ability to produce estimates that accurately reflect the activity of small-sized firms in the private sector.

Yet another reason why we cannot explain the fluctuations in growth of the private sector to a larger extent can be related to the efforts firms make in order to hide part of their operations from the government's sight. Depending on conditions and opportunities created in the market, as a result of government policies adopted during transition, firms may decide to either disguise their operations in the underground economy or to surface in the official sector. This amounts to saying that, during periods of deep transformations in the economic system, the growth generated by start-up private firms may be accompanied by changes in observed aggregate performance as a result of firms' 'migration' between the official and the unofficial sectors.

In the present study I develop a theoretical analysis of the incentives and/or disincentives that legally registered private firms have to operate in the unofficial sector. Such incentives and/or disincentives relate to taxation, institutions that support official activities and bureaucratic corruption that facilitates underground activities.

The issue of the unofficial economy is of a great interest in the transition literature, and it is often associated with the issue of bureaucratic corruption. In Table 1 I introduce some of the evidence we have on the extent of the two phenomena in transition countries.

Table 1 Unofficial economy and corruption in some transition countries

	Poland	Slovakia	Romania	Russia	Ukraine	Source
Unofficial Economy (as% of total GDP; 1995)	15.2	14.6	17.4	40.3	48.9	Johnson, Kaufmann et al.(1997)
Percentage of hidden sales	5.4	7.4	5.7	28.9	41.2	Johnson, Kaufmann et al(2000)
Response rate on hidden sales	*85%*	*65%*	*64%*	*49%*	*56%*	Johnson, Kaufmann et al(2000)
Percentage of hidden salaries	8.6	7.6	7.6	26.1	37.9	Johnson, Kaufmann et al(2000)
Taxes as % of Sales	15.5	16.4	17.2	23.9	24.2	Johnson, Kaufmann et al(2000)
Other payments to gov as % of sales	3.9	3.8	4.8	6	7.2	Johnson, Kaufmann et al(2000)
Profits (1996) as percent of sales	10	6	13	21	18	Johnson, Kaufmann et al(2000)
% who think that firms make extralegal payments for government services	20	38	20	91	87	Johnson, Kaufmann et al(2000)
% who say firms pay for protection (presumably mafia)	8	14.9	0.6	92.9	88.8	Johnson, Kaufmann et al(2000)
% saying courts can be used to enforce an agreements	72.9	67.9	86.9	58.4	54.7	Johnson, Kaufmann et al(2000)
Proportion of bribes spent on:						Hellman, Jones et al(2000)
Licenses	26.1	33.2	39.8	20.4	21.3	Hellman, Jones et al(2000)
Taxes	8.8	10.1	6.3	18.5	25.8	Hellman, Jones et al(2000)
Customs	15.8	11.8	15.2	8.8	12.2	Hellman, Jones et al(2000)
Public Services	7.4	5.7	16.1	11.7	10.3	Hellman, Jones et al(2000)
Index of Financial System Reforms (1996)	0.55	0.50	0.48	0.41	0.26	Study 1 in the thesis

The study of Johnson, Kaufmann et al(1997) provides us with an interesting empirical analysis of the unofficial economy in transition countries. In their analysis, the authors mainly rely on the estimates of the size the unofficial sector produced by Kaufmann and Kaliderda(1996). Based on this data series we learn that, in year 1995, the estimated magnitude of the unofficial sector in transition countries ranges from 5.8% of total GDP in Slovak Republic to 62.6% in Georgia. Large unofficial sectors, as reflected by the estimates based on electricity consumption data, are observed in Azerbaijan (60.6% of total GDP), Ukraine (48.9%), Russia (40.3%) and Moldova, Latvia and Kazakhstan (in the range of 34-35% of GDP). In the study the authors relate the size of the unofficial economy to measures of taxation and the quality of public goods provided by the government. Taxation is reflected by the index of tax fairness reported by CEER[1] Wall Street Journal in 1996. The quality of public goods supplied by governments in transition is proxied by indicators of legal safeguards of investments, the rule law (both indicators are reported in CEER) and by the index of government regulations of economic activities reported by Heritage Foundation. The CEER index of crime and corruption, as reported in the 1996 issue, is also employed. Among other results, the authors find that the unofficial economy is large when the quality of public goods provided in the official sector is poor, and when the rule of law is weak. The size of the unofficial economy also correlates negatively with the fairness of taxes, and positively with the regulations that the government imposes on economic activities. Furthermore, the authors find that a decrease in corruption reduces the share of the unofficial economy by 5 to 6 %. These empirical results are interpreted in the study as supporting the hypothesis that high taxes, excessive government regulations and the associated high bureaucratic corruption are factors that drive firms into the unofficial economy.

The fact that unofficial activities are pervasive in some of the transition countries is also reflected in survey studies that analyze data collected at the firm level. Johnson, Kaufmann et al (2000) find that the average percentage of hidden sales of legally registered private firms in Ukraine amounts to almost 41%, In Russia firms hide, on average, as much as 30% of their sales. These findings should be interpreted in the light of the fact that the rate of response to the question on hidden sales in the survey is

[1] Central European Economic Review

relatively low in the two countries (40% in Russia and 56% in Ukraine). The proportion of hidden sales is found to be much lower (on average) for firms in the other countries included in the survey, respectively Poland (5.4%), Slovakia (7.4%) and Romania (5.7%). The study also reveals that 87% of the managers interviewed in Ukraine think that firms (in their country) make 'extralegal payments for government services'. In Russia, 98% of managers believe so. In the other three countries, the proportion of managers that believe that firms engage in corrupting public official ranges between 20% (Poland and Romania) and 38% (Slovakia).

Further details on the type of extralegal payments advanced by firms to public officials are to be found in Hellman, Jones et al (2000), although based on a different data set[2]. The survey in the study covers all transition economies and it reveals that in all of the five transition countries included in Table 1 the highest proportion of bribes paid by firms to public officials is related to licenses. In Ukraine and Russia, the second highest proportion is related to taxes. Significant proportions of bribes also appear to be related to customs in transition economies.

Conclusions of empirical analyses associated with the surveys studies mentioned above prove less sanguine with respect to the interpretation of the relationship between the unofficial economy and bureaucratic corruption, when compared to the conclusions formulated in Johnson, Kaufmann et al(1997). In Johnson, Kaufmann et al(2000) we learn that their multivariate regression analysis, that includes the percentage of unreported sales as the dependent variable, does not produce any significant association between unofficial activities and the payments advanced by firms for private protection (presumably mafia protection). Furthermore, no significant association is detected between hidden sales and managers' perceptions on the 'workability of the courts'. However, bribes paid to government officials are significantly associated with the magnitude of underreported sales. Based on these results the authors conclude the following: '*these results suggest either that avoiding bureaucratic corruption is an incentive for unofficial activity or that firms that hide their output need to pay bribes. Unfortunately, our data do not allow us to distinguish between the two possibilities.*' (Johnson, Kaufmann et al(2000)).

[2] BEEPS survey

We therefore have two hypotheses on how the size of unofficial activities relates to extent of bureaucratic corruption, and both hypotheses lead to the same empirical implication: higher bribes are associated with higher levels of unofficial activities. As it shall be discussed in Section I, the hypothesis that high levels of taxation and bureaucratic corruption, as associated with the implementation of (excessive) government regulations, are the factors that drive firms into the underground economies is central to the theoretical model formalized in Friedman, Johnson et al (1997). The alternative hypothesis that firms need to pay bribes if active in the unofficial sector is the cornerstone of the analysis in this study. I define a theoretical setup that links taxation, the quality of institutions that support firm's official activities, tax evasion, and bureaucratic corruption that facilitates tax evasion.

The main message conveyed by the theoretical analysis in this study is that the effect of taxation on the extent of firms' participation in the official sector should be interpreted in connection with the benefits a firm extracts from being active in the sector, and with the factors that facilitate activities underground. In an economic environment characterized by well-functioning financial markets, and with high-quality judicial institutions and protection of property rights, firms may be willing to tolerate higher levels of tax rates without necessarily migrate in the underground sector. Firms' incentives to be present in the official sector also relate to low incentives that bureaucrats may have to engage in corrupt deals with firms that do not comply with the law. However, in economies with institutions that do not (adequately) support business activities in the official sector, even low levels of tax rates may prove high enough to strengthen the temptation to evade taxes and operate in the underground. I find that, when conditions in the two sectors combine such that activities in the underground are profitable, a government that experiences 'vanishing' tax revenues should concentrate on enticing firms to operate in the official sector rather than attempt to squeeze more taxes from existing official activities. Policy implications related to incentives that public officials have to engage in corrupt acts are also analyzed.

The analysis unfolds as following: Section I focuses on the concepts of the unofficial economy and corruption, as well as on the existing theoretical models that are relevant to the current analysis. In Section II I introduce the model and the associated analysis, and in Section III I collect the results. Section IV includes discussions on the assumptions in the model and on some possible extensions.

Section I: Typologies and related models

The theoretical framework introduced in this study relates to two main strands of existing theoretical literature: theories that address the causes and consequences of the unofficial economy, and the theoretical literature on corruption. Both subjects have generated a substantial research interest, and therefore the corresponding literature is very rich. As a review of the literature is outside the scope of this study, I will supply the reader mainly with references to the relevant review studies. What this section includes are typologies related to the two concepts of 'unofficial economy' and 'corruption' that may prove useful in organizing the related literature, as well as discussions of theoretical models that are directly relevant to the analysis in this study.

Unofficial Economy

A detailed discussion on various definitions advanced for the concept of unofficial economy is provided in Dallago(1990). Alternative names associated with the concept are the following: hidden, parallel, underground, shadow, illegal, criminal, second[3], clandestine, black, informal, unobserved, unmeasured and so on[4]. The author recommends caution in the use of the terms criminal, informal and unmeasured. Informal economy is defined as including irregular activities performed '*within a family or in small communities, based on relationships of kinships or friendship*'. The criminal sector includes activities that are prohibited by law[5] such as drug production and distribution, traffic of persons etc. The term of unmeasured (or under-recorded) economy blurs the distinction between activities that are not covered by official

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[3] The term 'second economy', introduced by Grossman, refers to the (hidden) activities that developed in parallel with the official sector in the Soviet – type economies.
[4] A rich collection of abstracts of (pre-1991) theoretical and empirical studies that focus on various issues related to unofficial economy is Danesh(1991).
[5] Some activities may be rendered illegal, without necessarily having a criminal nature (for example this is the case of the distribution of alcohol when the state chooses to maintain a monopoly).

statistics, due to the limitations or the deliberate choice of the statistical authorities, and the activities of economic agents that attempt to evade official registration. Finally, the author's preferred term is that of 'irregular economy', by which he designates what we usually hope to capture in economics, when studying the unofficial economy: '*a complex of phenomena and activities engaged in for economic ends (…) that share the common characteristic of being deliberate attempts to evade or avoid the rules (laws, regulations, contracts and agreements) that apply to a particular context, the purpose being to achieve a goal that is permitted, tolerated or at any rate not explicitly condemned in the economic system concerned. Moreover, the phenomena must have a general social character*' (Dallago(1990)).

A useful typology related to the concept of 'unofficial economy' can be defined by distinguishing the unofficial activities of individuals from the unofficial activities of firms.

Underground activities of individuals relate to unofficial employment and/or personal income tax evasion[6]. Unofficial employment refers to the situation when an individual is not declared as employed, and therefore s/he is potentially eligible for associated welfare benefits. The income corresponding to unofficial employment escapes taxation completely. Income tax evasion is usually considered when an officially employed individual does not declare the total income s/he earns. The main difference between the two concepts refers to the official status of (un)employment of the individual although, in practice, it is often difficult to have a clear distinction between them. The body of literature that is most relevant to the issue of unofficial unemployment is reviewed in Schneider and Enste(2000), and it usually focuses on the incentives that individuals and households have to engage in employment in the black labor market. Such incentives are defined in terms of high levels of taxation on labor, official unemployment and high complexity of the tax systems. The theoretical work on income tax evasion was pioneered by Allingham and Sandmo(1972), and it is the subject of reviews in Cowell(1990), Pyle(1991) and Andreoni and Erard(1998). Models that analyze income tax evasion focus on individuals' incentives (and possibilities) to

[6] As mentioned in Pyle(1991) a distinction is to be made between tax evasion and tax avoidance. Tax avoidance implies the use of legal loopholes in order to reduce the reported level of taxable income.

evade taxes, as well as on the corresponding schemes employed by the government in order to reduce the extent of tax evasion. In this respect the probability of being detected and punished for tax evasion, and to a lower extent the costs of compliance, are central to this type of models.

Underground activities pursued by firms can also be considered in terms of unofficial employment of resources (when the firm is not legally registered), or as related to tax evasion (when the firm is officially registered, but it does not declare the total volume of its sales/profits[7]). As in the case of individuals' unofficial activities, it is possible to consider some of the activity of unregistered firms as a special case of tax evasion, in which case we do not account for the official status of the firm.

Theoretical models that analyze firm's underground activities usually rely on the assumption that the main factor that drives firms into the unofficial economy is taxation, but they impose different constraints on firms' activities in the shadow sector.

Loayza(1996) analyzes the effects of the unofficial activities on the official sector in an endogenous growth model. The model relies on the assumption that firms in both sectors (official and unofficial) need to employ public goods that are in limited supply and subject to congestion: the higher the total level of economic activity in the two sectors, the lower the amount of public goods available to a particular firm. Public goods are assumed to be less productive in the unofficial sector than they are in the official sector. Furthermore, the author assumes that, if active in the unofficial sector, firms pay penalties as a result of their illegal activities. The penalty rate is directly proportional to the size of the unofficial sector. The public goods for which firms in the two sectors compete are provided by the government and financed based on the tax revenues the state collects from the official sector. The model sustains the prediction of a vicious circle as following: the higher the level of unofficial activities, the more public goods that are diverted to the underground sector, the less profitable the activities in the official sector, and the lower the taxes collected by the government. Lower tax revenues translate into a lower supply of public goods. The two sectors coexist in equilibrium

[7] There are several ways in which tax evasion can occur. Firms evade taxes by underreporting their total income, or by overcharging the expenditure side in their taxable income reports. Yet another way of evading taxes, particularly popular in transition economies, is barter trade. However, reasons behind barter transactions are believed to be more complex than the pure motivation of tax evasion. In this study I abstract from tax evasion as a result of over-reporting expenditures or barter transactions.

when the marginal returns on the use of capital in the sectors are equalized. Given the setup in the study, the model does not allow for the possibility that a firm may decide to be active in both sectors in parallel.

Similar assumptions are made in Johnson, Kaufmann et al(1997). The authors formulate a theoretical model with the objective to analyze the allocation of labor between official activities and the underground activities, and the corresponding implications for tax revenues and public goods provided by the government. Public goods are necessary inputs for firms' activities in both sectors but, if active in the unofficial sector, firms employ public goods provided by the mafia. The mafia has a similar role in the unofficial sector as the state has in the official sector: it collects taxes from firms active in the underground sector and it provides public goods. The authors conjecture that the model supports two types of stable equilibria. A 'good' equilibrium ensues when most firms are active in the official sector as, based on the tax revenues collected, the government has the ability to provide high quality public goods. For a new entrant in the market it will therefore be profitable to be active in the official sector. The 'bad' equilibrium arises when most firms are already into the underground sector, as a result of high level of taxes imposed on official activities[8]. In this case the mafia is the main provider of public goods in the economy. As with the case of the model in Loayza(1996), the theoretical analysis cannot be used to support the hypothesis that, in equilibrium, a firm chooses to be active in both sectors in parallel.

Grossman(1995) builds a model that has the potential to support the empirical observation that a firm may be active in both sectors at the same time. The objective of the study is to analyze the effect that the competition between the mafia and the state has on firm's activities. The author assumes a representative firm that considers the allocation of its resources (labor) between the official and the unofficial sectors. Public goods are again necessary inputs for firm's activities in both sectors, and the state competes with the mafia in the provision of public goods. The state taxes firm's activities in the official sector and the mafia taxes the firm's illegal activities. Both the state and the mafia finance the public goods they provide based on the collected tax

[8] The authors also discuss the possibility that excessive government regulations and bureaucratic corruption are yet additional factors that drive firms into the shadow sector, but in the model they only formalize taxation.

revenues. Public goods provided by the government are less productive in the unofficial sector than they are in official sector. Public goods provided by the mafia are available only to illegal activities. With a state that seeks to maximize its political rent (defined as the difference between total tax revenue and the costs of public goods the state provides), both the government and the mafia will find it optimal to impose the same level of tax rates in the two sectors. The firm will then find it optimal to split its labor equally between the two sectors, and to employ all the available state public goods in its legal activities. As the firm's net total production is higher than it is the case when the state has a monopoly on the provision of public goods, the author concludes that competition between the mafia and the state benefits the firm. When the model is extended such that it accounts for disruptive effects of the mafia on the provision of public goods in the official sector, a similar optimal solution is obtained as long as the disruptive effects are not too high. If such effects are high enough, then the model predicts that the state collapses and the mafia reigns in the economy.

We can summarize the incentives and disincentives firms have to operate in one of the two sectors, as reflected in the three models describes above, as following:

- High tax rates on official activities translate into disincentives to operate in the official sector (all the three models).
- When the state is the only provider of public goods (Loayza(1996) and early variants of the model in Grossman(1995)), then disincentives to operate in the shadow sector are introduced in the form of lower productivity of public goods used in illegal activities. In Loayza(1996) additional constraints on activities in the shadow sector are introduced in the form of penalties associated with illegal activities.
- When the mafia is introduced as an alternative provider of public goods (Johnson, Kaufmann et al(1997) and Grossman(1995)), then the taxes paid to the mafia play the same role in the shadow sector as taxes imposed by the state play in the official sector.

As indicated earlier, additional factors that may strengthen firms' incentives to operate in the unofficial sector are excessive government regulations and the associated bureaucratic corruption. Let us now consider the main hypotheses advanced in relation to the role of the bureaucratic corruption.

Corruption

As with the types unofficial activities, we can distinguish different types of corruption, depending on the levels at which it occurs in the society. Political (or ‘grand’) corruption refers to situations when members of the political elite exploit their power in order to extract rents. Legislative corruption describes situations when the elected members of the legislative system enact laws according to specific private interests, often in conflict with the public interest. Judicial corruption focuses on specific cases of corruption in courts. An alternative view on the political, legislative and judicial corruption combined is introduced in Hellman, Jones et al(2000) in the form of state capture. The authors employ the concept of ‘state capture’ in order to describe situations when (state owned or private) firms persuade politicians and members of the legislative and judicial systems to adjust laws, regulations and rules according to their specific private interests. Bureaucratic (petty) corruption relates to the interactions between agents supposed to implement rules and regulations (the bureaucrats) and the economic agents that are subjects to regulations. Reviews of the theoretical and empirical literature on corruption are provided, *inter alia*, in Bardhan(1997), Rose-Ackerman(1999) and Jain(2000).

In the current analysis, of a specific interest is the effect of bureaucratic corruption on firms’ activities. There are various situations when firms find it necessary to buy bureaucratic favors. With the (strong) assumption of honest bureaucrats, it is possible that the government ability to meet the firms’ demand for bureaucratic services is very limited such that, for agents willing to comply with the law, an efficient implementation of regulations is impaired. This is partly the case of transition economies where the rapid explosion of private businesses was not matched by a corresponding development in bureaucratic infrastructure. In such situations a case can be made that stimulating the bureaucrats to do their job faster (and better) benefits the private agent. The hypothesis of a beneficial effect of bureaucratic corruption on firms’ activities is coined as ‘efficient grease (of the wheel of commerce)’ in Kaufmann and

Wei(2000)[9]. From this perspective, one would expect a positive effect of bureaucratic corruption on private agents' activities. Excessive government regulations, however, are often interpreted as tantamount to harassment and corruption. In contrast to the 'greasing-the-wheel' hypothesis, the 'sand-in-the-machine' role of corruption (Ades and Di Tella(1997)) refers to the fact that (excessive) government regulations, and the associated bureaucratic corruption, hinder firms' activities rather than help them. Moreover, the assumption of honest bureaucracy is often hard to justify, given the incentives bureaucrats have to engage in rent-seeking activities (Shleifer and Vishny(1993)). The view of bureaucracy (and corrupt public officials in general) as a 'grabbing hand' points out to situations when the bureaucrats exercise their discretionary powers and deliberately harass private agents (by making regulations more cumbersome) in order to extract rents.

A theoretical model that captures the effect of excessive government regulations and the associated bureaucratic corruption on firm's activities in the official sector is formulated in Friedman, Johnson et al(2000). The authors distinguish between the ambiguous total effect of taxes and the purely distortionary effect of excessive regulations and corruption on the activities in the official sector[10]. Taxes have a direct negative effect of firm's profits, but they also (may) translate into a higher supply of public goods available to the firm. The effects of bureaucratic corruption and a weak legal system are purely distortionary as they induce firms to transfer their activities to the shadow sector. The authors assume a representative firm that considers the following two options: either to invest its (exogenously given) retained earnings in the official economy, or to invest them in the unofficial sector. If the firm invests in the official sector, part of the proceeds will dissipate in taxes and in a deadweight loss associated with over-regulations and bureaucracy. Excessive regulations and a corrupt bureaucracy act as a tax on firm's official total returns, and the higher the total returns on investments in the official sector the higher the associated deadweight loss. Public goods help firms to obtain higher returns on investments in the official sector and they are financed based on the taxes the government collects in the sector. The firm also pays

[9] Although the authors argue that the hypothesis is actually not valid.

[10] Which is a point also made in Johnson, Kaufmann et al(1997), although not formalized in their model.

penalties in proportion to its volume of shadow activities. The authors assume a convex penalty function, such that the higher the amount of earnings allocated to unofficial activities, the higher the penalty rate. Penalties on unofficial activity also increase with the quality(effectiveness) of the legal system. Given certain assumptions on returns on activities in the official sector, the firm's optimal decision is to split its earning between the two sectors. The main prediction of the model is that over-regulation and corruption unambiguously and adversely affect the volume of activities in the official sector. The effect obtained for the tax rates is not unambiguous, in that higher tax rates can have two opposite effects on firm's incentives: the direct effect on strengthened incentives to evade taxes (and transfer earnings to the unofficial sector), and an indirect effect via improved public goods and a better legal system. The latter effect relies on the assumption that tax revenues are used by the government to improve on its public services.

The model in the next section addresses the same type of unofficial activities (tax evasion) as analyzed in the studies described in this section. The main difference, from the only theoretical model that links unofficial activities to corruption of Friedman, Johnson et al(2000), is that I rely on the assumption that the possibility that firms have to corrupt public officials facilitates firm's activities in the underground. In this sense the argument employed in the analysis is closer to the interpretation of the 'helping hand' role of corruption, rather than harassment, although the help the firm receives relates to its illegal activities. I also elaborate on the assumption that public goods are useful to firm's activities in the official sector in that I assume that the benefits the firm extracts from being in the sector are a function of the firm's size.

