ON MONETARY INTEGRATION AND MACROECONOMIC POLICY

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To my parents,
Maria and Lennart

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Abstract

Paper I:
Economic Determinants of Public Opinion about joining the EMU in Sweden and in the UK.

Potential Swedish and/or British memberships in the third stage of the EMU (the currency union) will be determined in referenda. The opinion polls that precede these referenda show strong variability, in particular in the Swedish public opinion, over the last four years. In this paper I derive a theoretical model and test it with opinion poll data to establish the economic factors driving the opinions. For Sweden, I find that an increased nominal exchange rate uncertainty makes the opinion more in favor of membership, while the opposite is true for employment uncertainty. In line with the theoretical model, the empirical results for the UK are weaker. The explanation is that the less exposed a country is to foreign trade, the less decisive is currency variability for movements in public support for membership. Similarly, the less rigid an economy is, the less decisive is the real uncertainty.

Paper II:
Nominal Wage Flexibility in a Monetary Union.

Membership in a monetary union reduces the possibilities of counteracting fluctuations in productivity by monetary policy. One condition for entrance not to lead to adverse unemployment performance is that wages are flexible with respect to productivity. In this paper I show that, depending on workers' risk aversion, the incentive for workers to choose more flexible nominal wages may increase after entering a monetary union. The reason is that the abolishment of exchange rates and the common monetary policy increases wage setters utility maximizing preset nominal wages. Assuming that individuals' preferences do not change, the institutional change in monetary policy may induce wage setters to increase wage flexibility.

Paper III:
Partisan Differences in Swedish Macroeconomic Policy.

The purpose of this paper is to trace partisan differences among Swedish governments during the period 1958-2000. According to the Partisan Theory of macroeconomic policy left-wing governments are relatively more concerned with the performance of the real side of the economy (real output and unemployment) as compared to right-wing governments, that place a higher weight on the nominal variables (inflation). Left-wing governments would therefore pursue more expansionary aggregate demand policy, and thereby be willing to risk a higher inflation, in order to improve real economic performance. In this paper we apply the model developed in Hibbs (1994) on Swedish data. Our empirical results support the partisan theory, showing that, ceteris paribus, aggregate demand policy under left-wing governments is relatively more expansionary than under right-wing governments, even if the expansionary policy sometimes leads to higher inflation.

Preface

Finally! This preface is intended to thank those directly involved in the work of this thesis, without forgetting (and that I mention already in the first paragraph) the never-ending support and caring from my friends in Bankeryd, in Göteborg, or wherever you happen to have settled.

The first and most important condition that must be fulfilled to be able to complete a thesis is to have a supervisor who believes in you when necessary and who makes you believe in yourself whenever that is necessary. In my case, Douglas Hibbs has more than well fulfilled this condition. For a long time I was always as nervous when entering his room, as I was encouraged, inspired and filled with new ideas when leaving the same room. Nowadays, only the second part is true. I am grateful to Douglas for all his help, for stimulating discussions and, not the least, for many nice barbecues.

There are many others that significantly have helped me during the process of writing this thesis. Henry Ohlsson came to Göteborg in November 1999 and I have had many valuable and fun talks with him ever since. Henry has never stopped coming up with new ideas and the post-seminar meetings at the Rover have been an important springboard into the world of academics. Thanks also to Donald Storrie and Dominique Anxo for encouragement, nice comments and many good stories.

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Besides writing, teaching is an important part of a Ph.D. candidate's life. Having had the opportunity to work together with Wlodek Bursztyn has really been stimulating. Wlodek is, without admitting it (publicly), the one man at the department knowing everything that is worth knowing about macroeconomics and I would like to thank him for giving me the opportunity to teach at "his" course. In addition he has scrutinized my work and given me many thoughtful comments. I also want to thank Arne Bigsten for his continuous support.

Not even as a Ph.D. candidate one can live in hope alone, and generous financial support from Stiftelsen Ekonomisk Forskning i Västsverige and from Jan Wallander

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The years I have spent working with this thesis have not only resulted in a yellow book. More important is perhaps that I have had the fortune to make some really close friends. I can't judge what is most fun and pleasing with spending all the time I spend with Susanna Lundström - the way she patiently listens to everything I say or the way she says everything that passes through her mind? No matter what, I enjoy every moment whether we talk about life or just research. I shared my first office with Anna Brink. I doubt I would have survived the first two years of the program would it not have been for her. The same goes for Johan Adler, who never refuses a lunch. After an infinite number of badminton games, Henrik Hammar has taught me that being "second best" is not the end of the world. Ola Olsson never denies me his time, neither for discussing research nor football. I realize I did not know humour before I met Åsa Löfgren. Last, but not least, Francisco Alpízar has really made my life as a PhD student easier with his never-ending enthusiasm. Thanks also to Anders Isaksson and Anders Ekbom for preventing me from forgetting the names of the most important skiers and tennis players of the 1970's. Half of my mailbox originates from Vienna!

Finally, I am indebted to my mother and father, my sister Emelia, and my brothers Markus and Johannes for your total and unconditional understanding (even if you perhaps do not understand).

Introduction

On September 14, 2003, Sweden will have a referendum where Swedish voters will answer the question "Do you think Sweden should introduce the Euro as currency?" The main part of this thesis concerns this question.