Section II: The Model

In this section I analyze the case of a legally registered private firm that considers three possible options: to operate in the official sector, to operate in the unofficial sector or both. Incentives to operate in the shadow economy are given by the combination of taxes imposed on declared activities in the official sector and the weak benefits the firm can extract by being in the official sector.

In terms of the constraints imposed on activities in the shadow economy I assume that, in order to be able to reap the results of its underground activities, the firm needs to engage in corrupt relationships with public officials in charge with the inspection of firm's activities. I work on the assumption that the tax inspectors can always detect the underground activities. Punishment is defined in terms of confiscation of all output produced in the underground sector. The firm, however, has the option to escape punishment by bribing the tax official. Therefore, the possibility to corrupt public officials is what facilitates firm's shadow activities. I interpret the extent to which the firm can corrupt public officials as an input in the 'technology' of production in the underground. The amount of corruption the firm acquires while active in the shadow sector has a price associated with it: bribes per unit of corruption. The price of corruption is determined as a result of the interaction between the demand of corruption generated by the firm and the supply of corruption generated by bureaucrat. The supply of corruption is also modeled as endogenous.

The central mechanism that drives the model is the corrupt deal between a firm that attempts to evade taxes and a public official in charge with the inspection of firm's activities. Let us consider the decision problem of each of two partners in the corrupt transaction.

II.1 The Firm's Problem

Consider a representative firm in the private sector that is formally registered and it engages in economic activities of a legal nature. The firm has a stock of productive capital $\overline{K}$ and it employs labor as required. The firm contemplates the possibility to allocate its resources between the official and the unofficial sector. Assume that the firm produces the same good or service in both sectors, thus using the same production technology. The amount of productive capital used in officially declared activities is denoted *K*, such that $K \leq \overline{K}$. The remaining capital $\overline{K} - K$ is used to produce output in the shadow sector. The input of labor is employed and distributed accordingly: L_F is the amount of labor the firm uses to produce its official output, and L_I is the labor employed to produce the unofficial output. Note that L_F does not necessarily represent the volume of official employment in the firm. The same applies for L_I in relation to the legal status of the employees. Whether the firm decides to declare the volume of employment or not it depends on labor market conditions that are not analyzed in the model. What the two variables on labor employment convey is the use of labor, and not the official status of the employees. However, in order to better distinguish between the two different uses of labor I introduce two corresponding wage rates, although an assumption of equal wages would not have a critical implication for the predictions of the model.

If it employs its resources in the official sector, the firm benefits from specific advantages that enhance the firm's legal operations. The firm's production function in the official sector is given by:

$$(1) \qquad y_F = B^{\delta} K^{\alpha} L_F^{\beta}, \qquad \alpha + \beta + \delta = 1 \text{ and } \delta << \alpha \textit{ or } \beta$$

with: $B = \gamma\,\overline{K}$, $0 < \gamma < 1$ and $\overline{K}$ fixed, and:

$y_F =$ the volume of realized sales in the official economy

$\gamma =$ the degree of attractiveness of the official economy from the firm's perspective (the higher the value of γ, the more conducive to business is the environment in the official sector. A maximum value of 1 for γ describes an ideal economic environment with perfectly functioning financial system, judicial system, police force and government)

The parameter γ represents the specific advantages the firm reaps if active in the official sector. A well—functioning financial system, including banking and capital markets, can provide strong incentives to the firm to keep its operations in the official sector. Given the assumption on fixed capital, we cannot extend the argument to external financing provided by the financial system. However, external financing is only one of the functions performed by agents in the financial system. Banks have a critical role in facilitating trade financing and in administering the current assets of a firm. Well-developed capital markets can also play an instrumental role in propagating information on the firm's activities to its (actual and potential) business partners, and in particular to its suppliers. The interpretation of the parameter γ, and its associated term *B*, can be extended to consider contract enforcement services provided by the legal system. Especially for firms with larger scale of operations, such services may prove invaluable if the legal system is functioning well. Protection of firm's property against theft can also be considered, in that the more assets the firm has the more vulnerable it is to abuses on its property, and therefore the higher its need for protection provided legally by the police. Other similar public services supplied by the state to officially registered firms can be included in the interpretation of the parameter γ, provided a case can be made that the extent to which the firm benefits from such services is directly proportional to the firm's size and that the services are not available freely to the operations in the shadow sector. For example, a public good that can benefit production in both sectors, and therefore is not considered as an advantage specific to the official sector, is the infrastructure (the quality of roads, railways, postal services etc) financed by the government. Such public goods can rather be included in the category of public goods (if in insufficient supply) of the type considered in the theoretical models of Loayza(1996) and Grossman(1995) discussed in Section I.

In the production function in (1) I also assume that the productivity of the institutions that support the official sector facilities is lower than the productivity of capital or labor. This is to say that, no matter how attractive the official sector is in terms of institutions (and given the assumption of no investments) what matter most for the expansion of the firm are still its internal operations in terms of the resources employed.

The production technology in the unofficial sector is assumed to be identical to the technology in the official sector, except for the fact that the term B that designates advantages specific to the official sector is replaced by factors that facilitate the activity in the shadow economy as following:

$$(2) \qquad y_I = C^{\delta}\left(\overline{K} - K\right)^{\alpha} L_I^{\beta}$$

where:

$y_I =$ the volume of sales realized in the unofficial sector

C = the amount of bureaucratic corruption that the firm acquires in order to be able to retain some of its output produced underground.

Note that bureaucratic corruption is a necessary input for the firm's activity in the unofficial sector. The firm needs to persuade the public officials (such as tax inspectors, custom officials, construction site inspectors and the police force) to 'ignore' its shadow activities. An additional possible interpretation of the corruption that the firm needs to acquire when pursuing illegal activities refers to the corruption of the police force, as related to services of contract enforcement and protection provided on a private basis. The case of no corruption[1] is interpreted as no possibility to corrupt public officials. In such an ideal case, the firm has no chance to retain its output produced underground. This is a strong assumption in that it implies that firm's underground activities are always transparent to public officials (which may not be the case in reality) and that, when detected, there is a harsh punishment in terms of confiscation of the total shadow output (as is the case of smuggling). The extent to which tax inspectors are able to detect the shadow activities of legally registered firms is a matter of debate, and also an interesting research topic[2]. However, the model supports the analysis of firms' incentives to operate in the shadow sector under the strictest of conditions. The relevant

[1] The model is not designed to account for the theoretical possibility that 'no corruption' means no need for corruption. Such an assumption implies that there is no risk associated to activities in the shadow sector.

[2] As illustrated in the literature on detection of income tax evasion mentioned in Section I.

question here is the following: are firms still willing to engage in shadow activities even if they know that the probability to be detected as tax evaders is 1?

The firm's objective is to maximize its total profits (as the sum of profits realized in the two sectors). The maximization program writes as following:

$$(3) \qquad \begin{cases} \max\limits_{K,\, L_F,\, L_I,\, C} \pi = (1-t) y_F + y_I - w_F L_F - w_I L_I - m \cdot C \\ s.t. \\ y_F = B^{\delta} K^{\alpha} L_F^{\beta} \\ y_I = C^{\delta} \left(\overline{K} - K\right)^{\alpha} L_I^{\beta} \\ K \le \overline{K} \\ \textit{and the non-negativity conditions}: \\ K \ge 0, L_F \ge 0, L_I \ge 0, C \ge 0 \end{cases}$$

where:

m = the bribe paid per unit of corruption

Assume that the tax rate on firm's official activity is such that $0 < t < 1$. The price (bribe) the firm pays per unit of corruption is denoted by *m*. The firm takes the price *m* as given and it decides on how much corruption *C* it can afford.

In order to simplify the analysis, consider an alternative way of formulating the maximization problem (3). I denote the proportion of capital that the firm uses in the official sector by *k* as following:

$$k = \frac{K}{\overline{K}} \text{ with } 0 \le k \le 1$$

such that we write: $K = k \cdot \overline{K}$, and $\overline{K} - K = (1-k) \cdot \overline{K}$

If $k = 0$, then the firm uses all its productive capital in the unofficial sector and if $k = 1$ the firm uses its capital in the official sector only.

Substituting for k in the maximization problem (3) gives us the following maximization program:

$$(3)' \quad \begin{cases} \max\limits_{k,\, L_F,\, L_I,\, C} \pi = (1-t)y_F + y_I - w_F L_F - w_I L_I - m \cdot C \\ s.t. \\ y_F = B^{\delta} \left(k \cdot \overline{K}\right)^{\alpha} L_F^{\beta} \\ y_I = C^{\delta} \left((1-k) \cdot \overline{K}\right)^{\alpha} L_I^{\beta} \\ k \le 1 \\ \text{and the non-negativity conditions:} \\ k \ge 0,\, L_F \ge 0,\, L_I \ge 0,\, C \ge 0 \end{cases}$$

Admissible Solutions and Optimal Decisions

The Lagrangian function of the maximization problem (3)' writes as:

$$(4) \qquad L = (1-t)y_F + y_I - w_F L_F - w_I L_I - m \cdot C + \lambda(1-k)$$

and the set of the admissible solutions is defined by the Kuhn-Tucker conditions:

$$(5) \qquad \frac{\partial L}{\partial k} \le 0,\, k \ge 0,\, k\frac{\partial L}{\partial k} = 0$$

$$(6) \qquad \frac{\partial L}{\partial L_F} \le 0,\, L_F \ge 0,\, L_F \frac{\partial L}{\partial L_F} = 0$$

$$(7) \qquad \frac{\partial L}{\partial L_I} \le 0,\, L_I \ge 0,\, L_I \frac{\partial L}{\partial L_I} = 0$$

$$(8) \qquad \frac{\partial L}{\partial C} \le 0,\, C \ge 0,\, C\frac{\partial L}{\partial C} = 0$$

$$(9) \qquad \frac{\partial L}{\partial \lambda} \ge 0,\, \lambda \ge 0,\, \lambda\frac{\partial L}{\partial \lambda} = 0$$

where:

(10) $\frac{\partial L}{\partial k} = (1-t)\frac{\partial y_F}{\partial k} + \frac{\partial y_I}{\partial k} - \lambda$

(11) $\frac{\partial L}{\partial L_F} = (1-t)\frac{\partial y_F}{\partial L_F} - w_F$

(12) $\frac{\partial L}{\partial L_I} = \frac{\partial y_I}{\partial L_I} - w_I$

(13) $\frac{\partial L}{\partial C} = \frac{\partial y_I}{\partial C} - m$

(14) $\frac{\partial L}{\partial \lambda} = 1 - k$

In the set of admissible solutions to the firm's maximization program three are cases that are of special interest:

Case 1: The firm allocates capital and employs labor such that it produces in both sectors (official and unofficial). This case corresponds to the interior solution defined as:

Case 1: $0 < k < 1, L_F > 0, L_I > 0, C > 0$

Case 2: The firm operates only in the official sector, thus employing all of its resources in that sector. This is the case where no corruption ensues, as defined by:

Case 2: $k = 1, L_F > 0, L_I = 0, C = 0$

Case 3: The firm transfers all its activities to the underground sector, with no resources effectively employed in the official sector. The case is defined by:

Case 3: $k = 0, L_F = 0, L_I > 0, C > 0$

The derivations of the results presented for each of the three cases are provided in details in the mathematical appendix attached to this study.

Case 1: The firm operates in both sectors in parallel

In Case 1 we have an interior solution with $0 < k < 1,\ y_F > 0,\ y_I > 0, C > 0$, where the constraint $k \leq 1$ on the use of capital in the official sector is not binding[3]. Corresponding to this case, the expression derived for the output produced by the firm in the official sector is the following:

$$(15) \qquad y_{F,1} = \left(\frac{\gamma \cdot m}{\delta}\right)\overline{K}(1-t)^{\frac{1-\delta}{\delta}}\left(\frac{w_I}{w_F}\right)^{\frac{\beta}{\delta}}$$

Note that the subscript 1 is attached to the variable y_F in order to indicate that the solution corresponds to Case 1.

The result in (15) indicates that the volume of the firm's official activity depends on the business environment in the official sector (as defined by the parameter γ and the tax rate *t*), the price the firm pays per unit of corruption in the unofficial sector (*m*), and the wage(s) the firm pays to labor employed in the two types of activities. Regarding wages, note that the lower the wage paid to the labor used for shadow activities, relative to the wage paid for labor employed in official activities, the lower the firm's output in the official sector. However, as mentioned before, such a conjecture requires the analysis of the employees' incentives to accept (un)official employment, which is outside the scope of the current analysis.

We can see that the direct incentive the firm has to be active in the official sector relate to the benefits it extracts by operating in the sector. The role of the cost per unit of corruption is interpreted in relation to the underground activities. In deciding how much to produce in the official sector, the firm balances the advantages (γ) and disadvantages (taxes) of the official sector with the advantages (possibly cheaper labor) and disadvantages (higher bribes) of activities in the unofficial sector.

Equation (15) also tells us that the higher the level of firm's total capital, the more it produces in the official sector. As we shall see, this result does not mean to convey that firms with higher capital are less tempted to evade taxes. The result simply

[3] Result 1 in the appendix illustrates the calculations corresponding to Case 1.

indicates that the more capital available to the firm, the larger the pool of resources that can be allocated between the two sectors.

Note that there is a negative relationship between the 'productivity' of official sector benefits and the volume of the official output: $\frac{\partial y_{F,1}}{\partial \delta} < 0$. The result relies on the assumption that the benefits the firm reaps in the officials sector (as captured in the term *B*) are modeled as a function of the total productive capital in the firm ($\overline{K}$), regardless of its alternative uses in the official or unofficial sector[4]. The implication is that the amount of benefits specific to the official sector that complement the other two inputs in the firm's official production is not subject to the firm's choice. More productive (exogenously given) benefits release other resources (capital and labor) from official production, such that they can be used in the shadow activities[5].

The derived expression for the output in the unofficial sector is:

$$(16) \qquad y_{I,1} = \overline{K}\left[\left(\frac{\delta}{m}\right)^{\delta/\alpha}\left(\frac{\beta}{w_I}\right)^{\beta/\alpha} - \frac{\gamma \cdot m}{\delta}(1-t)^{1/\delta}\left(\frac{w_I}{w_F}\right)^{\beta/\delta}\right]$$

which relies on the following condition:

$$(17) \qquad \left(\frac{\delta}{m}\right)^{\frac{\delta+\alpha}{\alpha}}\left(\frac{\beta}{w_I}\right)^{\beta/\alpha} > \gamma\,(1-t)^{1/\delta}\left(\frac{w_I}{w_F}\right)^{\beta/\delta}$$

From equation (16) we see that some of the disincentives to be in the official sector find their immediate correspondents in incentives to operate underground. The higher the tax rate imposed on official activities and the lower the benefits in the official sector, the stronger the firm's incentives to be active in the parallel sector. Also, lower costs per unit of corruption, and possibly lower wages with labor used to produce unofficial output, make activities in the shadow economy more appealing.

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[4] This observation is valid only when the firm produces at least *some* official output.

[5] The result is likely to change if we assume that the extent to which the firm benefits from being in the official sector depends on its volume of official activity, and not on its capital. Situations when such an assumption proves most necessary are discussed in Section IV.

A less intuitive result obtains if we consider that firm incurs the same costs with labor in the two sector $(w_F = w_I)$. In this case, from (15), we can see that the wage rate does not affect the official output, but it negatively affects the volume of unofficial activity (as suggested by (16)). This result indicates that the firm will always prefer to be part of the official sector (and therefore employ some labor), even if not completely, given the benefits it reaps in the sector regardless of its volume of activity. In the underground sector the firm incurs direct costs associated with each of the inputs (capital, labor, corruption) it employs. It is therefore in the shadow sector where the firm ponders the relative prices of inputs to a larger extent.

Condition (17) is central to the model in that it defines the situations when Case 1 is feasible and the output produced in the shadow sector is positive. The condition reflects the balance between the incentives and the disincentives that the firm has to operate in the two sectors. The left-hand side of condition (17) includes the two terms that represent the constraints in the shadow sector, in terms of high costs per unit of corruption and high costs of labor, and the right-hand side reflects the incentives (in terms of γ) and disincentives (taxes) to operate in the official sector. I discuss conditions (17) in more details later in this section, after I introduce the bureaucrat's problem.

When condition (17) holds, the firm's demand of corruption is given by the following expression:

$$(18) \qquad C_1 = \overline{K}\left[\left(\frac{\delta}{m}\right)^{\frac{\alpha+\delta}{\alpha}}\left(\frac{\beta}{w_I}\right)^{\beta/\alpha} - \gamma\cdot(1-t)^{1/\delta}\left(\frac{w_I}{w_F}\right)^{\beta/\delta}\right]$$

such that $C_1 > 0$ if and only if $y_{I,1} > 0$.

Note that the same factors that affect the volume of shadow activities given in (16), also affect the firm's demand of corruption in a similar manner.

For the ratio of capital that the firm allocates to its activities in the official sector I obtain the following expression (common to all the three cases):

$$(19) \qquad k = \frac{(1-t)y_F}{(1-t)y_F + y_I}$$

For Case 1 it translates into:

$$(20) \qquad k_1 = \frac{\gamma \cdot (1-t)^{1/\delta} \left(\frac{w_I}{w_F} \right)^{\beta/\delta}}{\left(\frac{\delta}{m} \right)^{\frac{1-\beta}{\alpha}} \left(\frac{\beta}{w_I} \right)^{\frac{\beta}{\alpha}}} < 1$$

The ratio of capital allocated to official activities decreases with the tax rate, and it increases with the benefits specific to the official sector and with the cost of corruption in the underground sector.

The levels of employment of labor in the firm are given by the following two equations:

$$(21) \qquad L_{F,1} = \frac{\beta(1-t)y_{F,1}}{w_F}$$

$$(22) \qquad L_{I,1} = \frac{\beta\, y_{I,1}}{w_I}$$

where $y_{F,1}$ and $y_{F,2}$ are given in (15) and (16).

<u>Case 2</u>: The firm considers operating in the official sector only

This case corresponds to the border solution with $k = 1,\ y_F > 0,\ y_I = 0,\ C = 0$. Capital and labor are employed in official activities and the firm has no need for bureaucratic corruption.

The output realized in the official sector in this case writes as[6]:

[6] See Result 2 in the appendix.

$$(23) \qquad y_{F,2} = \gamma^{\frac{\delta}{\alpha+\delta}} \overline{K} \left(\frac{\beta}{w_F} \right)^{\frac{\beta}{\alpha+\delta}} (1-t)^{\frac{\beta}{\alpha+\delta}}$$

and the demand for labor is given by a similar expression as in (21). All the variables that characterize the shadow economy are at the zero level:

$$y_{I,2} = 0, L_{I,2} = 0, C_2 = 0$$

Assume that condition (17) that defines the feasibility of the firm's activity in Case 1 holds. We can then compare the levels of output (official and shadow) the firm produces in Case 1, with the volume of (official) output that results in Case 2. Let us first compare the levels of official output produced in the two cases. Result 3 in the appendix indicates that the ratio of the two levels of official output can be written as following:

$$(24) \qquad \frac{y_{F,1}}{y_{F,2}} = (A)^{\frac{\alpha}{\alpha+\delta}} < 1$$

where the constant 0 < A < 1 if condition (17) holds. Expression (24) indicates that, when Case 1 is feasible, the level of official output the firm produces if active only in the official sector is higher than the level of officially declared output produced by the firm when it has the possibility to operate in both sectors.

A similar result is also obtained in terms of the pre-tax total levels of output[7]:

$$(25) \qquad y_{F,2} > y_{F,1} + y_{I,1}$$

indicating that, when Case 1 admissible, the total output corresponding to firm's activity in both sectors is lower than the total output produced when resources are employed only in the official sector.

However, it is more interesting to compare the levels of after-tax total output. In Result 4 in the appendix I also derive the following expression:

[7] See Result 4.

$$(26) \qquad (1-t)y_{F,2} = \left[(1-t)y_{F,1} + y_{I,1}\right]\cdot (A)^{\frac{\delta}{\alpha+\delta}}$$

indicating that $(1-t)y_{F,2} < \left[(1-t)y_{F,1} + y_{I,1}\right]$. If Case 1 is feasible, then the total volume of after-tax output in Case 1 is higher than the volume of after-tax output obtained in Case 2.

Based on the result in (24) we see that the tax revenue the government collects on official output when the firm is active in both sectors is lower than the tax revenue collected on firm's activity in Case 2. As we shall see shortly, the difference between the two levels of tax revenues translate into higher profits for the firm and bribes for the bureaucrat.

Case 3: The firm operates in the unofficial sector only.

Yet another feasible solution to the firm's problem is the border solution with $k = 0,\ y_F = 0,\ y_I > 0, C > 0$. This is the case of a phantom firm that, although legally registered, it does not declare any of its activities. In this case, the volume of output in the shadow sector is the following[8]:

$$(27) \qquad y_{I,3} = \left(\frac{\delta}{m}\right)^{\frac{\delta}{\alpha}} \overline{K} \left(\frac{\beta}{w_I}\right)^{\frac{\beta}{\alpha}}$$

and the inactivity in the official sector is reflected by:

$$y_{F,3} = 0,\ L_{F,3} = 0, k_3 = 0$$

The demand firm's of corruption is given by the expression:

$$(28) \qquad C_3 = \frac{\delta\, y_{I,3}}{m}$$

[8] See Result 5 in the appendix for derivations corresponding to Case 3.

and the labor employed for producing output $y_{I,3}$ is given by an expression similar to (22).

As in the previous case, we can compare the levels of firm's activity in the three cases in terms of levels of after –tax total output. First consider the comparison between the total level of net output in Case 1 and the output level obtained in Case 3. Result 6 in the appendix provides us with the following expression:

$$(29) \qquad y_{I,3} = (1-t)y_{F,1} + y_{I,1} < y_{F,1} + y_{I,1}$$

that indicates that, given Case 1 feasible, the total after-tax output the firm produces if active in both sectors is the same as the output that the firm generates if active in the underground sector only. The total level of output produced in Case 1 is therefore than the output produced in Case 3.

Result 7 in the appendix focuses on the comparison of output levels generated in Case 2 and Case 3. When Case 1 is feasible, then the comparison of Case 2 with Case 3 is straightforward and, based on the transitivity of results in (25) and (29), it translates into the following inequality:

$$(30) \qquad (1-t)y_{F,2} < y_{I,3}$$

The comparison between Case 2 and Case 3 is more interesting when we assume that conditions in the two sectors (in terms of the exogenous parameters in model) are such that Case 1 is not feasible. In Result 7 in the appendix I derive the following results:

$$(31) \quad y_{I,3} < (1-t)y_{F,2} < y_{F,2}$$

Therefore, when activity in the two sectors in parallel is not feasible, the results indicate that if the firm operates in the unofficial sector it will produce a lower output than the output obtained when active in the official sector.

Depending on the feasibility of Case 1, we can summarize the results above as following:

If Case 1 feasible (condition (17) holds):

After-tax output: $(1-t)\, y_{F,2} < \lfloor (1-t)\, y_{F,1} + y_{I,1} \rfloor = y_{I,3}$
Official output: $y_{F,2} > y_{F,1}$
Pre-tax output: $y_{F,2} > \lfloor y_{F,1} + y_{I,1} \rfloor > y_{I,3}$

If Case 1 not feasible (the reverse of condition (17) holds):

After tax output: $y_{I,3} < (1-t) y_{F,2}$
Pre-tax output: $y_{I,3} < y_{F,2}$

Based on these results we can derive the firm's optimal decision. The optimal solution to the firm's maximization problem (3)' is given by the admissible solution that generates the highest profits. Although from the mathematical point of view the optimal solution is straightforward[9], let us consider the profits the firm obtains in all of the three cases of interest. The profit results for the three cases are derived in the appendix under the headings Result 8, Result 9 and Result 10.

The profits the firm obtains when it operates in the two sectors in parallel are given by the following expression:

$$(32) \qquad \pi_1 = (1-t)\, y_{F,1} \left(\frac{\alpha}{A} + \delta \right)$$

where A is the same constant as before, with $0 < A < 1$ if condition (17) holds.

The profits the firms generates if active in the official sector only are:

$$(33) \qquad \pi_2 = (1-t)(\alpha + \delta)\, y_{F,2}$$

[9] By virtue of a quasi-concave objective function in a maximization problem with linear constraints, we know that an admissible interior solution is also optimal.

and the profits corresponding to Case 3 are given by:

$$(34) \qquad \pi_3 = \alpha\, y_{I,3}$$

Comparing profits in Case 1 with profits in Case 3 is straightforward as, based on the result in (29), we can write:

$$(35) \qquad \pi_1 = \pi_3 + (1-t)\delta\, y_{F,1} > \pi_3$$

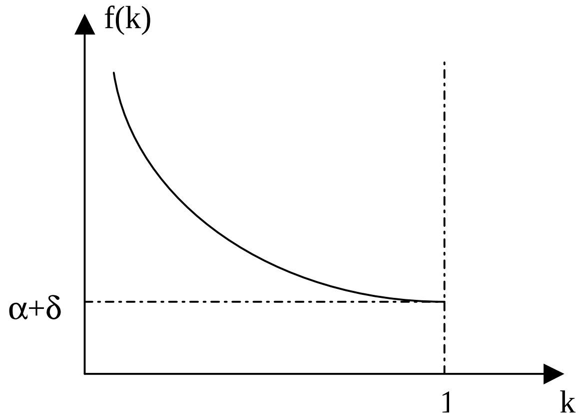
Expression (35) indicates that, even if the levels of after-tax output the firm obtains in Case 1 and Case 3 are equal, the firm would rather operate in both sectors simultaneously, rather than in the underground sector only, as that is how it generates higher profits.

For the comparison of profits in Case 1 with profits obtained in Case 2, when Case 1 admissible, I derive the ratio of the two levels of profits as following[10]:

$$(36) \qquad \frac{\pi_1}{\pi_2} = \frac{(A)^{\frac{\alpha}{\alpha+\delta}}\left(\frac{\alpha}{A}+\delta\right)}{(\alpha+\delta)} > 1 \quad \forall \quad A \in (0,1)$$

Consider the function: $f(A) = (A)^{\frac{\alpha}{\alpha+\delta}}\left(\frac{\alpha}{A}+\delta\right)$, recall that *0 < A < 1* when Case 1 is admissible, and note that $\lim_{A\to 1} f(A) = \alpha + \delta$. We also have $\frac{\partial f}{\partial A} < 0$ and $\lim_{A\to 0} f(A) = \infty$. As illustrated in the graph below, the numerator in expression (36) takes values higher than the (fixed) denominator for any value of A in its admissible range $(0,1)$.

[10] See Result 11 in the appendix.



This gives us the result that, if parallel activities in both sectors are feasible, then the resulting profits are higher than the profits generated in Case 2: $\pi_1 > \pi_2$.

So far I have established that when feasible, Case 1 is associated with the highest levels of profits, and therefore it is the firm's most preferred option among the three available choices that are of interest.

However, there is also the possibility that conditions in both sectors are such that the interior solution corresponding to Case 1 is not feasible. Then the firm is left with the options to either operate totally in the official sector, or to transfer all its operations to the underground sector. Its decision depends on which of the two cases generates more profits. The following result on the comparison of profits obtained in Case 2 with profits obtained in Case 3 is valid only when conditions (17) does not hold. Result 12 in the appendix illustrates the derivation of the following inequality:

$$(37) \qquad \pi_3 < \pi_2$$

indicating that profits generated when the firm allocates its resources to the official sector are higher than the profits generated by the firm when it operates completely in the underground sector. The reason is that the costs associated with corruption in the underground sector increase at a faster rate with firm's activity than taxes do in relation to the firm's volume of activity in the official sector. Therefore, if Case 1 is not admissible, the firm's optimal decision is to operate in the official sector.

We can now derive the decision tree that drives the allocation of firm's resources between the two sectors.

<u>If condition (17) does not hold</u> then $\pi_2 > \pi_3$ and the optimal decision for the firm is to employ all of its resources in the official economy. This corresponds to solution derived for Case 2:

(O1.1) $y^*_{F,2} = \gamma^{\frac{\delta}{\alpha+\delta}} \overline{K} \left(\frac{\beta}{w_F} \right)^{\frac{\beta}{\alpha+\delta}} (1-t)^{\frac{\beta}{\alpha+\beta}}$

(O1.2) $y^*_{I,2} = 0$

(O1.3) $C^*_2 = 0$

(O1.4) $L^*_{F,2} = \beta(1-t)\frac{y^*_{F,2}}{w_F}$

(O1.5) $L^*_{I,2} = 0$

(O1.6) $k^*_2 = 1$

where t and γ are taken as given.

The firm's optimal decision in this situation is associated with the highest possible level of output.

<u>If Case 1 feasible</u>, then $\pi_1 > \pi_2 > \pi_3$ and the firm's optimal decision is to operate in both sectors simultaneously. The optimal solution to the firm's problem is given by the following set of equations:

(O2.1) $y^*_{F,1} = \left(\frac{\gamma \cdot m}{\delta} \right) \overline{K} (1-t)^{\frac{1-\delta}{\delta}} \left(\frac{w_I}{w_F} \right)^{\frac{\beta}{\delta}}$

(O2.2) $y^*_{I,1} = \left(\frac{\delta}{m} \right)^{\frac{\delta}{\alpha}} \overline{K} \left(\frac{\beta}{w_I} \right)^{\frac{\beta}{\alpha}} - (1-t) y^*_{F,1}$

(O2.3) $C^*_1 = \frac{\delta \cdot y^*_{I,1}}{m}$

(O2.4) $L^*_{F,1} = \frac{\beta(1-t) y^*_{F,1}}{w_F}$

(O2.5) $L^*_{I,1} = \dfrac{\beta\, y^*_{I,1}}{w_I}$

(O2.6) $k^*_1 = \dfrac{(1-t)y^*_{F,1}}{(1-t)y^*_{F,1} + y^*_{I,1}} < 1$

where m, t, γ are taken as given.

In this situation the firm's decision to transfer part of its resources to the shadow sector results in lower levels of both official and total output when compared to the non-optimal option Case 2.

Given that the tax revenues the government collects from the firm in Case 1 are lower than the tax revenues the government would obtain if the firm were active only in the official sector, the results indicate that the possibility to operate in both sectors (official and unofficial) provides the firm with an opportunity to redistribute part of the output owed to the government (in the form of taxes) to itself and to the bureaucrat. From the analysis of profits generated in the three cases, when Case 1 is optimal, we can infer that operating completely in the shadow sector favors more the bureaucrat than in benefits the firm in terms of the redistribution of revenue that evades taxes. From the firm's perspective, the intermediate case that entails parallel activities in the two sectors offers the best 'redistribution' strategy.

Note that the output levels the firm produces in the two sectors depend on the price of corruption *m*, which is taken as given in the firm's problem. Let us now analyze the conditions that determine the price of corruption *m* and whether there can be any supply of corruption that meets the firm's demand of corruption.

II.2 The Bureaucrat's Problem

Picturing corruption as an input for the firm's activities necessarily raises the question of the corresponding supply of corruption and of the mechanism by which the price *m* of bureaucratic favors is settled. Assume a (representative) public official who is in charge with the inspection of firm's activities. More specifically, consider that the main focus of the bureaucrat's inspection is on whether the firm attempts to evade taxes.

I also assume that the bureaucrat has the ability to produce an accurate estimate of the extent of firm's shadow activities, and that he is willing to ignore such activities if motivated to do so. From results in the previous sub-section we learn that there are some cases when the firm needs to bribe the bureaucrat in order to retain (part of) its output realized underground. In such cases the bureaucrat needs to decide on the price per unit of corruption, given the demand of corruption expressed by the firm[11].

Assume that the employment conditions for the public official are such that he keeps his job and receives a salary S from the government as long as he is not detected as involved in corrupt deals with the agents he is supposed to monitor. If involved in corrupt transactions, but not caught, the bureaucrat enjoys additional revenue generated by selling favors to the businesses he monitors (in this case our representative firm). This income is given by $m \cdot C$ (the amount of corruption sold multiplied by price). If the bureaucrat is found guilty of corruption, then he not only loses his job (and salary), but he also has to pay a fixed penalty P.

The bureaucrat's expected income is given by the expression:

$$(38) \qquad Ey = \theta(S + m \cdot C) - (1 - \theta)P$$

where:

$\theta =$ the probability of ***not*** being caught as involved in corrupt transactions.

Assume there is a mechanism of exposure of corrupt public officials, as given by the following equation:

$$(39) \qquad \theta = e^{-\mu \cdot C}, \text{ with } 0 < \mu < 1$$

where:

$\mu =$ the effectiveness of the procedures implemented in order to expose and punish corrupt public servants.

[11] The process of setting a price for bureaucratic favors also reflects the bureaucrat's willingness to engage in the corrupt transaction.

Note that $\frac{\partial\theta}{\partial C} = -\mu \cdot e^{-\mu \cdot C} < 0$, such that the more corrupt the bureaucrat is, the higher the chance $(1-\theta)$ of his being caught and penalized. If the effectiveness of exposure is weak, such that μ is small, then the risk the bureaucrat faces in terms of losing his job is very small even at high levels of corruption (the effect that a change in C has on the probability θ increases in absolute value with an increase in μ, indicating that the probability of (not) getting caught is more sensitive to the volume of corrupt acts when the mechanism of exposure is more effective).

Assume the bureaucrat's utility is a function of his expected income of the form:

$$(40) \qquad U(Ey) = \frac{(Ey)^z - 1}{z}, \quad 0 < z < 1$$

such that $U'(Ey) > 0$ and $U''(Ey) < 0$.

The bureaucrat needs to decide on the level of bribes per unit of corruption (*m*) associated to a given demand for corruption (*C*), given his objective to maximize the utility of the expected income. For simplicity I consider the bureaucrat's problem in terms of *C* as a decision variable, with *m* taken as given[12].

$$(41) \qquad \begin{cases} \max\limits_{C} U(Ey) = \dfrac{(Ey)^z - 1}{z} \\ s.t. \\ Ey = \theta(S + m \cdot C) - (1-\theta)P \\ \theta = e^{-\mu \cdot C} \\ and\ the\ non-negativity\ condition: \\ C > 0 \end{cases}$$

The optimal solution to problem (41)[13] gives us the bureaucrat's supply of corruption *C*:

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[12] Given that one of the two variables has to be exogenous, the two approaches are equivalent.
[13] See Result 13 in the appendix.

$$(42) \qquad m = \frac{\mu\left(S+P\right)}{1-\mu C^*}$$

indicating that the price per unit of corruption is higher when the mechanism of exposing and punishing corrupt public officials is more effective (μ and/or P high), or when the salary of the bureaucrat is high enough such that the possibility of losing the job induces a strong disincentive to engage in corruption. The higher the amount of corruption that is on demand the higher the price charged by the bureaucrat (given the risks associated with corruption). A positive price for corruption, as given in (42), exists as long as $C < \frac{1}{\mu}$. The less effective the procedures implemented in order to expose and punish corrupt bureaucrats, the higher the chances that a market for corruption exists. The result in (42) can also be used to infer that there is a minimum level of bribes per unit of corruption ($\mu \cdot (S+P)$) that would persuade the bureaucrat to engage in corrupt deals with the firm[14]. The higher μ, S and/or P are, the more costly it is to persuade him to collude with the firm.

By combining the firm's optimal decision, when Case 1 is feasible, with the bureaucrat's optimal decision we obtain a market for corruption as a result of the interaction between the demand of corruption generated by the firm in Case 1:

$$C_1^* = \frac{\delta \cdot y_{I,1}^*}{m}$$

and the supply of corruption, as defined in the bureaucrat's problem, rewritten as:

$$C^* = \frac{m - \mu \cdot \left(S+P\right)}{\mu \cdot m}$$

When we equate the demand and supply of corruption a non-linear equation in m^* obtains as following:

$$(43) \qquad m = \mu \cdot \left[\delta \cdot y_{I,1}^* + \left(S+P\right)\right]$$

[14] This is derived based on the non-negativity condition that requires C > 0.

where $y^*_{I,1}$ is given in (O2.2) above. In Result 14 I prove that, when Case 1 admissible, equation (43) above has only one solution m^* in the admissible range $[\mu(S+P),+\infty)$ for *m*. The result indicates that, when the firm needs to buy corruption from the bureaucrat, there will be a supply that meets its demand, given levels of $\mu, S \text{ and } P$ such that condition (17) holds.

The equilibrium level of corruption in the market, when Case 1 is feasible, settles at:

$$(44) \qquad C^* = \frac{1}{\mu}\left(\frac{\delta \cdot y^*_{I,1}}{\delta \cdot y^*_{I,1} + (S+P)}\right), \text{ with } 0 < C < \frac{1}{\mu} \text{ for any } y^*_{I,1} > 0$$

Note that an equilibrium exists in the corruption market as long as the firm finds it profitable to operate in both sectors[15]. The equilibrium level of corruption increases with the volume of the underground economy, and it decreases when the devices implemented to prevent corrupt acts are more effective (the mechanism of exposure is defined by the parameter μ, the penalty P and the bureaucrat's salary S). Given the constraints on the bureaucrat's side, but also the firm's finite demand for corruption, the corruption level does not explode to infinity. However, when the effectiveness of exposure (and punishment) of corrupt bureaucracy is very weak, the corruption can reach very high levels given that its associated price is very low.

In order to make sure we have a complete characterization of the firm's behavior we need to understand the circumstances under which condition (17), that defines the optimality of Case 1 relative to Case 2, holds. Recall that condition (17) is given by the following inequality:

$$\left(\frac{\delta}{m}\right)^{\frac{\delta+\alpha}{\alpha}}\left(\frac{\beta}{w_I}\right)^{\beta/\alpha} > \gamma\,(1-t)^{1/\delta}\left(\frac{w_I}{w_F}\right)^{\beta/\delta}$$

that can be rewritten as:

[15] Recall that if activities in both sectors in parallel are not possible, then the second best option for the firm is to operate in the official sector only, and therefore there is be no demand of corruption in that case.

$$(45) \qquad t > 1 - \frac{1}{\gamma^{\delta}} f(m) Z$$

where $Z = (\delta)^{\frac{\delta(\alpha+\beta)}{\alpha}} \left(\frac{\beta}{w_I}\right)^{\frac{\beta\delta}{\alpha}} \left(\frac{w_F}{w_I}\right)^{\beta}$ is a constant, and $f(m) = \left(\frac{1}{m}\right)^{\frac{\delta(\alpha+\beta)}{\alpha}}$ such that $\frac{df}{dm} < 0$.

Inequality (45) indicates that Case 1 is admissible when the tax rate is above a certain threshold, denoted $\hat{t}$. For given values of $\alpha, \beta, \delta, w_I$ *and* w_F, the threshold $\hat{t}$ will be a function of γ and of the level of bribes per unit of corruption[16] that corresponds to $t = \hat{t}$. We can determine where the threshold $\hat{t}$ is in the admissible range $(0, 1)$ by noting that when $t = \hat{t}$, then condition (17) becomes an equality and the underground output given in (16) is equal to zero: $y_{I,1}(\hat{t}) = 0$. In this situation the solution in Case 1 converges to the solution in Case 2, such that $y_{F,1}(\hat{t}) = y_{F,2}(\hat{t})$. But when no output in the underground sector is produced, then there is no demand for corruption and the price per unit of corruption will hit its minimum possible level: $\hat{m} = \mu(S + P)$. We therefore obtain:

$$(46) \qquad \hat{t} = 1 - \frac{1}{\gamma^{\delta}} \left(\frac{1}{\mu(S+P)}\right)^{\frac{\delta(\alpha+\beta)}{\alpha}} Z$$

such that the higher γ, μ, S *or* P, the higher the threshold level $\hat{t}$. This amounts to saying that the higher the benefits specific to the official sector and/or the higher the minimum possible price per unit of corruption in the underground sector, the higher the level of the tax rate that the firm tolerates in the official sector without considering activities underground. If the tax rate imposed by the government on firm's official activities is lower than the threshold level $\hat{t}$ then condition (17) does not hold and Case 2 is optimal.

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[16] Recall that the equilibrium price per unit of corruption m^* is itself a function of *t* when Case 1 admissible.

From equation (46) we see that it is possible that, at low levels of $\gamma, \mu, S\ or P$, the threshold $\hat{t}$ is negative and therefore it is outside the admissible range of the tax rate. This means that, with very low advantages in the official sector and/or cheap corruption in the underground, any level of the tax rate higher than zero will prove high enough to induce the firm to operate in the underground sector.

One may also wonder what happens when the level for the tax rate is at one of the two extremes of the admissible range: $t = 0$ or $t = 1$. When $t = 0$ then the firm has no reason to consider underground activities, as there are no taxes to evade. In this case the firm's activity will be entirely official and given by the following equation:

$$\text{(47)} \qquad \breve{y}_F = \gamma^{\frac{\delta}{\alpha+\delta}} \overline{K} \left(\frac{\beta}{w_F} \right)^{\frac{\beta}{\alpha+\delta}}$$

The output level in (47) is higher than any level of official output the firm produces when Case 2 optimal and $t > 0$.

When $t = 1$ then the firm has no reason to produce in the official sector as, had it done so, it would have to surrender all the produced output to the government. Therefore, in this case the firm transfers all its operations to the underground sector, and the corresponding level of output is given by the following expression:

$$\text{(48)} \qquad \tilde{y}_I = \left(\frac{\delta}{\tilde{m}} \right)^{\frac{\delta}{\alpha}} \overline{K} \left(\frac{\beta}{w_I} \right)^{\frac{\beta}{\alpha}}$$

Equation (48) describes the situation when the solution in Case 1 converges to the solution in Case 3, with $y_{F,1}(t = 1) = 0$. In Result 15 I prove that $\tilde{y}_I$ is lower than any level of total output $y_{F,1} + y_{I,1}$ that the firm produces when Case 1 admissible and $t \in (\hat{t}, 1)$.

<u>The analytic results obtained in this Section up to this point can be summarized as following:</u>

If $\hat{t} \le 0$ (very weak institutions and/or cheap bureaucratic corruption), then the firm's total level of output is the following:

$$(49) \qquad y = \begin{cases} \breve{y}_F & if \quad t = 0 \\ solution\ in\ Case\ 1: y^*_{F,1} + y^*_{I,1} & if \ \ 0 < t < 1 \\ \tilde{y}_I & if \quad t = 1 \end{cases}$$

If $\hat{t} > 0$ (some benefits available in the official sector and/or high minimum costs with bureaucratic corruption), then the firm's total level of output is given by the following expression:

$$(50) \qquad y = \begin{cases} \breve{y}_F & if \quad t = 0 \\ solution\ in\ Case\ 2: y^*_{F,2} & if \ \ 0 < t < \hat{t} \\ y^*_{F,2}(\hat{t}) = y^*_{F,1}(\hat{t}) & if \quad t = \hat{t} \\ solution\ in\ Case\ 1: y^*_{F,1} + y^*_{I,1} & if \ \ \hat{t} < t < 1 \\ \tilde{y}_I & if \quad t = 1 \end{cases}$$

II.3 Comparative Statics Analysis

In this subsection I analyze the effects that changes in the exogenous parameters in the model have on the nature and the volume of firm's activities, as well as on related variables.

The set of exogenous parameters in the model includes:

- In the firm's decision problem: the quality of institutions and public services in the official sector (γ), the tax rate (t), the firm's stock of capital ($\overline{K}$) and the productivities of the input factors in the firm's production technology: α, β and δ. Of a specific interest are the two parameters directly related to public policy: γ and t.
- On the bureaucrat's side, as exogenous parameters we have the effectiveness of the mechanism of exposure (and punishment) of corrupt public officials (μ), the bureaucrat's salary (S) and the penalty imposed on corruption (P). Changes in the three variables can be considered as direct policy measures implemented with the objective to contain corruption.

As derived earlier, when $0 < t < 1$, there are two possible optimal decisions for the firm, as described in Case 1 and Case 2 in the previous subsection. Let us consider each of the two cases.

Case 2 Optimal

Case 2 is optimal as long as the level of the tax rate is in the range $\left(0, \max\left(0, \hat{t}\right)\right)$. The corresponding firm's optimal decision to operate in the official sector is given by the set of equations denoted with (O1.*) introduced earlier. In this case the bureaucrat's willingness to participate in corrupt transactions is not relevant anymore, as the firm has no interest to operate in the shadow sector. The firm's total volume of activity in the official sector, written as a function of the exogenous parameters in the model, is:

$$y_{F,2}^{*} = \gamma^{\frac{\delta}{\alpha+\delta}} \overline{K} \left(\frac{\beta}{w_F} \right)^{\frac{\beta}{\alpha+\delta}} (1-t)^{\frac{\beta}{\alpha+\beta}}$$

such that we obtain:

$$(51) \qquad \frac{\partial y_{F,2}^{*}}{\partial \gamma} > 0 \text{ and } \frac{\partial^2 y_{F,2}^{*}}{\partial \gamma^2} < 0$$

We therefore derive that increases in the benefits specific to the official sector induce the firm to increase its volume of activity in the sector. However, when the quality of institutions and public services is already high, then further improvements in institutions are associated with smaller benefits in terms of additional output.

In terms of changes in the tax rate we obtain:

$$(52) \qquad \frac{\partial y_{F,2}^{*}}{\partial t} < 0 \text{ and } \frac{\partial^2 y_{F,2}^{*}}{\partial t^2} > 0$$

indicating that increases in the tax rate provides the firm with disincentives to further expand its activities in the official sector, and the higher the tax rate at which the changes occur, the stronger the disincentive to produce. It can be shown that a similar effect applies to the amount of labor employed in the firm.

The fact that the firm's output shrinks with increases in the tax rate does not necessarily mean that the tax revenues the government collects also decrease. The amount of tax revenues the government collects from the firm in this case writes as:

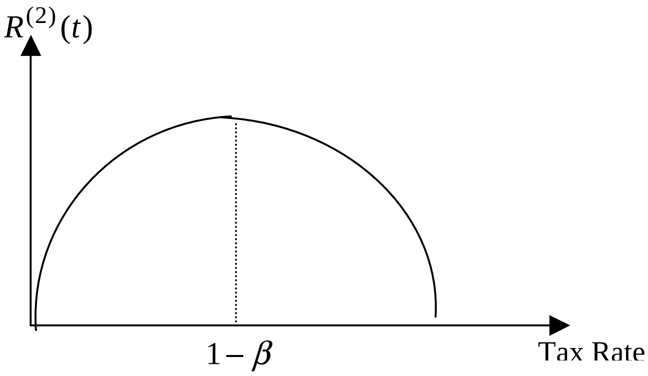
$$(53) \qquad R^{(2)}(t) = t\, y_{F,2}^{*}$$

such that we can calculate the change in tax revenues triggered by changes in taxes as:

$$(54) \qquad \frac{\partial R^{(2)}(t)}{\partial t} = \left(1 - \frac{t}{1-t} \cdot \frac{\beta}{1-\beta} \right) y_{F,2}^{*}$$

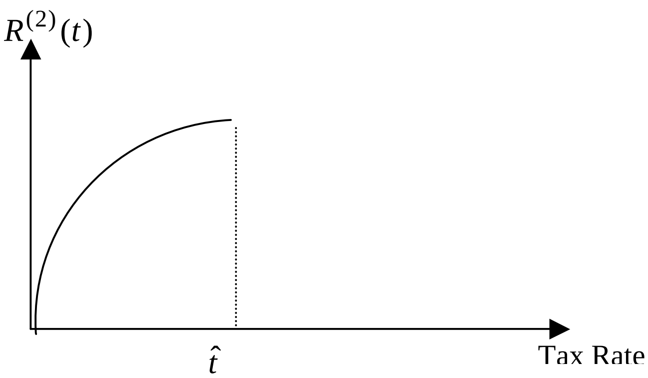
Equation (54) describes a classical Laffer curve at the firm level (Figure 2). The tax revenues that the government collects from the firm initially increase with the tax rate, as long as the tax rate is at a low level $(t < 1 - \beta < 1)$. The higher the productivity of labor (as the only non-fixed input in the production in the official sector), the lower the threshold tax that allows for increases in the tax rates to be associated with increases in tax revenues.

Figure 2: Tax Revenues as given in equation (54)



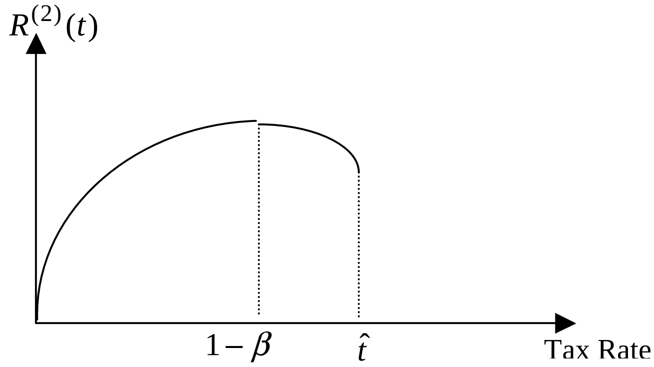
Recall that Case 2 is optimal only for a limited range of the tax rate levels, $(0, \max(0, \hat{t}))$. Assuming that $\hat{t} > 0$, and depending on how the values of $\hat{t}$ compare with $1-\beta$, we have two possible situations for the tax revenues that the government collects from the firm in Case 2. Figure 3 illustrates the case when $0 < \hat{t} < 1-\beta$.

Figure 3: Tax Revenues when Case 2 optimal and $0 < \hat{t} < 1-\beta$



In Figure 4, we have the situation when $0 < 1-\beta < \hat{t}$.

Figure 4: Tax Revenues when Case 2 optimal and $0 < 1-\beta < \hat{t}$



However, the analysis of the effects of changes in γ and in the tax rate is incomplete as long as we do not consider the possibility that at lower levels of γ and/or high levels of taxes it is likely that the firm will be tempted to transfer part of its operations to the underground sector. This means that condition (17) on feasibility of Case 1 becomes less binding.

Case 1 Optimal

The feasibility of solution in Case 1 is defined by the condition:

$$\max(0, \hat{t}) < t < 1$$

Let us assume that the government first imposes a tax rate at a level higher than the threshold $\hat{t}$, such that the firm has an incentive to partly operate in the shadow sector, and see what happens when further changes are induced in the system.

When Case 1 optimal we need to consider the optimal decisions of both agents: the firm and the bureaucrat. We therefore have the following set of equilibrium relationships:

The level of output in the official sector: $y^*_{F,1} = \left(\frac{\gamma \cdot m^*}{\delta}\right)\overline{K}(1-t)^{\frac{1-\delta}{\delta}}\left(\frac{w_I}{w_F}\right)^{\frac{\beta}{\delta}}$

The level of output in the unofficial sector: $y^*_{I,1} = \overline{K}\left(\frac{\delta}{m^*}\right)^{\delta/\alpha}\left(\frac{\beta}{w_I}\right)^{\beta/\alpha} - (1-t)y^*_{F,1}$

The equilibrium price of corruption: $m^* = \mu \cdot \left[\delta \cdot y^*_{I,1} + (S+P)\right]$

The equilibrium level of corruption: $C^*_1 = \frac{1}{\mu}\left(\frac{\delta \cdot y^*_{I,1}}{\delta \cdot y^*_{I,1} + (S+P)}\right)$

The ratio of capital used in the formal sector: $k^*_1 = \frac{(1-t)y^*_{F,1}}{(1-t)y^*_{F,1} + y^*_{I,1}}$

and the corresponding levels of employed labor, as given by equations (O2.4) and (O2.5) introduced earlier.

The equations above combine in a simultaneous equation system with the endogenous variables: y^*_F, y^*_I, m^*, C^* and k^*, and the following exogenous policy variables[1]:

$\gamma =$ the quality of institutions in the official sector

$t =$ the tax rate

$\mu =$ the effectiveness of the mechanism of exposure of corrupt bureaucrats

$S =$ the bureaucrat's salary

$P =$ the penalty the bureaucrat pays (in addition to losing his job) in case he is detected as corrupt

For the sake of simplicity, I base the direct calculations on the first three equations in the system.

Consider total differentiation of the first three equations in y^*_F, y^*_I, m^* written in matrix form as following:

[1] Note that, for simplicity of notations, I drop the subscript '1' although all the variables refer to equilibrium levels in Case 1.

(55) $$J_0 \cdot \begin{bmatrix} dy_F^* \\ dy_I^* \\ dm^* \end{bmatrix} = M \cdot \begin{bmatrix} d\gamma \\ dt \\ d\mu \\ dS + dP \end{bmatrix}$$

where:

(56) $$J_0 = \begin{bmatrix} \frac{1}{y_F^*} & 0 & -\frac{1}{m^*} \\ (1-t) & 1 & \frac{\delta}{\alpha m^*}\left[(1-t)y_F^* + y_I^*\right] \\ 0 & -\mu\delta & 1 \end{bmatrix}$$

(The determinant of matrix J_0 is $|J_0| > 0$)

(57) $$M = \begin{bmatrix} \frac{1}{\gamma} & -\frac{1-\delta}{\delta(1-t)} & 0 & 0 \\ 0 & y_F^* & 0 & 0 \\ 0 & 0 & \frac{m^*}{\mu} & \mu \end{bmatrix}$$

In order to evaluate the effects of changes in policy variables on the endogenous variables considered, I use the Cramer's rule of solving simultaneous equation systems. Details on the corresponding calculations are included in the mathematical appendix. In the following paragraphs I only focus on the results.

<u>Effects of changes in the parameter γ</u>[2]

Consider first the effects of changes in the quality of institutions (benefits) specific to the official sector[3], as represented by γ. The total effect a change in γ has on the level of the firm's output in the official sector is given by the following expression:

[2] Assume that changes in γ are not high enough to render Case 1 inadmissible.

[3] Result 16 in the appendix.

(58) $$\frac{dy_F^*}{d\gamma} = \frac{\frac{y_F^*}{\gamma}\left[|J_0| - \frac{\mu\delta(1-t)}{m^*}\right]}{|J_0|} > 0$$

Everything else constant, a positive change in the advantages that benefit the firm in the official sector makes activity in the sector more appealing, and it therefore induces an increase in the volume of production in the sector. The associated results $\frac{dk^*}{d\,\gamma} > 0$ and $\frac{dL_F^*}{d\,\gamma} > 0$ tell us that increases in the official activities are realized by increasing the amount of resources (capital and labor) employed in the sector.

The corresponding effect on the volume of underground activities is derived as:

(59) $$\frac{dy_I^*}{d\gamma} = -\frac{\frac{(1-t)}{\gamma}}{|J_0|} < 0$$

with the expected negative sign.

We can also derive the combined effect of a change in γ on the total level of firm's output by noting that $\frac{dy_F^*}{d\gamma} > abs\left(\frac{dy_I^*}{d\gamma}\right)$. This inequality helps deriving the following net effects on the firm's activity:

$$\frac{d(y_F^* + y_I^*)}{d\gamma} > 0$$

$$\frac{d((1-t)y_F^* + y_I^*)}{d\gamma} > 0$$

$$\frac{d\pi_1^*}{d\gamma} > 0$$

$$\frac{d(L_F^* + L_I^*)}{d\gamma} > 0 \text{, at least if } w_I = w_F$$

Given that the positive effect of higher benefits specific to the official sector on the volume of official activities dominates the corresponding negative effect on the volume of shadow activities, the combined net effect on the total volume of firm's activities is unambiguously positive. A similar effect on the level of total employment of labor in the firm is obtained under the assumption that the two wages are equal. With increases in γ, the firm's profits also rise.

Reductions in the volume of shadow activities are associated with reduced demands for the inputs of labor $\frac{dL_I^*}{d\gamma} < 0$ and corruption $\frac{dC^*}{d\gamma} < 0$. The depressed demand of corruption also lowers the equilibrium price per unit of corruption:

$$\text{(60)} \qquad \frac{dm^*}{d\gamma} = -\frac{(1-t)\mu\delta}{\gamma}\frac{1}{|J_0|} = \mu\delta\frac{dy_I^*}{d\gamma} < 0$$

Note, however, that the market for corruption is more resilient than the firm's activity in the shadow sector, as indicated by the fact that the induced change in the price of corruption is lower (in absolute value and given $\mu\delta < 1$) than the change triggered in the volume of the underground activity. And the lower the effectiveness of the procedures designed to detect and punish corrupt public officials, the less sensitive the equilibrium level of bribe per unit of corruption to changes in the benefits specific to the official sector.

When combining the results above we obtain that the net effect of increases in γ on the total amount of bribery is negative:

$$\frac{d(m^*C^*)}{d\gamma} < 0$$

We therefore see that the beneficial effect of improved institutions in the official sector does not only translate into a higher level of firm's activity, but also into a lower equilibrium level of bribery associated with the shadow activities.

Yet another effect of improvements in the quality of institutions that enhance activities in the official sector relates to the threshold level $\hat{t}$ of the tax rate. Positive changes in γ translate into increases in the threshold level $\hat{t}$, such that the prevailing tax rate is now closer to the threshold level (and it can even be below $\hat{t}$ if increases in γ are high enough). Therefore better institutions reduce the appeal of underground economies, with positive effects on firm's output and profits, and also on the tax revenues the government collects from the firm. Labor may also gain in terms of higher employment, depending on how the two wage rates compare with each other (and with the prevailing tax rate). The bureaucrat loses as a result of increases in γ, as indicated by the associated decreases in the total level of bribery.

<u>Effects of changes in the tax rate *t*[4]</u>

The effects of changes in the tax rate *t* on the volume of firm's activities in the official sector are given by the following expression[5]:

$$\text{(61)} \qquad \frac{dy_F^*}{dt} = y_F^* \frac{1-\delta}{\delta(1-t)} \left[\frac{\dfrac{\mu\delta(1-t)}{m^*(1-\delta)}}{|J_0|} - 1 \right] < 0$$

We therefore see that, *ceteris paribus*, an increase in the tax rate (from a level where shadow activities are already profitable) unambiguously induces a negative change in the volume of activities declared officially by the firm. An increase in taxes alters the marginal productivities of firm's inputs employed in the official sector (with the corresponding effects $\dfrac{\partial k^*}{\partial t} < 0, \dfrac{\partial L_F^*}{\partial t} < 0$ on the use of capital and labor in the sector). The change in the tax rate also has an additional feedback effect on the official sector via its impact on the firm's incentives to transfer part of its operations to the

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[4] Again, assume that decreases in *t* (when discussed) are not large enough such that they render Case 1 inadmissible.

[5] See Result 17 in the appendix.

underground. The effect of changes in t on the volume of shadow activities is given in the following equation:

(62) $$\frac{dy_I^*}{dt} = \frac{1}{\delta}\frac{1}{|J_0|} > 0$$

and it can be shown that $\left|\frac{dy_F^*}{dt}\right| > \left|\frac{dy_I^*}{dt}\right|$, such that an increase in the tax rate induces a negative net effect on the level of firm's total output. A similar result obtains for the total level of employment of labor, if we can assume that $w_I = w_F$. These results are given below as following:

$$\frac{d(y_F^* + y_I^*)}{dt} < 0$$

$$\frac{d((1-t)y_F^* + y_I^*)}{dt} < 0$$

$$\frac{d\pi_1^*}{dt} < 0$$

$$\frac{d(L_F^* + L_I^*)}{d\gamma} < 0 \text{, at least if } w_I = w_F$$

We also obtain that profits in the firm are also reduced when the tax rate increases.

The effect that higher taxes in the official sector have on the volume of underground activities can be better understood if we consider the associated effects in the market for corruption. Effects induced by tax rate changes on the equilibrium quantities in the corruption market are the following:

(66) $$\frac{dC^*}{dt} = \frac{\delta(S+P)}{m^*\left[\delta y_I^* + (S+P)\right]}\frac{dy_I^*}{dt} > 0$$

(67) $$\frac{dm^*}{dt} = \frac{\mu}{|J_0|} > 0$$

We can infer that the volume of the shadow activities increases as a result of increases in the tax rates, but it does so to a lower extent that it would have if an increased volume of firm's activity in the underground did not affect the market for corruption. With more resources shifted from the official sector to the unofficial sector (as a result of increased taxes on official activities) the firm needs to acquire more corruption in order to make the activity underground profitable. An increased demand for corruption propagates in the system and it results in a higher equilibrium bribe per unit of corruption (given that the remaining conditions that drive the supply of corruption do not change). The two opposing effects (higher resources shifted to the shadow sector and increased costs with corruption in the sector) combine such that the net effect on the firm's side is still an increase in its shadow activities. Therefore, when parallel activities in both sectors are feasible, an increase in tax rates does not only induce a higher level of shadow activities, but also higher equilibrium levels for bureaucratic corruption and bribes per unit of corruption. In such situations the total amount of bribery $\left(m^{*}C^{*}\right)$ rises.

We can further compare the effect of an increase in the parameter γ on the volume of shadow economy with the corresponding effect of a change in taxes. It can be proved that the following result holds: $\frac{dy_I}{dt} < abs\left(\frac{dy_I}{d\gamma}\right)$ if and only if $(1-t) > \frac{\gamma}{\delta}$. This happens at low levels of taxes or small levels of γ. The result indicates that simultaneous changes (in the same direction) in the two policy variables have different (opposite in sign, and of different magnitudes) effects on the volume of the firm's unofficial activity, depending on the conditions in the two sectors. With higher taxes, for given γ and δ, the inequality above is less likely to hold, and therefore the effect of an increase in the quality of institutions is likely to be dominated by the effect of a similar change in the tax rate. The same holds for higher levels of γ, with given levels for t and δ. The effect of improvements in institutions is more likely to dominate the effect of an increase in the tax rate in markets with low taxes and/or underdeveloped institutions[6].

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[6] Note that the setup of the analysis does not necessarily support the generalization of the results at the aggregate level.

A similar result can also be obtained in terms of the levels of official output, $\frac{dy_F}{dt} < abs\left(\frac{dy_F}{d\gamma}\right)$ for $(1-t) > \frac{\gamma}{\delta}$, such that we can see that at relatively lower levels of t $\left(\hat{t} < t < \frac{\gamma+\delta}{\delta}\right)$ the net effect of an increase in γ on the firm's total output will be higher than the corresponding net effect of a decrease in the tax rate $\left(\left|\frac{d(y_{F,1}^{*} + y_{I,1}^{*}}{dt}\right| < \left|\frac{d(y_{F,1}^{*} + y_{I,1}^{*}}{d\gamma}\right|\right)$.

Let us consider now the effect an increase in the tax rate has on the tax revenues the government collects on firm's official activities when Case 1 is feasible. The output declared by the firm in the official sector is given by the following expression (also introduced as (O2.1) earlier in this section):

$$y_F^{*} = \left(\frac{\gamma \cdot m^{*}}{\delta}\right)\overline{K}(1-t)^{\frac{1-\delta}{\delta}}\left(\frac{w_I}{w_F}\right)^{\frac{\beta}{\delta}}$$

The tax revenues the government collects are:

$$R^{(1)}(t) = ty_F^{*} \tag{68}$$

and it can be proved that:

$$\frac{dR^{(1)}(t)}{d\,t} = y_F^{*} + t\frac{d\,y_F^{*}}{d\,t} < 0 \tag{69}$$

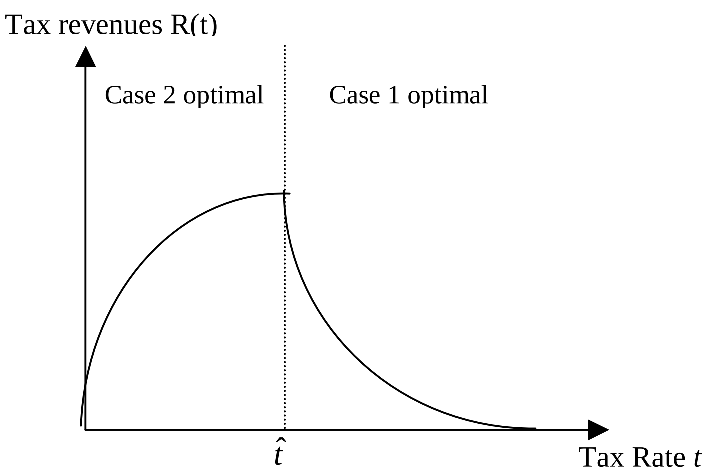
It can also be proved that $\frac{d^2R^{(1)}(t)}{d\,t^2} > 0$ such that the tax revenue function, in the relevant range for the tax rate, is convex. We therefore obtain an unambiguously negative effect of increases in the tax rate on the tax revenues the government collects from the firm when Case 1 is optimal. This amounts to saying that, when the conditions in the two sectors are such that the firm finds it profitable to operate in both sectors in parallel, then the Laffer curve (in relation to firm's activities) vanishes, and we are left with decreasing tax revenues as the tax rate increases. This happens for any level of the tax rate higher than the critical threshold $\hat{t}$ (given in (49)). Note that this discussion relies on the assumption that all the other exogenous parameters in the system are fixed.

In order to combine the results on the tax revenues the government collects from the firm when Case 2 is feasible and when Case 1 is feasible we need an assumption on the level of the threshold tax rate $\hat{t}$. More specifically, we need to know how the level of the tax rate that maximizes tax revenues in Case 2 $(1-\beta)$ compares with the tax level $\hat{t}$ beyond which the firm considers the possibility to operate in the shadow sector[7]. The tax revenue function is given by the following expression:

$$(70) \qquad R(t) = \begin{cases} R^{(2)}(t)\ if\ \ t \le \hat{t} \\ R^{(1)}(t)\ if\ \ t > \hat{t} \end{cases}$$

Assume that the productivity of labor and conditions in the sectors are such that $\hat{t} < 1-\beta$. Then the graph in Figure 5 describes the shape of the tax revenue function, as resulting from considering the possibility that higher tax rates induce the firm to transfer (part of) its resources to shadow sector.

Figure 5 Tax revenues when $0 < \hat{t} < 1-\beta$

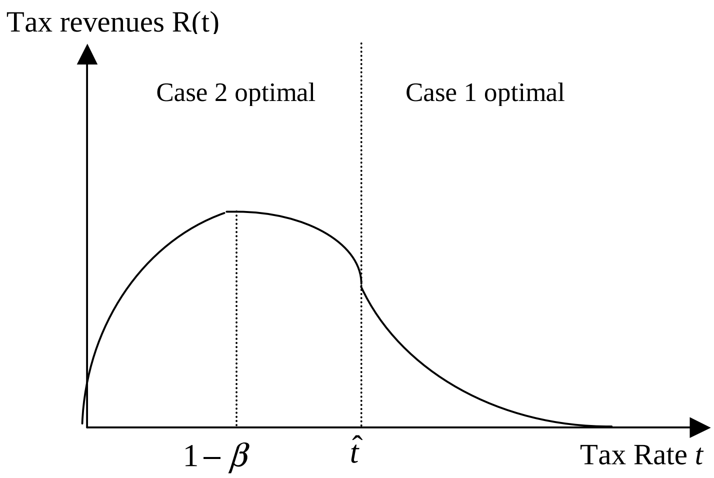


[7] The higher β the lower the chances that $\hat{t} < 1-\beta$.

As long as the tax rate imposed on the firm in the official sector is kept under the critical level $\hat{t}$, then small increases in the tax rate will result in higher tax revenues collected from the firm. However, as soon as the tax rate exceeds the threshold then, with further increases in the tax rate, the government will experience rapid decreases in the tax revenues that it collects from the firm.

When the opposite assumption on the critical level $\hat{t}$ holds, meaning $\hat{t} > 1-\beta$, then the shape of the tax revenue function (as related to firm's activity) is as illustrated in Figure 6.

Figure 6 Tax revenues when $1-\beta < \hat{t} < 1$

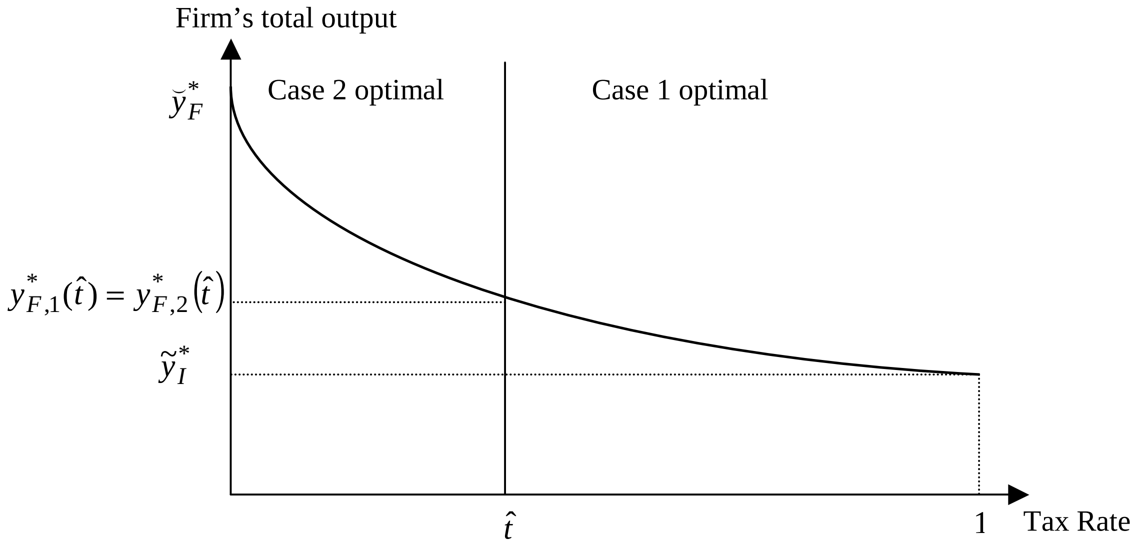


In this situation, tax revenues will start falling even before the firm considers trasnferring its resources to the undeground sector, the difference being that, with at tax levels higher than the thershold level $\hat{t}$, tax revenues vanish much more rapidly.

As in the case of the volume of firm's official production, the firm's total output also falls as the tax rate increases. The evolution of firm's total output over the possible range of values of the tax rate is as illustrated in Figure 7.

We therefore see that increases in the tax rate negatively affect the optimal levels of output that the firm produces, regardless of which of the two Cases is optimal. A similar graph obtains for the optimal levels of the after-tax output in the admissible range of the tax rate. Furthermore, the same pattern is obtained for the level of total employment of labor at the optimum, at least for the case when the two wage rates are equal. These results are derived in Result 17 in the appendix.

Figure 7 Firm's optimal decisions along the admissible range of tax rate levels



Note that this analysis relies on the assumption that no other parameters in the system change in the same time with the change in the tax rate. A similar analysis can be performed in connection with the each of the other parameters in the system, one at a time, while keeping the the others constant.

Effects of changes in the parameter μ[8]

A change in the effectiveness of the procedures implemented in order to expose and punish the corrupt public officials propagate in the system through the direct effect it has on the bueaucrat's incentives to engage in corrupt transactions. The effect of a change in μ on the equilibrium price per unit of corruption is derived as following:

$$(72) \qquad \frac{dm^*}{d\mu} = \frac{m^*}{\mu y_F^*} \frac{1}{|J_0|} > 0$$

As expected, the higher the risk of being detected and punished that the bureaucrat perceives, the higher the (equilibrium) price he charges per unit of corruption at a given

[8] See Result 18 in the appendix.

(equilibrium) level of corruption. The equilibrium price m^* is more sensitive to changes in the effectiveness of the exposure mechanism μ when the equilibrium bribe is already at a high level, or when the initial effectiveness is low.

The effect of a change in μ on the volume of firm's activity in the underground sector is given by the following result:

$$\frac{dy_I^*}{d\mu} = -\frac{1}{\mu}\left[(1-t)(1+\delta)+\delta\frac{y_I^*}{y_F^*}\right]\frac{1}{|J_0|} < 0 \tag{73}$$

indicating that, as costs associated with the shadow activities increase, the firm has less of an incentive to pursue such activities. This is also reflected in the allocation of resources, in that both the ratio of capital used in the underground sector and the amount of labor used for such activities decrease with a positive change in μ $\left(\frac{d(1-k^*)}{d\mu} < 0, \frac{dL_I^*}{d\mu} < 0\right)$. The equilibrium level of corruption is also reduced in this situation, as a result of firm's lower demand for corruption:

$$\frac{dC^*}{d\mu} = \frac{dC^*}{dy_I^*}\frac{dy_I^*}{dt} = -\frac{1}{\mu}C^* + \frac{\delta(S+P)}{m^*\left[\delta y_I^* + (S+P)\right]}\frac{dy_I^*}{d\mu} < 0 \tag{74}$$

The results also indicate that, despite the fact that the equilibrium price of corruption increases and the equilibrium quantity of corruption decreases with increases in μ, the total amount of bribery is depressed $\left(\frac{d(m^*C^*)}{d\mu} < 0\right)$.

Given the adverse effects an increase in the effectiveness of the exposure mechanism has on the market for corruption and on the firm's incentives to operate in the underground, a change in μ will benefit the firm's official activities:

$$\frac{dy_F^*}{d\mu} = \frac{1}{\mu}\frac{1}{|J_0|} > 0 \tag{75}$$

An increase in μ also benefits the government in terms of the tax revenues collected from the firm on its official activities.

The effect of an increase in μ on the firm's total output net of taxes proves positive:

$$\frac{d\left((1-t)y_F^* + y_I^*\right)}{d\mu} > 0$$

However, the results above do not necessarily translate into corresponding positive effects on the level of total output produced by the firm. I find that the following result holds:

$$\frac{d\left(y_F^* + y_I^*\right)}{d\mu} \begin{cases} > 0 & \text{if} \quad \hat{t} > \dfrac{\delta}{1+\delta} \\ < 0 & \text{if} \quad \hat{t} < \dfrac{\delta}{1+\delta} \end{cases}$$

The effects of changes in μ on the firm's total level of activity are therefore not unambiguously positive.

As with changes in the quality of institutions in the official sector, changes in μ also have the potential to affect the threshold level $\hat{t}$ of the tax rate that determines whether the firm will operate in both sectors in parallel or not. Increases in μ will shift the threshold level $\hat{t}$ closer to the prevailing tax rate, and it can even become higher than t if the increases in μ are high enough.

<u>Effects of changes in *S* and *P*[9]</u>

The bureaucrat's salary S and the penalty P have twin roles in the current set-up of the model. I will therefore consider changes in either of the two variables in the form $d(S+P)$. The channel through which changes in S and P propagate in the system is

[9] See Result 19 in the appendix.

similar to the one discussed for changes in μ. Changes in bureaucrat's salary and/or the penalty he pays if exposed as corrupt affect the price the bureaucrat charges per unit of corruption, for a given level of the demand of corruption, as illustrated in the following result:

$$\text{(76)} \qquad \frac{dm^*}{d(S+P)} = \frac{\mu}{y_F^*}\frac{1}{|J_0|} > 0$$

The comparison of the magnitude of the effect of a change in μ, as given in (72), with the result above reveals that an increase in μ is more effective in terms of its effect on the equilibrium level of bribe per unit of corruption than corresponding increases in *S* and *P* $\left(\left|\frac{dm^*}{d\mu}\right| > \left|\frac{dm^*}{d(S+P)}\right|\right)$. An increase in μ is more persuasive in deterring the bureaucrat's involvement in corrupt acts when compared to increases in *S* or *P*. This is due to the fact that a change in μ has a direct effect on the probability that the bureaucrat will be exposed, given the same level of corruption. In case of exposure the bureaucrat has much more to lose: losses in terms of the forgone salary and the penalty he has to pay are augmented by the bribes he has to surrender.

From the perspective of tightening the conditions in the market for corruption, the results in the model indicate that public money spent on improving the effectiveness of exposing corrupt officials may help reach the objective better than policies that relate to the bureaucrat's salary and the corresponding penalty. However, I cannot advance such a prediction as definitive, given that the model ignores the costs associated with the implementation of such policies. As alternative research efforts suggest[10], it is more likely that a combination of policies related to the levels of *S*, *P* and μ will prove more effective for containing corruption.

From the firm's perspective, higher levels set for *S* and *P* translate into higher costs associated with the input of corruption, and they therefore depress the firm's corresponding demand:

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[10] See discussions in the next section.

$$\text{(77)} \qquad \frac{dC^*}{d(S+P)} = \frac{1}{\mu} \frac{\delta \frac{dy_I^*}{d(S+P)}(S+P) - \delta y_I^*}{\left[\delta y_I^* + (S+P)\right]^2} < 0$$

As with the case of increases in μ, I obtain that increases in *S* and *P* also trigger a net reduction in the total level of bribery $\left(\frac{d(m^* C^*)}{d(S+P)} < 0\right)$.

The direction of the effects of changes in S and/or P on the levels of firm's official and unofficial activity is similar as found in the case of changes in μ, although the differ in size:

$$\text{(78)} \qquad \frac{dy_F^*}{d(S+P)} = \frac{\mu}{m^*} \frac{1}{|J_0|} > 0$$

$$\text{(79)} \qquad \frac{dy_I^*}{d(S+P)} = -\frac{\mu}{m^*}\left[(1-t)\left(1+\frac{\delta}{\alpha}\right) + \frac{\delta}{\alpha} \frac{y_I^*}{y_F^*}\right] \frac{1}{|J_0|} < 0$$

The net result of changes in $(S+P)$ on the level of firm's total output is not unambiguous. Based on the results above, I find that the following inequalities hold:

$$\frac{d(y_F^* + y_I^*)}{d(S+P)} \begin{cases} > 0 & if \quad \hat{t} > \dfrac{\delta}{\alpha+\delta} \\ < 0 & if \quad \hat{t} < \dfrac{\delta}{\alpha+\delta} \end{cases}$$

For the level of output net of taxes and for the level of profits I obtain:

$$\frac{d((1-t)y_F^* + y_I^*)}{d(S+P)} > 0$$

$$\frac{d\pi_1^*}{d(S+P)} > 0$$

A comparison of effects of changes in μ with effects of changes in $(S+P)$ produces the following result:

$$(80) \qquad \left|\frac{dy_F^*}{d\mu}\right| > \left|\frac{dy_F^*}{d(S+P)}\right|$$

such that the policy device μ proves more effective in inducing an increase in the level of official activities than the alternative policy devices *S* and *P*. This also indicates that changes in μ will trigger a higher positive effect on the tax revenues of the government, when compared to changes in *S* and/or *P*.

As in the case of changes in μ, changes in *S* and/or *P* will also affect the threshold level $\hat{t}$ of the tax rate that defines the boundary between the two optimal cases.

For easy reference I summarize the results obtained in this subsection as following:

<u>If Case 2 Optimal</u>

$$\gamma \uparrow \Rightarrow \begin{cases} y_{F,2}^* \uparrow, \quad (1-t)y_{F,2}^* \uparrow, \quad \pi_2^* \uparrow \\ L_{F,2}^* \uparrow \\ R^{(2)}(t) \uparrow \\ \hat{t} \uparrow \end{cases}$$

$$t \uparrow \Rightarrow \begin{cases} y_{F,2}^* \downarrow, \quad (1-t)y_{F,2}^* \downarrow, \quad \pi_2^* \downarrow \\ L_{F,2}^* \downarrow \\ R^{(2)}(t) \uparrow\downarrow \end{cases}$$

<u>If Case 1 Optimal</u>

$$\gamma \uparrow \Rightarrow \begin{cases} y_{F,1}^* \uparrow, \quad y_{I,1}^* \downarrow, \quad y_{F,1}^* + y_{I,1}^* \uparrow, \quad (1-t)y_{F,1}^* + y_{I,1}^* \uparrow, \quad \pi_1^* \uparrow \\ L_{F,1}^* + L_{I,1}^* \uparrow \\ R^{(1)}(t) \uparrow \\ m^* \downarrow, \quad C^* \downarrow, \quad m^*C^* \downarrow \\ \hat{t} \uparrow \end{cases}$$

$$t\uparrow\Rightarrow\begin{cases}y^*_{F,1}\downarrow,\quad y^*_{I,1}\uparrow,\quad y^*_{F,1}+y^*_{I,1}\downarrow,\quad (1-t)y^*_{F,1}+y^*_{I,1}\downarrow,\quad \pi^*_1\downarrow\\ L^*_{F,1}+L^*_{I,1}\downarrow\\ R^{(1)}(t)\downarrow\\ m^*\uparrow,\quad C^*\uparrow,\quad m^*C^*\uparrow\end{cases}$$

$$\mu\uparrow\Rightarrow\begin{cases}y^*_{F,1}\uparrow,\quad y^*_{I,1}\downarrow,\quad y^*_{F,1}+y^*_{I,1}\uparrow\downarrow,\quad (1-t)y^*_{F,1}+y^*_{I,1}\uparrow,\quad \pi^*_1\uparrow\\ L^*_{F,1}+L^*_{I,1}\uparrow\\ R^{(1)}(t)\uparrow\\ m^*\uparrow,\quad C^*\downarrow,\quad m^*C^*\downarrow\\ \hat{t}\uparrow\end{cases}$$

$$S+P\uparrow\Rightarrow\begin{cases}y^*_{F,1}\uparrow,\quad y^*_{I,1}\downarrow,\quad y^*_{F,1}+y^*_{I,1}\uparrow\downarrow,\quad (1-t)y^*_{F,1}+y^*_{I,1}\uparrow,\quad \pi^*_1\uparrow\\ L^*_{F,1}+L^*_{I,1}\uparrow\\ R^{(1)}(t)\uparrow\\ m^*\uparrow,\quad C^*\downarrow,\quad m^*C^*\downarrow\\ \hat{t}\uparrow\end{cases}$$

Section III: Summary of Results

The analysis in this study focuses on the balance between the incentives and the disincentives a legally registered firm has to engage in tax evasion. By virtue of the definition of unofficial activities, tax evasion is interpreted as firm's participation in the shadow sector in the economy. The firm has a fixed stock of productive capital $(\overline{K})$ and it employs labor as required.

In relation to its activities in the official sector, the firm's incentives to be active in the sector depend on the quality of institutions (γ) in the official sector. The quality of institutions is defined in terms of the development of financial markets, as well as of the benefits the firm extracts from the use of public goods such as contract enforcement in courts, protection of property provided legally by the police etc. I assume that such benefits are not available freely to activities performed in the underground sector. Disincentives to operate in the official sector depend on the level of the tax rate (t) that the government imposes on the firm's official activities.

In relation to its activities in the underground sector, the firm's incentives to operate in the shadow sector derive from the fact that the firm does not pay taxes to the government. However, in order to be able to retain the output it realizes in the sector, the firm needs to corrupt public officials in charge with the inspection of its activities. Bureaucratic corruption (C) is modeled as an input in the firm's production process in the unofficial sector.

If there is a demand for corruption, the bureaucrat needs to set a corresponding price (m). In doing so the bureaucrat compares the additional revenue he can extract by selling favors to the firm with the associated risks. The risks the bureaucrat assumes when he engages in corrupt transactions are defined in terms of a probability of being caught and fired. This probability is modeled as a function of the effectiveness of the exposure procedures (μ) and of the amount of corruption that the bureaucrat sells. Moreover, if detected as involved in corrupt activities, the bureaucrat also pays a penalty (P), in addition to losing his salary (S).

I find that, given the assumptions of the model, operating in the shadow sector (and therefore tax evasion) is not always optimal for the firm. There is a possibility that conditions in the two sectors (as defined by $(\gamma, t, \mu, S \text{ and } P)$) combine such that it is more profitable for the firm to engage only in official activities, and thus pay the corresponding taxes to the government. This situation is labeled as Case 2 in the analysis in the previous subsections. There is also an alternative option that the firm has under these circumstances, and that is to transfer all of its operations to the underground (labeled as Case 3). However, Case 3 is an alternative that generates lower profits.

When conditions in the two sectors (as defined by $(\gamma, t, \mu, S \text{ and } P)$) are such that it becomes profitable for the firm to transfer part of its operations to the underground sector, then its optimal strategy will be to do so. This is labeled as Case 1 in the analysis. The firm's options either to be active completely in the official sector (Case 2) or to operate only in the unofficial sector (Case 3) would still generate profits, but not as high as in Case 1. When Case 1 is optimal an interesting situation ensues as the firm generates a lower level of total output, when compared to the non-optimal option Case 2. Furthermore, as the output the firm realizes in the official sector in Case 1 is lower than the corresponding official output produced in Case 2, the tax revenues that the government collects at the optimum are also lower than in Case 2.

Case 1 optimal also corresponds to the situation when a market for bureaucratic corruption develops. Part of the tax revenues that is diverted to the unofficial sector is redistributed as bribes to the corrupt bureaucrat. The more the firm needs to operate in the underground sector, the higher the bureaucrat's share in the profits generated by the firm in that sector. It is therefore not optimal for the firm to transfer all of its operations to the shadow sector, even if it meets excessive taxation in the official sector. If the firm were to operate only in the unofficial sector, much of its profits would dissipate in bribes to the corrupt bureaucrat.

The condition that defines the feasibility (and optimality) of Case 1 is central to the model. Given the levels of the parameters $(\gamma, \mu, S \text{ and } P)$ that prevail in the two sectors, I derive a corresponding threshold level for the tax rate $(\hat{t})$. The threshold level $\hat{t}$ gives us the maximum level of the tax rate that the firm will tolerate, while active in the official sector, without considering the possibility to operate in the shadow sector. The better the institutions and public services available to activities in the official sector and the more effective the *preventive* anti-corruption policies (in terms of $(\mu, S \text{ and } P)$)

the higher the threshold level for the tax rate that the firm will tolerate in the official sector. The role of the parameters $\mu, S \text{ and } P$ is to reflect the minimum costs associated with corruption necessary for activities in the shadow sector. At higher values of the three parameters, the anti-corruption policies are more effective in preventing the firm's attempts to corrupt the public officials. Therefore, we are likely to gain a better understanding of the effects of taxation on firm's activities if we also consider the balance between the incentives that a legal firm has to operate in the official sector and the incentives it has to be active in the shadow sector. In an environment with poor institutions, a less motivated bureaucracy and/or lax anti-corruption policies even a small level of the tax rate can prove high enough to induce and sustain tax evasion, underground activities and bureaucratic corruption.

Effects of changes in the parameters in the system on the firm's activity, government tax revenues and corruption are also considered in the analysis in the preceding section.

When Case 2 is optimal, increases in the tax rate result in decreases in the firm's level of activity in the official sector. Such changes do not necessarily push the firm into the unofficial sector as long as increases in the tax rate are small enough such that they do not alter the balance between the incentives the firm has to stay in official sector and the corresponding incentives it has to migrate to the underground. This depends on the level where the tax rate already is, relative to the threshold level $\hat{t}$, before the change is implemented. If after the change the tax rate is still below $\hat{t}$, the results reveal a decrease in the firm's output, a reduction in the employment of labor in the firm, and a decrease in the firm's profits. The tax revenues that the government collects from the firm do not necessarily decrease in this case. Depending on how the tax rate compares to the productivity of labor (as the only non-fixed input in the firm's production in Case 2), it is possible that increases in the tax rate from initially small levels generate higher tax revenues, despite the decrease in the firm's total output. We therefore infer that, with increases in taxes, the firm loses in terms of profits, the labor loses in terms of employment and the government may or may not lose in terms of tax revenues.

For a given level of the tax rate, positive changes in the advantages specific to the official sector (as represented by γ) benefit the firm, the employees and the government. An increase in γ is associated with higher output, higher employment of labor in the firm, and higher tax revenues collected by the government. Positive changes in institutions specific to the official sector have two types of effects on firm's activity. There is a direct effect derived from fact that, with better institutions and public goods, the firm is able to produce more output for given levels of resources (capital and labor), and there is also an indirect positive effect on the employment of resources (in this case, the effect refers to higher levels of employment of labor). Increases in γ also strengthen the firm's incentives to remain active in the official sector by increasing the threshold level $\hat{t}$ for the tax rate.

When comparing the effects of two similar policies, a decrease in the tax rate and an increase in γ, I find that the tax rate policy has a larger impact (in terms of additional output that the firm produces) in situations where $t > 1 - \beta$ (that is, on the side of the Laffer curve where the government's tax revenues are decreasing with higher tax rates). At lower levels of the tax rate the relative effectiveness of the two policy measures depends on the relationhip between the tax rate level, the productivity of public services and the productivity of labor.

Assume that the government charges a tax rate that is higher than the threshold level $\hat{t}$, such that it becomes optimal for the firm to be active in the underground sector. This can correspond to a situation when the tax rate is already on the decreasing branch of the Laffer curve, and the government attempts to increase its revenues by charging an even higher tax rate. In this case the *preventive* anti-corruption policies (in terms of $(\mu, S \textit{ and } P)$) are not strong enough[1] and a market for corruption develops. This is the situation when Case 1 is optimal.

With Case 1 optimal, an increase in the tax rate triggers changes in the productivity of inputs (capital and labor) in the official sector, and therefore it induces the firm to transfer part of its resources to underground activities. The volume of firm's official activities decreases as a result, and so do the tax revenues the government collects from the firm. The reallocation of resources favors activities in the shadow sector, but there is a limit to which they can grow given the fact that higher levels of

[1] The firm is now willing to pay at least the minimum level of bribe per unit of corruption solicited by the bureaucrat.

shadow activities require more corruption The higher demand of corruption translates into a higher price than the bureaucrat charges per unit of corruption. In the equilibrium, the volume of unofficial activities, the volume of labor used for that purpose, the amount of corruption and its associated price increase. The net effect of the increase in the tax rate on the total level of firm's output is negative, as the associated reduction triggered in the volume of official activities dominates the corresponding increase in the volume of underground activities.

Based on the results related to the effects of an increase in the tax rate, when Case 1 optimal, we can infer that the government loses in terms of tax revenues, the firm loses in terms of output and profits, the labor (in total) may lose in terms of employment, and the corrupt bureaucrat gains in terms of total bribery.

In this case also changes in the benefits specific to the official sector prove an effective device to persuade the firm to increase its involvement in the official sector and pay the corresponding taxes. Increases in γ have similar effects on the firm's official activity as discussed above (when Case 2 is optimal). There is a direct effect on the firm's volume of activity, given the same employment of resources, and an indirect effect related to the reallocation of resources in favor to the official activities. A third effect of an increase in γ relate to its positive impact on the firm's incentives to operate in the official economy for a given level of the tax rate. An increase in γ translates into a higher threshold level $\hat{t}$ for the tax rate, thus making the condition that defines the optimality of Case 1 more binding. With better institutions in the official sector the firm perceives the tax rate as less of a problem and it may find it profitable to cease its underground activities altogether (if the increase in γ is large enough and if the prevailing tax rate is not much higher than the initial threshold level). In any case, the volume of unofficial activities will decrease as result. The net effect the increase in γ has on the firm's total output is positive due to the fact that the associated increase induced in the volume of official activities dominates the negative effect on the volume of unofficial activities. The same result extends to the changes in the firm's profits and to changes in level of total labor employment in the firm. Given the effect on the volume of official activities, the government will also experience higher tax revenues.

Changes in benefits specific to the official sector also affect the market for corruption through their effects on the firm's demand of corruption. The equilibrium levels of the amount of corruption and its associated price decrease as a result of increases in γ. It therefore appears that the only one who loses from improved institutions in the official sector is the corrupt bureaucrat.

Consider now what happens if conditions that define the supply of corruption $(\mu, S\ and\ P)$ change. Positive changes in the any of the three of parameters will reduce the bureaucrat's incentives to engage in corrupt transactions. This translates into higher costs per unit of corruption that the firm meets in the underground sector. Changes in any of the three anti-corruption devices also have the potential to alter the threshold level $\hat{t}$ for the tax rate. Higher levels of $\mu, S\ and\ P$ make corruption in the shadow sector more expensive, and therefore the firm will tolerate higher taxes in the official sector without considering the possibility to operate in the shadow sector. Note that, while the net effects of changes in $\mu, S\ and\ P$ on total bribery operate in the same direction as the corresponding effect derived for changes in institutions in the official sector, the mechanism is different. While improvements in public services and institutions in the official sector, and/or decreases in the tax rate, result in reductions in the equilibrium levels of both *C* and *m*, positive changes in $\mu, S\ and/or\ P$ trigger an increase in the equilibrium price of corruption and a decrease in the equilibrium quantity of corruption.

All the three policy measure $(\mu, S\ and\ P)$ have the potential to positively affect the firm's volume of the official activity, and to reduce its corresponding volume of shadow activities. However, their effects on the firm's total volume of activity are not unambiguously positive.

A change in the effectiveness of the mechanism of exposure and punishment of corrupt bureaucrats (μ) is most effective among the three anti-corruption devices in terms of its effects on the equilibrium price of corruption and on the level of official activities. However, in terms of its effects on the volume of unofficial activities and the equilibrium level of corruption, increases in μ are not necessarily more effective than increases in *S* or *P*. This is due to the fact that the increase in the equilibrium price of corruption associated with positive changes in *S* and/or *P* is lower than the corresponding effect of changes in μ. With increases in *S* and *P* , buying corruption proves more expensive for the firm, but not as expensive as in the case when

μ increases. The higher effect of changes in μ on the equilibrium price of corruption relates to the fact that, with a more effective mechanism of exposure, the bureaucrat perceives that the risks associated with a given level of corruption are higher.

Although we do not obtain an unambiguous result on the net effect of increases in $\mu, S \text{ and } P$ on the firm's total level of output[2], what we do know is that such changes will trigger positive changes in firm's profits. We can therefore say the firm gains as a result of such policies, and so does the government in terms of higher tax revenues. Under certain conditions labor may also gain in terms of more employment. The only one who loses is the corrupt bureaucrat as the total level of bribery is reduced as a result of positive changes in any of the three parameters[3].

Based on the predictions of the model, the following general conclusions can be briefly summarized:

- Better institutions that support economic activities in the official sector are associated with a higher level of firm's volume of official activities and a with lower volume of unofficial activities (if any).
- It is not always the case that increases in the tax rate induce tax evasion and growth of activities in the unofficial sector. However, this is likely to happen when a high tax rate is imposed with no regard to the incentives the firm has to actually pay the total amount of taxes it owes to the government.
- Even at high levels of taxes, and poor institutions in the official sector, the firm still has some incentives to be present in the official sector and not to migrate completely to the shadow sector.
- With bureaucratic corruption unofficial activities flourish but there is a limit to which they can develop even if the technology in the unofficial sector does not display decreasing returns.
- With an active underground sector, the decreasing side of the Laffer curve of the tax revenues that the government collects from firm becomes convex at higher levels of taxes.

[2] And given that the levels of $\mu, S \text{ and } P$ are such that Case 1 is still optimal.

[3] Note that it is not clear that this conclusion holds in the specific situation when the salary of the bureaucrat increases.

- As the firm transfers its operations to the underground sector the volume of its official activities decreases and the corresponding volume of the unofficial activities increases. The net effect on the firm's total output is negative at the optimum, as the reduction in the official activities dominates the associated increase in the volume of unofficial operations. No case when both official and unofficial activities develop in the same direction is detected[4].
- At the optimum, a higher level of total bribery is associated with a higher level of unofficial activities.
- At very high levels of taxation it is possible that everybody in the economy loses (the firm, the government and labor), but not the corrupt public official.
- Policies that have the objective to strengthen firm's incentives to operate in the official sector and policies implemented in order to contain corruption benefit the firm, the government, and possibly labor, but not the corrupt public servant.

[4] This is most probably due to the assumption of fixed capital.

Section IV: Discussions on assumptions and possible extensions of the model

Some of the assumptions on which the model in this study relies on may be perceived as too strong, when compared to what we are likely to observe in reality. In this section I discuss the possible implications of relaxing these assumptions and/or possibilities to extend the model.

1. The firm pays its taxes on official activities

In the model I assume that the firm necessarily pays its taxes corresponding to the volume of its official activities. In transition economies this may not necessarily be the case as the government often tolerates tax arrears of both state-owned and private firms. In Hellman and Schankerman(2000) we learn that privatized firms are as likely to benefit from tax arrears as the state-owned enterprises. However, the evidence in the study indicates that the government is less likely to tolerate tax arrears of the private start-ups. The *de novo* private firms are found to have a different relationship with the state. While they experience less state intervention on their operational decisions and they also receive lower benefits from the state (in terms of subsidies and tax arrears), the start-up private firms are more likely to pay higher bribes (calculated as a percentage of the firm’s annual revenues) to public officials. The model in this section is therefore more suitable for the analysis of the behavior of the *de novo* private firms, rather than privatized or state-owned enterprises.

2. Fixed stock of capital

In order to isolate the effects of bureaucratic corruption on the firm’s decisions I assume that the firm does not consider further increases in its stock of productive capital. This is a simplifying assumption with a limited grip on reality indeed.

There are two main conceivable ways in how a firm expands its stock of productive capital. A first possibility is to finance investments based on external financing, as raised from banks (in the form of bank credits) and/or from the capital markets (either debt or equity). In both cases, it is likely that the firm will need to have a good history in terms of past levels of officially declared activities. Therefore, the more use the firm has of the facilities of a well-developed financial system, the more likely it is that the firm has strong incentives to be active in the official sector. Note that in this case the benefits the firm reaps from the official sector will be a function of the firm's past levels of activity in the sector. Such considerations require a dynamic framework with path dependency in firm's decisions. On the other hand, with investments, the firm acquires a larger pool of resources that can be allocated between the two sectors, and therefore its volume of unofficial activities may not increase but it does not necessarily decrease.

A second possibility the firm has for financing its investments is to use the retained profits generated in the two sectors. An interesting distinction can be made in that, while each 1$ of profits generated in the official sector can translate directly into a 1$ invested in productive capital, this is not necessarily the case with profits generated in the unofficial sector. To the extent the firm needs to legally justify the sources of the funds it invests, it is conceivable that the firm will incur some costs with its attempts to surface the illegal profits (very much in the spirit of money laundering). With illegal profits, a 1$ in profits will translate into less than 1$ investment in productive capital. This, however, can be partly compensated by higher levels of profits generated in the underground sector relative to the official sector. Therefore, it is difficult to predict at this stage of the analysis what the net effects on firm's total activity will be when investments are considered in the analysis.

3. Identical technology in the two sectors

Given the nature of unofficial activities I consider in the model (it is the same activity, the only issue being hiding part of the operations in order to evade taxes), the assumption of identical productivities of labor and capital is not far-fetched. However, it is more difficult to justify why the corruption input in the underground production has the same productivity as the institutions specific to the official sector. The main objective I have with imposing this assumption is to rule out the possibility that the nature of total returns to scale in the two sectors has a bearing on the predictions of the model. The objective is therefore to isolate the effects of other factors considered in the model, given that technological aspects are not an issue. If, for example, we assume that corruption is less productive than institutions in the public sector, we will therefore operate with total decreasing returns to scale in the unofficial sector that necessarily alters the allocation of resources between two sectors to the benefit of the official sector. Such an assumption weakens the firm’s incentives to operate underground. Ultimately, the support for one of the three possible assumptions on how the productivity of corruption compares to the productivity of institutions in the public sector is an empirical issue.

4. Official versus unofficial employment of labor

The current set-up of the model does not help us understand the incentives the firms and the employees have to engage in contracts of unofficially registered employment. Such considerations require augmenting the model with regulations and taxes imposed on labor, which is outside the scope of the current analysis. However, the model emphasizes the fact that labor (whether officially employed or not) can be used in both sectors. We can imagine that an employee is officially employed (thus paying taxes and social security contributions) and yet produce unofficial output in the firm. A possibility to extend the model, such that it accounts for both the use of labor and its legal status, is to consider four types of labor: officially employed and used in official activities, officially employed and used in unofficial activities, and the corresponding types related to unofficial activities. The bigger the firm and the more decentralized its management scheme, the more likely it is that the labor will be officially employed. However, that does not necessarily prevent the use of labor for generating unofficial output.

5. The probability that the firm is detected and punished for tax evasion

One of the main predictions in the model is that, even if the firm knows that it will be detected and ‘punished’ for tax evasion with probability 1, it still has some incentives to engage in tax evasion. A corollary of this result is that efforts implemented to contain tax evasion through inspections and high penalties imposed on it may not achieve their objective, and they may even generate adverse consequences in terms of bribery. Incentives to evade taxes, and develop underground activities, may be best tackled by a combination of such measures: more attractive conditions in the official sector for the firm *and/or* well - motivated public officials. Schemes designed to 'tie' firms to the official sector may prove a highly rewarding policy.

Relaxing the assumption on the probability that the firm is detected and punished for its underground endeavors has the effect of strengthening its incentives to be active in the shadow sector. However, this probability is most likely a function of the scale of the underground activities: the larger the scale, the higher the probability. Therefore such a model would converge to the current set-up to the point where the firm carries the risk to lose all its underground output with certainty. The implication is that the firm will need to balance the scale of its underground activities with the increasing associated probability of detection and punishment.

Additional refinements to the model can be conceived by noting the possibility to distinguish between detection and punishment. Especially if we include the mafia in the picture, it is possible that tax inspectors do have the ability to detect cases of tax evasion, but they cannot enforce the law (even if motivated to do so). This is the case when the state is not able to protect its public servants against the mafia.

6. The bureaucrat's problem

The formal set-up I consider for the bureaucrat's problem is a very simplified version of alternative, more elaborate, models that consider the bureaucrats' incentives to engage in corrupt transactions. The model in this study, for example, ignores the nature of the bureaucratic system (whether centralized or not as analyzed in Shleifer and Vishny(1993)), and it also ignores the possibility of repeated inspections on the firm's activity by different (non-collusive) public officials. With a centralized bureaucracy repeated inspections of non-collusive inspectors may be less of a possibility. In this case the effectiveness of the mechanism of exposure and punishment of corrupt public officials is central to the bureaucrat's incentive to engage in corrupt acts. It is possible that, in a centralized bureaucracy, the bureaucrats will collude with each other such that the higher is the general level of corruption in the bureaucracy, the less likely it is that an individual will be punished for corruption. Such an assumption requires endogenizing the parameter μ, defined as a function of the total level of corruption in the bureaucracy.

With the assumption of repeated inspections of the firm's activities by different public officials, who do not collude with each other the firm will have to consider bribing all the public officials, each at a time, when they come in inspection. On the bureaucrat's side, he may also have weaker incentives to accept bribes, given the risk that further inspections on the firm's activity have the potential to reveal the corrupt transaction. However, while considerably reducing the scope for a market of bureaucratic corruption and tax evasion, the costs associated with maintaining such a scheme for detecting and punishing tax evasion may prove very high. Such issues are analyzed in details in the literature on income tax evasion.

Yet another possibility ignored in the model is an endogenous compensation scheme for the bureaucrat that ties his bonuses to the cases of tax evasion detected and declared. Such an assumption is analyzed in Chand and Moene(1997), where we learn that the effectiveness of a bonus scheme depends on the extent to which the corruption penetrates the higher echelons in the bureaucracy.

7. Government policy on taxes

It is often assumed that the government uses the collected tax revenue in order to improve on its public services and on the public goods it provides. Such an assumption would require endogenizing the parameter γ as a function of the tax revenues the government collects at the aggregate level. If we can assume that all firms are identical, the γ will be a function of a multiple of the level of tax revenues the government collects from the firm. However, as it is the case in some developing countries, the government may find alternative uses for public funds (such as subsidies, welfare programs etc) that do not necessarily contribute to increased incentives a firm has to operate in the official sector. On the contrary, to the extent that the government shelters inefficient (state-owned) competitors, the firm may meet even more restrictions in the market (as reflected by lower levels of γ), given the same level of the tax rate. Endogenizing γ therefore requires a more elaborate analysis of the government's relationships with agents in the economy and of its choices with respect to use of tax revenues.

8. Empirical implications

The empirical implications on the model in this study are best tested on data collected at the firm level, rather than on aggregate data. The reason resides in the fact the higher up we go on the aggregation scale, the more likely it is that we operate with economic results generated by heterogeneous economic agents At the aggregate level, there is also an issue on the informational content of aggregate estimates for the unofficial economy and of aggregate indices for corruption. In relation to the aggregate estimates of the unofficial economy, the estimation methods available do not necessarily allow for distinguishing between different types of unofficial activities (household unofficial activities, criminal activities, of unofficial activities related to legal firms' operations). The general indices of corruption are also unlikely to prove reliable in empirical endeavors, as they cannot shed much light on the mechanism behind the effects of corruption on the economic system, if such effects are detected.

There are several predictions of the model in this study that can be directly tested empirically at the firm level. First, the model predicts that increases in tax rates do not necessarily lead to increased tax evasion by legal firms. The magnitude of tax rates should be considered in relation to the quality of institutions that enhance firm's activity in the official sector.

Second, in the presence of an unofficial sector, an empirical analysis that considers the total level of capital as generating the observed results and it is based on the equation:

$$\log y_F = const + \alpha \log \overline{K} + \beta \log L_F$$

is likely to be inaccurate, given that the actual capital used for generating the results y_F could actually be smaller ($k\overline{K}$). Therefore the alternative is to estimate an equation that considers a lower level of capital, as corresponding to the production function we specified for the official sector in the model. Rewrite the production function as follows:

$$y_F = B^{\delta}\left(k\overline{K}\right)^{\alpha} L_F^{\beta} = \gamma^{\delta} k^{\alpha} \overline{K}^{\alpha+\delta} L_F^{\beta}$$

such that the equation to be estimated becomes:

$$\log y_F = const + \delta \log \gamma + \alpha \log k + (\alpha + \delta) \log \overline{K} + \beta \log L_F$$

Omitting the terms in k and γ underestimates the parameter associated to $\overline{K}$ and also affects the estimate of β, as the observed employment L_F is likely to correlate with the omitted terms. However, as the same problem also applies to the productivity of labor, estimation of the equation above can prove challenging if the observed level of employment of labor does not correspond to its use for official sector activities. At this stage of the analysis it is difficult to provide a solution for this empirical problem.

Third, the model also has some prediction on the level of bribery (as a product of the amount of corruption and the price per unit of corruption). Ideally we would need to be able to distinguish empirically between the pervasiveness of corruption (that could proxy C) and the magnitude of bribes for a given type of bureaucratic favor (as a proxy for m). When firms declare they pay higher bribes, it is likely that the result refers to the total level of bribery (*mC*), while when firms declare they pay bribes more often then we can infer that the result refers to how pervasive corruption is. Such distinctions are made in survey studies such as the empirical research that relate to the BEEPS dataset for transition economies mentioned in the first study in this thesis.

One of the predictions of the model, in relation to the total amount of bribery, is that improved institutions and regulations specific to the official sector and/or lower taxes will be associated with lower levels of bribery generated through bureaucratic corruption. Such policy measures will be associated with a lower level of unofficial activities and a higher volume of activities in the official sector. Measures designed to contain the incentives the bureaucrat has to engage in corrupt transactions will also be associated with a lower total level of bribery and a lower level of tax evasion.

Finally, the model predicts that bribery and unofficial economy complement each other.

Mathematical Appendix

<u>Result 1:</u> Solution in Case 1 $\left(0 < k < 1,\ y_F > 0,\ y_I > 0, C > 0\right)$

For Case 1, the Kuhn Tucker conditions translate into the following set of first-order conditions for the firm's maximization problem:

$$\text{(R1.1)}\quad k > 0 \text{ and } \frac{\partial L}{\partial k} = (1-t)\frac{\partial y_F}{\partial k} + \frac{\partial y_I}{\partial k} = 0 \qquad \Rightarrow (1-t)\frac{y_F}{y_I} = \frac{k}{1-k}$$

$$\text{(R1.2)}\quad L_F > 0 \text{ and } \frac{\partial L}{\partial L_F} = (1-t)\frac{\partial\, y_F}{\partial L_F} - w_F = 0 \qquad \Rightarrow \beta(1-t)y_F = w_F L_F$$

$$\text{(R1.3)}\quad L_I > 0 \text{ and } \frac{\partial L}{\partial L_I} = \frac{\partial\, y_I}{\partial L_I} - w_I = 0 \qquad \Rightarrow \beta\, y_I = w_I L_I$$

$$\text{(R1.4)}\quad C > 0 \text{ and } \frac{\partial L}{\partial C} = \frac{\partial\, y_I}{\partial\, C} - m = 0 \qquad \Rightarrow \delta\, y_I = m \cdot C$$

$$\text{(R1.5)}\quad \lambda = 0 \text{ and } \frac{\partial L}{\partial \lambda} = 1 - k > 0 \qquad \Rightarrow k < 1$$

From (R1.1) the expression of the ratio of capital employed in the official sector writes as a function of the levels of output produced in both sectors:

$$\text{(R1.6)}\qquad k = \frac{(1-t)y_F}{(1-t)y_F + y_I}$$

and the corresponding proportion of capital used in the shadow activities is:

$$\text{(R1.7)}\qquad 1-k = \frac{y_I}{(1-t)y_F + y_I}$$

Calculate the ratio of the two levels of output as given by the production functions (1) and (2) in the main text:

$$\text{(R1.8)}\qquad \frac{y_F}{y_I} = \left(\frac{B}{C}\right)^{\delta}\left(\frac{k}{1-k}\right)^{\alpha}\left(\frac{L_F}{L_I}\right)^{\beta}$$

and use the definition of term $B = \gamma\,\overline{K}$ and the first order conditions (R1.1), (R1.4), and (R1.2) and (R1.3) written as:

$$C = \frac{\delta \cdot y_I}{m}$$

$$\frac{k}{1-k} = \frac{(1-t)y_F}{y_I}$$

$$\frac{L_F}{L_I} = \frac{(1-t)y_F}{y_I}\frac{w_I}{w_F}$$

to rewrite the ration (R1.8) as following:

$$\frac{y_F}{y_I} = \left(\frac{\gamma \overline{K} m}{\delta}\right)^{\delta} \frac{1}{y_I^{\delta}} (1-t)^{\alpha} \left(\frac{y_F}{y_I}\right)^{\alpha} \left(\frac{w_I}{w_F}\right)^{\beta} (1-t)^{\beta} \left(\frac{y_F}{y_I}\right)^{\beta}$$

For $y_I \neq 0$, collecting terms in the equation above results in the following expression:

$$y_F^{\delta} = \left(\frac{\gamma \overline{K} m}{\delta}\right)^{\delta} (1-t)^{1-\delta} \left(\frac{w_I}{w_F}\right)^{\beta}$$

which gives us the level of output produced in the official economy:

$$\text{(R1.9)} \qquad y_F = \left(\frac{\gamma \cdot m}{\delta}\right) \overline{K} (1-t)^{\frac{1-\delta}{\delta}} \left(\frac{w_I}{w_F}\right)^{\frac{\beta}{\delta}}$$

For determining the output in the shadow sector, use the first order conditions (R1.3) and (R1.4), and the expression in (R1.7) to write:

$$y_I = \left(\frac{\delta \cdot y_I}{m}\right)^{\delta} \frac{y_I^{\alpha}}{[(1-t)y_F + y_I]^{\alpha}} \overline{K}^{\alpha} \left(\frac{\beta \cdot y_I}{w_I}\right)^{\beta} = \left(\frac{\delta}{m}\right)^{\delta} \frac{y_I}{[(1-t)y_F + y_I]^{\alpha}} \overline{K}^{\alpha} \left(\frac{\beta}{w_I}\right)^{\beta}$$

For $y_I \neq 0$ the equation above can be reduced to:

$$(1-t)y_F + y_I = \left(\frac{\delta}{m}\right)^{\frac{\delta}{\alpha}} \overline{K} \left(\frac{\beta}{w_I}\right)^{\frac{\beta}{\alpha}}$$

which gives us the level output in the shadow economy as a function of the output in the official sector:

$$\text{(R1.10)} \qquad y_I = \left(\frac{\delta}{m}\right)^{\frac{\delta}{\alpha}} \overline{K} \left(\frac{\beta}{w_I}\right)^{\frac{\beta}{\alpha}} - (1-t)y_F$$

By using (R1.9) in (R1.10) we derive the output produced in the underground sector as given by the following expression:

$$\text{(R1.11)} \qquad y_I = \overline{K} \left[\left(\frac{\delta}{m}\right)^{\delta/\alpha} \left(\frac{\beta}{w_I}\right)^{\beta/\alpha} - \frac{\gamma \cdot m}{\delta} (1-t)^{1/\delta} \left(\frac{w_I}{w_F}\right)^{\beta/\delta} \right]$$

Note that the interior solution of Case 1 exists if and only if $y_I > 0$, which reduces to the condition:

$$\left(\frac{\delta}{m}\right)^{\delta/\alpha} \left(\frac{\beta}{w_I}\right)^{\beta/\alpha} > \frac{\gamma \cdot m}{\delta} (1-t)^{1/\delta} \left(\frac{w_I}{w_F}\right)^{\beta/\delta}$$

which, for further reference, I rewrite as:

$$\text{(R1.12)} \qquad \left(\frac{\delta}{m}\right)^{\frac{\delta+\alpha}{\alpha}}\left(\frac{\beta}{w_I}\right)^{\beta/\alpha} > \gamma\,(1-t)^{1/\delta}\left(\frac{w_I}{w_F}\right)^{\beta/\delta}$$

The firm's demand for bureaucratic corruption is determined based on the first order condition (R1.4) and the expression of the output level in the shadow sector in (R1.11):

$$\text{(R1.13)} \qquad C = \overline{K}\left[\left(\frac{\delta}{m}\right)^{\frac{\alpha+\delta}{\alpha}}\left(\frac{\beta}{w_I}\right)^{\beta/\alpha} - \gamma\cdot(1-t)^{1/\delta}\left(\frac{w_I}{w_F}\right)^{\beta/\delta}\right]$$

such that $C < 0 \quad iff \quad y_I > 0$.

The corresponding demand levels for labor used for the two types of activity are derived based on the first order conditions (R1.2) and (R1.3), and the output levels given in (R1.9) and (R1.11), as following:

$$\text{(R1.14)} \qquad L_F = \left(\frac{\beta}{w_F}\right)\left(\frac{\gamma\cdot m}{\delta}\right)\overline{K}(1-t)^{\frac{1}{\delta}}\left(\frac{w_I}{w_F}\right)^{\frac{\beta}{\delta}}$$

$$\text{(R1.15)} \qquad L_I = \overline{K}\left(\frac{\beta}{w_I}\right)\left[\left(\frac{\delta}{m}\right)^{\delta/\alpha}\left(\frac{\beta}{w_I}\right)^{\beta/\alpha} - \frac{\gamma\cdot m}{\delta}(1-t)^{1/\delta}\left(\frac{w_I}{w_F}\right)^{\beta/\delta}\right]$$

Finally, the ratio of capital allocated for use in the official sector can be written in terms of the exogenous parameters in the system (for $\overline{K} \neq 0$) as:

$$\text{(R1.16)} \qquad k = \frac{(1-t)y_F}{(1-t)y_F + y_I} = \frac{\overline{K}\,\frac{\gamma\cdot m}{\delta}(1-t)^{1/\delta}\left(\frac{w_I}{w_F}\right)^{\beta/\delta}}{\overline{K}\left(\frac{\delta}{m}\right)^{\delta/\alpha}\left(\frac{\beta}{w_I}\right)^{\beta/\alpha}} = \frac{\gamma\cdot(1-t)^{1/\delta}\left(\frac{w_I}{w_F}\right)^{\beta/\delta}}{\left(\frac{\delta}{m}\right)^{\frac{\alpha+\delta}{\alpha}}\left(\frac{\beta}{w_I}\right)^{\frac{\beta}{\alpha}}}$$

For further reference consider the following change of notation for the results corresponding to Case 1:

$$\text{(R1.17)} \qquad \begin{cases} y_F \to y_{F,1} \\ y_I \to y_{I,1} \\ L_F \to L_{F,1} \\ L_I \to L_{I,1} \\ C \to C_1 \\ k \to k_1 \end{cases}$$

<u>Result 2:</u> Solution in Case 2 $\left(k=1,\ y_F>0,\ y_I=0, C=0\right)$

The Kuhn – Tucker conditions for the border solution in Case 2 translate into:

(R2.1) $k>0$ and $\dfrac{\partial L}{\partial k}=(1-t)\dfrac{\partial y_F}{\partial k}-\lambda=0$

(R2.2) $L_F>0$ and $\dfrac{\partial L}{\partial L_F}=(1-t)\dfrac{\partial\, y_F}{\partial L_F}-w_F=0 \qquad \Rightarrow \beta(1-t)y_F=w_F L_F$

(R2.3) $L_I=0$ and $\dfrac{\partial L}{\partial L_I}<0$

(R2.4) $C=0$ and $\dfrac{\partial L}{\partial C}<0$

(R2.5) $\lambda>0$ and $\dfrac{\partial L}{\partial \lambda}=1-k=0 \qquad \Rightarrow k=1$

The output realized by the firm in the official sector (only) writes as:

$$y_F=\left(\gamma\overline{K}\right)^{\delta}\,\overline{K}^{\alpha}L_F^{\beta}$$

where we can use condition (R2.2) to substitute for labor and obtain:

$$y_F=(\gamma)^{\delta}\,\overline{K}^{\alpha+\delta}\left(\frac{\beta(1-t)}{w_F}\right)^{\beta}y_F^{\beta}$$

Therefore the level of official output produced by the firm in Case 2 is given by the following expression:

(R2.6) $$y_F=\gamma^{\frac{\delta}{\alpha+\delta}}\,\overline{K}\left(\frac{\beta}{w_F}\right)^{\frac{\beta}{\alpha+\delta}}(1-t)^{\frac{\beta}{\alpha+\beta}}$$

The corresponding demand for labor:

(R2.7) $$L_F=\beta(1-t)\frac{y_F}{w_F}=\gamma^{\frac{\delta}{\alpha+\delta}}\,\overline{K}\left(\frac{\beta}{w_F}\right)^{\frac{1}{\alpha+\delta}}(1-t)^{\frac{1}{\alpha+\delta}}$$

The variables that characterize the activity in the unofficial sector are all at the zero level:

(R2.8) $$y_I=0,\ L_I=0,\ C=0$$

and the ratio of capital in the official sector is 1. For further reference consider the following change of notation for the results corresponding to Case 2:

(R2.9) $$\begin{cases} y_F\to y_{F,2}\\ y_I\to y_{I,2}\\ L_F\to L_{F,2}\\ L_I\to L_{I,2}\\ C\to C_2\\ k\to k_2\end{cases}$$

Result 3: Comparison of official output levels in Case 1 and Case 2

Consider using expression (R1.9) from Result 1, and the equation (R2.6) from Result 2 in order to calculate the ratio:

(R3.1)
$$\frac{y_{F,1}}{y_{F,2}} = \frac{\left(\frac{\gamma \cdot m}{\delta}\right)\overline{K}(1-t)^{\frac{1-\delta}{\delta}}\left(\frac{w_I}{w_F}\right)^{\frac{\beta}{\delta}}}{\gamma^{\frac{\delta}{\alpha+\delta}}\overline{K}\left(\frac{\beta}{w_F}\right)^{\frac{\beta}{\alpha+\delta}}(1-t)^{\frac{\beta}{\alpha+\delta}}} = \frac{(\gamma)^{\frac{\alpha}{\alpha+\delta}}(1-t)^{\frac{\alpha}{\delta(\alpha+\delta)}}\left(\frac{w_I}{w_F}\right)^{\frac{\beta}{\delta}}}{\left(\frac{\beta}{w_F}\right)^{\frac{\beta}{\alpha+\delta}}\left(\frac{\delta}{m}\right)}$$

Write:

$$\left(\frac{\beta}{w_F}\right)^{\frac{\beta}{\alpha+\delta}} = \left(\frac{\beta}{w_I}\right)^{\frac{\beta}{\alpha+\delta}}\left(\frac{w_I}{w_F}\right)^{\frac{\beta}{\alpha+\delta}}$$

such that (R3.1) becomes:

$$\frac{y_{F,1}}{y_{F,2}} = \frac{(\gamma)^{\frac{\alpha}{\alpha+\delta}}(1-t)^{\frac{\alpha}{\delta(\alpha+\delta)}}\left(\frac{w_I}{w_F}\right)^{\frac{\alpha\beta}{\delta(\alpha+\delta)}}}{\left(\frac{\beta}{w_I}\right)^{\frac{\beta}{\alpha+\delta}}\left(\frac{\delta}{m}\right)} = \left[\frac{\gamma(1-t)^{\frac{1}{\delta}}\left(\frac{w_I}{w_F}\right)^{\frac{\beta}{\delta}}}{\left(\frac{\beta}{w_I}\right)^{\frac{\beta}{\alpha}}\left(\frac{\delta}{m}\right)^{\frac{\alpha+\delta}{\alpha}}}\right]^{\frac{\alpha}{\alpha+\delta}} = (A)^{\frac{\alpha}{\alpha+\delta}}$$

where: $A = \frac{\gamma(1-t)^{\frac{1}{\delta}}\left(\frac{w_I}{w_F}\right)^{\frac{\beta}{\delta}}}{\left(\frac{\beta}{w_I}\right)^{\frac{\beta}{\alpha}}\left(\frac{\delta}{m}\right)^{\frac{\alpha+\delta}{\alpha}}}$ is exactly the expression for $k_1 < 1$ derived for Case 1, in Result 1 (equation (R1.16). We therefore know that, if and only if Case 1 is feasible, $0 < A < 1$.

For Case 1 feasible we then have the result:

(R3.2)
$$\frac{y_{F,1}}{y_{F,2}} = (A)^{\frac{\alpha}{\alpha+\delta}} < 1$$

and it can be proved that $\lim_{k_1 \to 1} \frac{y_{F,1}}{y_{F,2}} = 1$, indicating that as condition (R1.12) in Result 1 becomes more binding, the official output the firm produces in Case 1 converges (increases) to the official output corresponding to Case 2.

<u>Result 4:</u> Comparison of pre- and after-tax total levels of output in Case 1 and Case 2

The level of output the firm retains after paying taxes in Case 2 is $(1-t)y_{F,2}$, and the total output the firm retains after paying taxes (and bribes) in Case 1 is $(1-t)y_{F,1} + y_{I,1}$.

From Result 3 we know that:

$$\frac{y_{F,1}}{y_{F,2}} = (A)^{\frac{\alpha}{\alpha+\delta}} < 1$$

where $A = k_1$ (the ratio of capital used in the official sector in Case 1). In equation (R1.6) in Result 1 we derived the following expression for k_1:

$$k_1 = \frac{(1-t)y_{F,1}}{(1-t)y_{F,1} + y_{I,1}}$$

such that we can write:

$$y_{F,2}\left[\frac{(1-t)y_{F,1}}{(1-t)y_{F,1} + y_{I,1}}\right]^{\frac{\alpha}{\alpha+\delta}} = y_{F,1}$$

which breaks into:

$$y_{F,2}\frac{(1-t)^{\frac{\alpha}{\alpha+\delta}}\, y_{F,1}^{\frac{\alpha}{\alpha+\delta}}}{\left[(1-t)y_{F,1} + y_{I,1}\right]^{\frac{\alpha}{\alpha+\delta}}} = y_{F,1} \;\Rightarrow\; y_{F,2}(1-t)^{\frac{\alpha}{\alpha+\delta}} = y_{F,1}^{\frac{\delta}{\alpha+\delta}}\left[(1-t)y_{F,1} + y_{I,1}\right]^{\frac{\alpha}{\alpha+\delta}}$$

Rewrite the result above as:

$$y_{F,2} = \left[(1-t)y_{F,1} + y_{I,1}\right]\frac{y_{F,1}^{\frac{\delta}{\alpha+\delta}}}{\left[(1-t)y_{F,1} + y_{I,1}\right]^{\frac{\delta}{\alpha+\delta}}}(1-t)^{\frac{\delta}{\alpha+\delta}}\frac{1}{1-t}$$

and use $\left[\frac{(1-t)y_{F,1}}{(1-t)y_{F,1} + y_{I,1}}\right]^{\frac{\delta}{\alpha+\delta}} = (k_1)^{\frac{\delta}{\alpha+\delta}} = (A)^{\frac{\delta}{\alpha+\delta}}$

We therefore obtain:

$$\text{(R4.1)} \qquad (1-t)y_{F,2} = \left[(1-t)y_{F,1} + y_{I,1}\right](A)^{\frac{\delta}{\alpha+\delta}}, \text{ for } 0 < A < 1$$

Let us consider now how the two cases compare in terms of the total pre-tax levels of output. We need to compare $y_{F,2}$ with $y_{F,1} + y_{I,1}$.

Note that we can write:

$$y_{F,1} + y_{I,1} = ty_{F,1} + (1-t)y_{F,1} + y_{I,1} = ty_{F,1} + \frac{(1-t)y_{F,1}}{A} = y_{F,1}\left(t + \frac{(1-t)}{A}\right)$$
$$= y_{F,1}\left(\frac{1-(1-A)t}{A}\right)$$
$$y_{F,2} - (y_{F,1} + y_{I,1}) = y_{F,1}\, A^{-\frac{\alpha}{\alpha+\delta}} - y_{F,1}\left(\frac{1-(1-A)t}{A}\right) = y_{F,1}\left[A^{-\frac{\alpha}{\alpha+\delta}} - \left(\frac{1-(1-A)t}{A}\right)\right]$$
$$= y_{F,1}\, A^{-\frac{\alpha}{\alpha+\delta}}\left[1 - \frac{1-(1-A)t}{A^{\frac{\delta}{\alpha+\delta}}}\right]$$

Denote:

$$\text{(R4.2)} \qquad g(t) = 1 - \frac{1-(1-A)t}{A^{\frac{\delta}{\alpha+\delta}}}$$

where we know the following:

$$\lim_{\substack{t\to\hat{t}\\ t>\hat{t}}} A(t) = 1; \; \lim_{\substack{t\to 1\\ t<1}} A(t) = \lim_{\substack{A\to 0\\ A>0}} A(t) = 0$$

such that we obtain:

$$\lim_{\substack{t\to\hat{t}\\ t>\hat{t}}} g(t) = 0$$

and by using L'Hopital Rule:

$$\lim_{\substack{t\to 1\\ t<1}} g(t) = +\infty$$

Moreover $\frac{dg(t)}{dt} > 0$, such that we obtain that the function $g(t)$ increases continuously, with t in the admissible range, between the value 0 and $+\infty$. Therefore we obtain:

$$\text{(R4.3)} \qquad y_{F,2} > y_{F,1} + y_{I,1} \text{ for any } t \in (\hat{t}, +\infty)$$

where the threshold $\hat{t}$ defines the admissibility of Case 1 (see the associated discussion in the main text).

<u>Result 5:</u> Solution in Case 3 $k = 0,\ y_F = 0,\ y_I > 0, C > 0$

The Kuhn Tucker condition in Case 3 translate into the following set of conditions:

(R5.1) $k = 0$ and $\dfrac{\partial L}{\partial k} = \dfrac{\partial y_I}{\partial k} < 0$

(R5.2) $L_F = 0$ and $\dfrac{\partial L}{\partial L_F} < 0$

(R5.3) $L_I > 0$ and $\dfrac{\partial L}{\partial L_I} = \dfrac{\partial\, y_I}{\partial L_I} - w_I = 0 \qquad \Rightarrow \beta\ y_I = w_I L_I$

(R5.4) $C > 0$ and $\dfrac{\partial L}{\partial C} = \dfrac{\partial\, y_I}{\partial\, C} - m = 0 \qquad \Rightarrow \delta\ y_I = m \cdot C$

(R5.5) $\lambda = 0$ and $\dfrac{\partial L}{\partial \lambda} = 1 - k > 0$

The output in the shadow sector writes as:

$$y_I = (C)^\delta\, \overline{K}^\alpha L_I^\beta = \left(\frac{\delta\, y_I}{m}\right)^\delta \overline{K}^\alpha \left(\frac{\beta\, y_I}{w_I}\right)^\beta = \left(\frac{\delta}{m}\right)^\delta \overline{K}^\alpha \left(\frac{\beta}{w_I}\right)^\beta y_I^{\beta+\delta}$$

For $y_I \neq 0$, the expression above rewrites as:

$$y_I^\alpha = \left(\frac{\delta}{m}\right)^\delta \overline{K}^\alpha \left(\frac{\beta}{w_I}\right)^\beta$$

such that we obtain:

(R5.6) $$y_I = \left(\frac{\delta}{m}\right)^{\frac{\delta}{\alpha}} \overline{K} \left(\frac{\beta}{w_I}\right)^{\frac{\beta}{\alpha}}$$

Using (R5.4) and (R5.3) above we derive the demands for the inputs of labor and corruption as:

(R5.7) $$C = \left(\frac{\delta}{m}\right)^{\frac{\alpha+\delta}{\alpha}} \overline{K} \left(\frac{\beta}{w_I}\right)^{\frac{\beta}{\alpha}}$$

(R5.8) $$L_I = \left(\frac{\delta}{m}\right)^{\frac{\delta}{\alpha}} \overline{K} \left(\frac{\beta}{w_I}\right)^{\frac{\alpha+\beta}{\alpha}}$$

The variables that characterize activity in the official sector are all at their zero levels:

(R5.9) $$k = 0,\ y_F = 0,\ L_F = 0$$

For further reference consider the following change of notation for the results corresponding to Case 3:

$$\text{(R5.10)} \qquad \begin{cases} y_F \to y_{F,3} \\ y_I \to y_{I,3} \\ L_F \to L_{F,3} \\ L_I \to L_{I,3} \\ C \to C_3 \\ k \to k_3 \end{cases}$$

<u>Result 6:</u> Comparisons of output levels in Case 1 and Case 3

Based on equation (R1.10), derived in Result 1, we can infer:

$$\text{(R6.1)} \qquad (1-t)y_{F,1} + y_{I,1} = \left(\frac{\delta}{m}\right)^{\frac{\delta}{\alpha}} \overline{K} \left(\frac{\beta}{m}\right)^{\frac{\beta}{\alpha}}$$

Note that the term in the RHS of the equation above is identical to the expression that gives us the level of total output in the shadow economy in Case 3, as determined in (R5.6). We can therefore write:

$$\text{(R6.2)} \qquad y_{I,3} = (1-t)y_{F,1} + y_{I,1}$$

Based on (R6.2), corresponding relationship in terms of pre-tax levels of output writes as:

$$\text{(R6.3)} \qquad y_{I,3} = y_{F,1} + y_{I,1} - t\, y_{F,1} < y_{F,1} + y_{I,1}$$

<u>Result 7:</u> Comparisons of output levels in Case 2 and Case 3

We can use the results derived previously in order to infer how the output levels in Case 2 and Case 3 compare to each other; for that purpose we first need to distinguish between two main cases, depending on whether Case 1 is admissible or not.

If solution in Case 1 is admissible, then we have the following results:

(From (R4.1)) $\qquad (1-t)y_{F,2} < \lfloor (1-t)y_{F,1} + y_{I,1} \rfloor$

(From (R6.2)) $\qquad y_{I,3} = (1-t)y_{F,1} + y_{I,1}$

Such that we infer:

$$\text{(R7.1)} \qquad (1-t)y_{F,2} < y_{I,3}$$

indicating that the output the firm retains in Case 3 is higher than the output the firm retains in Case 2.

If solution in Case 1 is not admissible, then we need to compare Case 2 and Case 3 based on the condition:

$$\text{(R7.2)} \qquad \left(\frac{\delta}{m}\right)^{\frac{\delta+\alpha}{\alpha}} \left(\frac{\beta}{w_I}\right)^{\beta/\alpha} < \gamma \, (1-t)^{1/\delta} \left(\frac{w_I}{w_F}\right)^{\beta/\delta}$$

which is the reverse of condition (R1.12) that defines the admissibility of Case 1.

Rewrite condition (R7.2) as:

$$\left(\frac{\delta}{m}\right)^{\frac{\delta+\alpha}{\alpha}} \left(\frac{\beta}{w_I}\right)^{\frac{\beta(\alpha+\delta)}{\delta}} < \gamma \, (1-t)^{\frac{\beta}{\delta}} (1-t)^{\frac{\alpha+\delta}{\delta}} \left(\frac{\beta}{w_F}\right)^{\frac{\beta}{\delta}}$$

Multiply both sides of the inequality by $\overline{K}^{\frac{\alpha+\delta}{\delta}}$ and obtain:

$$\left(\frac{\delta}{m}\right)^{\frac{\delta+\alpha}{\alpha}} \left(\frac{\beta}{w_I}\right)^{\frac{\beta(\alpha+\delta)}{\delta}} \overline{K}^{\frac{\alpha+\delta}{\delta}} < \gamma \, (1-t)^{\frac{\beta}{\delta}} (1-t)^{\frac{\alpha+\delta}{\delta}} \left(\frac{\beta}{w_F}\right)^{\frac{\beta}{\delta}} \overline{K}^{\frac{\alpha+\delta}{\delta}}$$

From (R2.6) and (R5.6) we have the following equations:

$$y_{F,2} = \gamma^{\frac{\delta}{\alpha+\delta}} \overline{K} \left(\frac{\beta}{w_F}\right)^{\frac{\beta}{\alpha+\delta}} (1-t)^{\frac{\beta}{\alpha+\beta}}$$

$$y_{I,3} = \left(\frac{\delta}{m}\right)^{\frac{\delta}{\alpha}} \overline{K} \left(\frac{\beta}{w_I}\right)^{\frac{\beta}{\alpha}}$$

such that we see that the inequality above can be written in terms of the two levels of output as following:

$$y_{I,3}^{\frac{\alpha+\delta}{\delta}} < (1-t)^{\frac{\alpha+\delta}{\delta}} y_{F,2}^{\frac{\alpha+\delta}{\delta}}$$

and therefore we infer that the following combined result holds when Case 1 is not admissible:

$$\text{(R7.3)} \qquad y_{I,3} < (1-t) y_{F,2} < y_{F,2}$$

<u>Result 8:</u> Profits in Case 1

(R8.1)
$$\pi_1 = (1-t)y_{F,1} + y_{I,1} - w_I L_{I,1} - w_F L_{F,1} - mC_1 = (1-t)(\alpha+\delta)y_{F,1} + \alpha y_{I,1}$$
$$= \alpha\left[(1-t)y_{F,1} + y_{I,1}\right] + (1-t)\delta y_{F,1} = \alpha\frac{(1-t)y_{F,1}}{A} + (1-t)\delta y_{F,1}$$

The constant A is the same as above when Case 1 is admissible, meaning $0 < A < 1$.

Therefore the profits in Case 1 write as:

(R8.2)
$$\pi_1 = (1-t)y_{F,1}\left(\frac{\alpha}{A} + \delta\right)$$

<u>Result 9:</u> Profits in Case 2

(R9.1)
$$\pi_2 = (1-t)y_{F,2} - w_F L_{F,2} = (1-t)(\alpha+\delta)y_{F,2}$$

<u>Result 10:</u> Profits in Case 3

(R10.1)
$$\pi_3 = y_{I,3} - w_I L_{I,3} - mC_3 = \alpha y_{I,3}$$

Note that based on (R8.1) and (R6.2) we can also write:

(R10.2)
$$\pi_1 = \alpha\left[(1-t)y_{F,1} + y_{I,1}\right] + (1-t)\delta y_{F,1} = \pi_3 + (1-t)\delta y_{F,1}$$

<u>Result 11:</u> Comparison of profits in Case 1 and Case 2, when Case 1 admissible

Based on (R8.2), (R9.1) and (R3.2) we derive:

(R11.1)
$$\frac{\pi_1}{\pi_2} = \frac{(1-t)y_{F,1}\left(\frac{\alpha}{A}+\delta\right)}{(1-t)(\alpha+\delta)y_{F,2}} = \frac{(1-t)(A)^{\frac{\alpha}{\alpha+\delta}}y_{F,2}\left(\frac{\alpha}{A}+\delta\right)}{(1-t)(\alpha+\delta)y_{F,2}} = \frac{(A)^{\frac{\alpha}{\alpha+\delta}}\left(\frac{\alpha}{A}+\delta\right)}{(\alpha+\delta)}$$

if $y_{F,2} \neq 0$ and $t \neq 1$.

<u>Result 12:</u> Comparison of profits in Case 2 and Case 3, when Case 1 is not feasible.

Given the result (R7.3) indicating that $y_{I,3} < (1-t)y_{F,2}$, we then write:

(R12.1)
$$\pi_3 = \alpha y_{I,3} < \pi_2 = (\alpha+\delta)\left[(1-t)y_{F,2}\right]$$

Result 13: The Bureaucrat's Problem

The maximization problem the public official considers is the following:

$$(R13.1)\qquad \begin{cases} \max\limits_{C} U(Ey) = \dfrac{(Ey)^z - 1}{z} \\ s.t. \\ Ey = \theta(S + m \cdot C) - (1-\theta)P \\ \theta = e^{-\mu \cdot C} \\ and\ the\ non-negativity\ condition: \\ C > 0 \end{cases}$$

We can write the first order condition of the problem as:

$$(R13.2)\qquad \frac{\partial U(Ey)}{\partial C} = \frac{1}{(Ey)^{1-z}} \frac{\partial Ey}{\partial C} = 0$$

which reduces to:

$$(R13.3)\qquad \frac{\partial Ey}{\partial C} = 0$$

Equation above expands to:

$$(R13.4)\qquad \frac{\partial \theta}{\partial C}(S + m \cdot C) + \theta \cdot m + \frac{\partial \theta}{\partial C} P = 0$$

with $\dfrac{\partial \theta}{\partial C} = -\mu \cdot e^{-\mu \cdot C} = -\mu \cdot \theta$

Using $\theta = e^{-\mu \cdot C}$ in (R13.4), for finite C and the probability $\theta \neq 0$, we obtain:

$$(R13.5)\qquad m = \frac{\mu \cdot (S + P)}{1 - C \cdot \mu}, \text{ such that } m > 0 \text{ iff } C < \frac{1}{\mu}$$

The supply of corruption can be rewritten as:

$$(R13.6)\qquad C = \frac{m - \mu \cdot (S + P)}{\mu \cdot m}$$

such that we see that $C > 0$ iff $m > \mu \cdot (S + P)$.

Result 14

Prove that the non –linear equation:

$$\text{(R14.1)} \qquad m = \mu\left[\delta\, y^*_{I,1} + (S+P)\right]$$

has one solution in the admissible range $\left[\mu(S+P), +\infty\right)$ for a given t in $(\hat{t}, 1)$.

Note that the optimal solution for $y^*_{I,1}$ writes as:

$$y^*_{I,1} = \overline{K}\left[\left(\frac{\delta}{m}\right)^{\delta/\alpha}\left(\frac{\beta}{w_I}\right)^{\beta/\alpha} - \frac{\gamma \cdot m}{\delta}(1-t)^{1/\delta}\left(\frac{w_I}{w_F}\right)^{\beta/\delta}\right]$$

Substitute for $y^*_{I,1}$ in (R14.1) and obtain:

$$m = \mu\delta\overline{K}\left(\frac{\delta}{m}\right)^{\frac{\beta}{\alpha}} - \mu\,\gamma\, m(1-t)^{\frac{1}{\delta}}\left(\frac{w_I}{w_F}\right)^{\frac{\beta}{\delta}} + \mu(S+P)$$

that can be rewritten as:

$$\text{(R14.2)} \qquad D\,m - \mu\delta\overline{K}\left(\frac{\delta}{m}\right)^{\frac{\beta}{\alpha}} - \mu(S+P) = 0$$

where:

$$0 < D = 1 - \mu\,\gamma(1-t)^{\frac{1}{\delta}}\left(\frac{w_I}{w_F}\right)^{\frac{\beta}{\delta}} < 1$$

Rearrange terms in (R14.2) as:

$$D\,m^{\frac{\alpha+\beta}{\alpha}} - \mu\delta\overline{K}(\delta)^{\frac{\beta}{\alpha}} - \mu(S+P)m^{\frac{\beta}{\alpha}} = 0$$

and consider the function:

$$\text{(R14.3)} \qquad f(m) = D\,m^{\frac{\alpha+\beta}{\alpha}} - \mu\delta\overline{K}(\delta)^{\frac{\beta}{\alpha}} - \mu(S+P)m^{\frac{\beta}{\alpha}}$$

Calculate:

$$f(m = \mu(S+P)) = D\,(\mu(S+P))^{\frac{\alpha+\beta}{\alpha}} - \mu\delta\overline{K}(\delta)^{\frac{\beta}{\alpha}} - \mu(S+P)(\mu(S+P))^{\frac{\beta}{\alpha}} =$$
$$= (D-1)(\mu(S+P))^{\frac{\alpha+\beta}{\alpha}} - \mu\delta\overline{K}(\delta)^{\frac{\beta}{\alpha}} < 0$$

Note also that $\lim_{m\to+\infty} f(m) = +\infty$ and:

$$\frac{df(m)}{dm} = D\frac{\alpha+\beta}{\alpha}m^{\frac{\beta}{\alpha}} - \mu(S+P)\frac{\beta}{\alpha}m^{\frac{\beta-\alpha}{\alpha}} = \frac{\beta}{\alpha}m^{\frac{\beta}{\alpha}}\left(D\frac{\alpha+\beta}{\beta} - \frac{\mu(S+P)}{m}\right) > 0$$

in the admissible range for *m*.

We therefore obtained that the function $f(m)$ is continuously increasing from a negative level (corresponding to $m = \mu(S+P)$) to $+\infty$ when $m \to +\infty$. This indicates that there must be a level $m^* > \mu(S+P)$ such that $f(m^*) = 0$. This gives use the solution of equation (R14.1) above.

<u>Result 15</u>

Prove that:

(R15.1) $\tilde{y}_I < y^*_{F,1} + y^*_{I,1}$ for any $t \in (\hat{t}, 1)$

where:

(R15.2) $$\tilde{y}_I = \left(\frac{\delta}{\tilde{m}}\right)^{\frac{\delta}{\alpha}} \overline{K} \left(\frac{\beta}{w_I}\right)^{\frac{\beta}{\alpha}}$$

and

(R15.3) $$y^*_{F,1} + y^*_{I,1} = ty^*_{F,1} + (1-t)y^*_{F,1} + y^*_{I,1} = ty^*_{F,1} + \left(\frac{\delta}{m^*}\right)^{\frac{\delta}{\alpha}} \overline{K} \left(\frac{\beta}{w_I}\right)^{\frac{\beta}{\alpha}}$$

Anticipating results in derived Result 17, we know that:

$$\frac{dm}{dt} > 0 \qquad \text{for any } t \in (\hat{t}, 1)$$

such that $\tilde{m} > m^*$ for any $t \in (\hat{t}, 1)$

We therefore have:

$$\tilde{y}_I = \left(\frac{\delta}{\tilde{m}}\right)^{\frac{\delta}{\alpha}} \overline{K} \left(\frac{\beta}{w_I}\right)^{\frac{\beta}{\alpha}} < \left(\frac{\delta}{m^*}\right)^{\frac{\delta}{\alpha}} \overline{K} \left(\frac{\beta}{w_I}\right)^{\frac{\beta}{\alpha}} < ty^*_{F,1} + \left(\frac{\delta}{m^*}\right)^{\frac{\delta}{\alpha}} \overline{K} \left(\frac{\beta}{w_I}\right)^{\frac{\beta}{\alpha}}$$

such that inequality (R15.1) holds for any $t \in (\hat{t}, 1)$.

<u>Result 16:</u> Effects of changes in γ[1]

Consider the system:

$$(R16.1) \qquad J_0 \cdot \begin{bmatrix} dy_F \\ dy_I \\ dm \end{bmatrix} = M \cdot \begin{bmatrix} d\gamma \\ dt \\ d\mu \\ dS + dP \end{bmatrix}$$

where:

$$(R16.2) \qquad J_0 = \begin{bmatrix} \frac{1}{y_F} & 0 & -\frac{1}{m} \\ (1-t) & 1 & \frac{\delta}{\alpha m}[(1-t)y_F + y_I] \\ 0 & -\mu\delta & 1 \end{bmatrix}$$

$$(R16.3) \qquad M = \begin{bmatrix} \frac{1}{\gamma} & -\frac{1-\delta}{\delta(1-t)} & 0 & 0 \\ 0 & y_F & 0 & 0 \\ 0 & 0 & \frac{m}{\mu} & \mu \end{bmatrix}$$

In order to evaluate the effects of changes in policy variables on the endogenous variables considered, we use the Cramer's rule for solving simultaneous equation systems.

The determinant of the system matrix J_0 writes as:

$$(R16.4) \; |J_0| = \frac{1}{y_F} + \frac{\mu\delta(1-t)}{m} + \frac{\mu\delta^2}{\alpha m y_F}[(1-t)y_F + y_I] = \frac{1}{y_F} + \frac{\mu\delta(1-t)}{m}\left(1 + \frac{\delta}{\alpha}\frac{1}{k}\right) > 0$$

For the effect of a change in γ on $y_{F,1}$ calculate the ratio:

$$\frac{dy_F}{d\gamma} = \frac{|J_1|}{|J_0|} \text{ where: } J_1 = \begin{bmatrix} \frac{1}{\gamma} & 0 & -\frac{1}{m} \\ 0 & 1 & \frac{\delta}{\alpha m}[(1-t)y_F + y_I] \\ 0 & -\mu\delta & 1 \end{bmatrix}$$

$$|J_1| = \frac{1}{\gamma} + \frac{\mu\delta^2}{\gamma\alpha m}[(1-t)y_F + y_I] = \frac{1}{\gamma}\left[1 + \frac{\mu\delta^2}{\gamma\alpha m}[(1-t)y_F + y_I]\right] = \frac{y_F}{\gamma}\left[|J_0| - \frac{\mu\delta(1-t)}{m}\right] > 0$$

[1] Note that all the variables in this section represent optimal levels derived in Case 1.

The sign of $|J_1|$ is obtained based on the observation that:

$$|j_0| > \frac{\mu\delta(1-t)}{m}\left(1+\frac{\delta}{\alpha}\frac{1}{k}\right) > \frac{\mu\delta(1-t)}{m}$$

Therefore, the resulting effect writes as:

$$\text{(R16.5)} \qquad \frac{dy_F}{d\gamma} = \frac{\frac{y_F}{\gamma}\left[|J_0| - \frac{\mu\delta(1-t)}{m}\right]}{|J_0|} > 0$$

The corresponding effect on the volume of output in the shadow sector is:

$$\frac{dy_I}{d\gamma} = \frac{|J_2|}{|J_0|}, \text{ where: } J_2 = \begin{bmatrix} \frac{1}{y_F} & \frac{1}{\gamma} & -\frac{1}{m} \\ (1-t) & 0 & \frac{\delta}{\alpha m}[(1-t)y_F + y_I] \\ 0 & 0 & 1 \end{bmatrix}$$

and:

$$|J_2| = -\frac{(1-t)}{\gamma} < 0$$

such that the effect is:

$$\text{(R16.6)} \qquad \frac{dy_I}{d\gamma} = -\frac{\frac{(1-t)}{\gamma}}{|J_0|} < 0$$

The effect on the equilibrium price of corruption is calculated in a similar manner as:

$$\text{(R16.6)} \qquad \frac{dm}{d\gamma} = -\frac{(1-t)\mu\delta}{\gamma}\frac{1}{|J_0|} = \mu\delta\frac{dy_I}{d\gamma} < 0$$

Based on these results, and on equation (43) in the main text, we can also calculate the associated effects on the firm's choices of inputs C and k.

$$\text{(R16.7)} \qquad \frac{dC}{d\gamma} = \frac{dC}{dy_I}\frac{dy_I}{d\gamma} = \frac{\delta(S+P)}{m[\delta y_I + (S+P)]}\frac{dy_I}{d\gamma} < 0$$

Similarly, using (R1.6) we obtain the effect of γ on the firm's choice on how much capital to use in the formal sector as given by:

$$\text{(R16.8)} \qquad \frac{dk}{d\gamma} = \frac{(1-t)y_I \dfrac{dy_F}{d\gamma} - (1-t)y_F \dfrac{dy_I}{d\gamma}}{[(1-t)y_F + y_I]^2} > 0$$

Let us prove now that $\left|\dfrac{dy_F}{d\gamma}\right| > \left|\dfrac{dy_I}{d\gamma}\right|$.

Note that we can write $\left|\dfrac{dy_F}{d\gamma}\right| = \left|\dfrac{dy_I}{d\gamma}\right| \dfrac{y_F\left[|J_0| - \dfrac{\mu\delta(1-t)}{m}\right]}{(1-t)} > \left|\dfrac{dy_I}{d\gamma}\right|$ as $\dfrac{y_F\left[|J_0| - \dfrac{\mu\delta(1-t)}{m}\right]}{(1-t)} > 1$ (based on (R16.4).

Result 17: Effects of changes in t[2]

Consider first the effects of changes in the tax rate on activity in the underground sector. The effect of a change in the tax rate on the volume of activity in the underground economy is:

$$\frac{dy_I}{dt} = \frac{|J_3|}{|J_0|}, \text{ where } J_3 = \begin{bmatrix} \dfrac{1}{y_F} & -\dfrac{1-\delta}{\delta(1-t)} & -\dfrac{1}{m} \\ (1-t) & y_F & \dfrac{\delta}{\alpha m}[(1-t)y_F + y_I] \\ 0 & 0 & 1 \end{bmatrix}$$

and $|J_3| = 1 + \dfrac{1-\delta}{\delta} = \dfrac{1}{\delta} > 0$,

such that:

$$\text{(R17.1)} \qquad \frac{dy_I}{dt} = \frac{1}{\delta}\frac{1}{|J_0|} > 0$$

The effect of changes in the tax rate on the equilibrium price of corruption is given by:

$$\frac{dm}{dt} = \frac{|J_4|}{|J_0|}, \text{ where } J_4 = \begin{bmatrix} \dfrac{1}{y_F} & 0 & -\dfrac{1-\delta}{\delta(1-t)} \\ (1-t) & 1 & y_F \\ 0 & -\mu\delta & 0 \end{bmatrix}$$

$$|J_4| = \mu(1-\delta) + \mu\delta = \mu > 0$$

[2] Note that all the variables in this section represent optimal levels derived in Case 1.

such that:

$$\text{(R17.2)} \qquad \frac{dm}{dt} = \frac{\mu}{|J_0|} > 0$$

The effect of a tax rate change on the equilibrium level of corruption is calculated, on equation (43) in the main text, as:

$$\text{(R17.3)} \qquad \frac{dC}{dt} = \frac{dC}{dy_I}\frac{dy_I}{dt} = \frac{\delta(S+P)}{m[\delta y_I + (S+P)]}\frac{dy_I}{dt} > 0$$

The effects on the activity in the offical sector and related variables are the following:

$$\frac{dy_F}{dt} = \frac{|J_5|}{|J_0|}, \text{ where } J_5 = \begin{bmatrix} -\frac{1-\delta}{\delta(1-t)} & 0 & -\frac{1}{m} \\ y_F & 1 & \frac{\delta}{\alpha m}[(1-t)y_F + y_I] \\ 0 & -\mu\delta & 1 \end{bmatrix}$$

$$|J_5| = -\frac{1-\delta}{\delta(1-t)} + \frac{\mu\delta y_F}{m} - \frac{\mu\delta(1-\delta)}{\alpha m(1-t)}[(1-t)y_F + y_I]$$
$$= -\frac{1-\delta}{\delta(1-t)} - \frac{\mu\delta(1-\delta)}{\alpha m(1-t)}y_I + \frac{\mu\delta y_F}{m}\left[1 - \frac{(1-\delta)}{\alpha}\right]$$

It can be proved that $|J_5|$ can be reduced to the following expression:

$$|J_5| = y_F \frac{1-\delta}{\delta(1-t)}\left[\frac{\mu\delta(1-t)}{m(1-\delta)} - |J_0|\right]$$

such that:

$$\frac{dy_F}{dt} = \frac{|J_5|}{|J_0|} = \frac{y_F \frac{1-\delta}{\delta(1-t)}\left[\frac{\mu\delta(1-t)}{m(1-\delta)} - |J_0|\right]}{|J_0|} = y_F \frac{1-\delta}{\delta(1-t)}\left[\frac{\frac{\mu\delta(1-t)}{m(1-\delta)}}{|J_0|} - 1\right]$$

The sign of the effect $\frac{dy_F}{dt}$ is given by the sign of the term in the brackets. If we insert the expression of $|J_0|$ we obtain:

$$\frac{\frac{\mu\delta(1-t)}{m(1-\delta)}}{|J_0|} = \frac{\frac{\mu\delta(1-t)}{m(1-\delta)}}{\frac{1}{y_F} + \frac{\mu\delta(1-t)}{m}\left(1+\frac{\delta}{\alpha}\frac{1}{k}\right)} < 1 \text{ as } \frac{\mu\delta(1-t)}{m(1-\delta)} < \frac{\mu\delta(1-t)}{m}\left(1+\frac{\delta}{\alpha k}\right),$$ which is based on the following inference:

$$\alpha+\beta+\delta=1 \Rightarrow \alpha<1-\delta \Rightarrow k<1<\frac{1-\delta}{\alpha} \Rightarrow \frac{1}{1-\delta}<\frac{1}{\alpha k} \Rightarrow \frac{1}{1-\delta}=1+\frac{\delta}{1-\delta}<1+\frac{\delta}{\alpha k}$$

We therefore obtain that:

(R17.4) $$\frac{dy_F}{dt} = y_F\,\frac{1-\delta}{\delta(1-t)}\left[\frac{\frac{\mu\delta(1-t)}{m(1-\delta)}}{|J_0|}-1\right]<0$$

For the effect of a tax rate change on the ratio of capital employed in the official economy, a similar result is obtained as in the case of the volume of activity in that sector:

(R17.5) $$\frac{dk}{dt} = \frac{y_I\left[(1-t)\frac{dy_F}{dt}-y_F\right]-(1-t)y_F\,\frac{dy_I}{dt}}{[(1-t)y_F+y_I]^2}<0$$

<u>Result 18:</u> Effects of changes in μ[3]

$$\frac{dy_F}{d\mu}=\frac{|J_6|}{|J_0|}, \text{ where } J_6=\begin{bmatrix} 0 & 0 & -\frac{1}{m} \\ 0 & 1 & \frac{\delta}{\alpha m}[(1-t)y_F+y_I] \\ \frac{m}{\mu} & -\mu\delta & 1 \end{bmatrix} \text{ and}$$

$$|J_6|=\frac{1}{\mu}>0$$

such that

(R18.1) $$\frac{dy_F}{d\mu}=\frac{1}{\mu}\frac{1}{|J_0|}>0$$

The effect on the shadow activities is:

[3] Note that all the variables in this section represent optimal levels derived in Case 1.

$$\frac{dy_I}{d\mu} = \frac{|J_7|}{|J_0|}, \text{ with } J_7 = \begin{bmatrix} \frac{1}{y_F} & 0 & -\frac{1}{m} \\ (1-t) & 0 & \frac{\delta}{\alpha m}[(1-t)y_F + y_I] \\ 0 & \frac{m}{\mu} & 1 \end{bmatrix}$$

$$|J_7| = -\frac{(1-t)}{\mu} - \frac{\delta}{\mu y_F}[(1-t)y_F + y_I] = -\frac{1}{\mu}\left[(1-t)(1+\delta) + \delta\frac{y_I}{y_F}\right] < 0$$

$$\text{(R18.2)} \qquad \frac{dy_I}{d\mu} = -\frac{1}{\mu}\left[(1-t)(1+\delta) + \delta\frac{y_I}{y_F}\right]\frac{1}{|J_0|} < 0$$

The effect of changes in μ on the equilibrium price of corruption is given by:

$$\frac{dm}{d\mu} = \frac{|J_8|}{|J_0|}, \text{ with } J_8 = \begin{bmatrix} \frac{1}{y_F} & 0 & 0 \\ (1-t) & 1 & 0 \\ 0 & -\mu\delta & \frac{m}{\mu} \end{bmatrix}$$

$$|J_8| = \frac{m}{\mu y_F} > 0$$

such that:

$$\text{(R18.3)} \qquad \frac{dm}{d\mu} = \frac{m}{\mu y_F}\frac{1}{|J_0|} > 0$$

The associated effects on the equilibrium level of corruption and on the ratio of capital in the official sector are the following:

$$\text{(R18.4)} \qquad \frac{dC}{d\mu} = \frac{dC}{dy_I}\frac{dy_I}{dt} = -\frac{1}{\mu}C + \frac{\delta(S+P)}{m[\delta y_I + (S+P)]}\frac{dy_I}{d\mu} < 0$$

$$\text{(R16.5)} \qquad \frac{dk}{d\mu} = \frac{(1-t)y_I\frac{dy_F}{d\mu} - (1-t)y_F\frac{dy_I}{d\mu}}{[(1-t)y_F + y_I]^2} > 0$$

<u>Result 19:</u> Effects of changes in *S* and *P*[4]

The effect on the volume of official activities:

$$\frac{dy_F}{(dS+dP)}=\frac{|J_9|}{|J_0|}, \text{ with } J_9=\begin{bmatrix} 0 & 0 & -\frac{1}{m} \\ 0 & 1 & \frac{\delta}{\alpha m}[(1-t)y_F+y_I] \\ \mu & -\mu\delta & 1 \end{bmatrix}$$

$$|J_9|=\frac{\mu}{m}>0$$

such that the effect obtains as:

$$\text{(R19.1)} \qquad \frac{dy_F}{(dS+dP)}=\frac{\mu}{m}\frac{1}{|J_0|}>0$$

The change in the firm's decision on the extent to which to operate in the parallel sector is given by:

$$\frac{dy_I}{(dS+dP)}=\frac{|J_{10}|}{|J_0|}, \text{ where: } J_{10}=\begin{bmatrix} \frac{1}{y_F} & 0 & -\frac{1}{m} \\ (1-t) & 0 & \frac{\delta}{\alpha m}[(1-t)y_F+y_I] \\ 0 & \mu & 1 \end{bmatrix}$$

$$|J_{10}|=-\frac{(1-t)\mu}{m}-\frac{\delta\mu}{\alpha m y_F}[(1-t)y_F+y_I]=-\frac{\mu}{m}\left[(1-t)\left(1+\frac{\delta}{\alpha}\right)+\frac{\delta}{\alpha}\frac{y_I}{y_F}\right]<0$$

such that:

$$\text{(R19.2)} \qquad \frac{dy_I}{(dS+dP)}=-\frac{\mu}{m}\left[(1-t)\left(1+\frac{\delta}{\alpha}\right)+\frac{\delta}{\alpha}\frac{y_I}{y_F}\right]\frac{1}{|J_0|}<0$$

The effect of changes in S and/or P on the equilibrium price of corruption is:

$$\frac{dm}{(dS+dP)}=\frac{|J_{11}|}{|J_0|}, \text{ where: } J_{11}=\begin{bmatrix} \frac{1}{y_F} & 0 & 0 \\ (1-t) & 1 & 0 \\ 0 & -\mu\delta & \mu \end{bmatrix}$$

$$|J_{11}|=\frac{\mu}{y_F}>0$$

and:

[4] Note that all the variables in this section represent optimal levels derived in Case 1.

(R19.3) $$\frac{dm}{(dS+dP)} = \frac{\mu}{y_F}\frac{1}{|J_0|} > 0$$

The corresponding change in the equilibrium level of corruption is given by:

(R19.4) $$\frac{dC}{d(S+P)} = \frac{1}{\mu}\frac{\delta \frac{dy_I}{d(S+P)}(S+P) - \delta y_I}{[\delta y_I + (S+P)]^2} < 0$$

Finally, the effect of S and/or P on the ratio of capital employed in the formal sector writes as:

(R19.5) $$\frac{dk}{d(S+P)} = \frac{(1-t)y_I \frac{dy_F}{d(S+P)} - (1-t)y_F \frac{dy_I}{d(S+P)}}{[(1-t)y_F + y_I]^2} > 0$$

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