For an economist, the question of membership in a monetary union induces quite a few interesting research topics. In this thesis, I have focused on two. First, on which criteria do individuals base their decisions on membership? Second, membership in a monetary union is an institutional change that induces changes in the way individuals optimally behave. Therefore, when analyzing the welfare consequences of a monetary union, I argue that one have to incorporate these induced changes in individual behavior.

The debate in Sweden on whether or not to join the EMU has been going on ever since Sweden joined the EU in 1995. One reason why I started writing on the topic is that the public opinion pattern on membership in the EMU has been surprisingly variable. How can this variability be explained? A common approach in the study of public opinion on international economic policies is to start by asking two questions. The first concerns identification of the political agents relevant for policy making. In the literature, there are two main alternatives: The first choice is the mass electorate, but on many issues it is assumed that the mass electorate are incapable of holding politicians responsible for policy-making, why instead organized interest groups play the role of being the prime political actors. There are many reasons to claim that in the case of EMU membership, the relevant political actors are the mass electorate. The question has been on the table for a long time and it has been widely debated in media as well as among politicians. Further, by deciding that the question of membership in the currency union will be subject to a referendum, the politicians in fact identify the mass electorate as the primary political agents.

After having identified the relevant political agents, a second question is what criteria the mass electorate bases its decision on. In economics the most common approach to use is to apply a self-interest model. That is, individuals support the policy alternative that maximizes their utility. When voting on membership in a monetary union, therefore, an underlying assumption is that individuals weight welfare costs and benefits from membership in order to come up with a decision.

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The remaining problem is then to identify and quantify the welfare consequences of a common currency.

The welfare consequences of the creation of the EMU is, however, a widely debated and still not settled issue. The main part of the exploding economics literature on the subject has been devoted to analyze how to conduct macroeconomic policies in the EMU, including questions like: What is the optimal monetary policy of the ECB? Can a common monetary policy successfully live together with decentralized fiscal policies or which restrictions should be put on fiscal policy in the member states? What rule will the Euro play as an international currency? and so on.

Less attention has being paid to the direct welfare consequences for individual citizens in the Euro area. In political science, one approach in the field of international political economy is to study the distributive consequences of a change in international economic policy. Applied to the EMU, the institutional change of introducing a common currency and a common monetary policy will not affect individuals symmetrically. Analogously to the partisan theory of macroeconomic policy, the welfare consequences of a common currency and a common monetary policy also depend on, for example, the income distribution. The partisan theory of macroeconomic policy predicts that individuals who are more dependent on labor income are more willing to accept a higher inflation in order to try and push employment below the natural rate. Accordingly, the adoption of a common currency is welfare enhancing for the groups in society that suffer from currency uncertainty. On the other hand, the common monetary policy may reduce welfare for groups that do not benefit from the lower currency variability, but instead are more dependent on a national monetary policy and a national, potentially shock-absorbing, exchange rate. The latter category of individuals most often coincide with individuals in the lower range of the income distribution.

To my knowledge, Paper I of this thesis is the first attempt to analyze the rationality of EMU public opinion over time. The paper should therefore be read complementary to previous studies on public opinion on the EMU issue that have analyzed how cross-country support for monetary integration varies with the prospective gains from a common currency.

Theoretically, Gärtner (1997) shows that since the main focus of the Maastricht convergence criteria is to discipline monetary and fiscal policy, the net gain for a country of joining the common currency should be increasing in the country's past

record of the inflation rate and in the governmental debt. Alesina and Barro (2002) reach similar conclusions. In particular, the countries gaining most from entering a currency union are small open economies with a historical record of high inflation, that also are closely connected, via trade and the business cycle to one particular large economy.

These theoretical propositions are confirmed by data. Using public opinion data from 12 EU countries from 1995, Gärtner (1997) finds strong evidence that public opinion were more in favour of the euro in countries that had a record of high inflation and loose fiscal discipline. Gabel (1999) focuses on how the distributional consequences of a monetary union shape public support for the EMU. Using a pooled data set from the *Eurobarometer* Gabel finds that public support is higher in groups working in the traded sector of an economy. The reason is that they are the ones gaining most from a common currency. Conversely, the public sector to a larger extent produces non-tradable goods and services and, in addition, depends more on government spending. People employed in the government sector therefore tends to be less inclined to the idea of a common currency. Still, even though these proposed explanations explain the cross-country variability in public support for the common currency, they cannot explain the fluctuations over time observed in the Swedish EMU opinion.

In terms of quantity, the literature on the EMU is quite impressive. Despite this, the predictions on what will happen to Sweden if it joins the union are vague. We don't know with certainty what the consequences will be for growth, employment or inflation. In fact, the only things we really know will happen to Sweden if it joins is that the Swedish Krona will be replaced by the common Euro, that monetary policy will be conducted by the ECB, and that fiscal policy will have to follow the rules of the Stability and Growth Pact. Paper I takes off from this lack of consensus of what the macroeconomic consequences of membership will be and assumes that the Swedish opinion pattern can be explained by individuals' rational responses to the things we know will take place. The underlying idea of the paper comes from the observation that the pattern of the Swedish EMU opinion to a large extent follows the development in the nominal exchange rate SEK/EUR (see Figure 1). Since the most obvious difference after entrance is that Sweden will have the same currency as its main trading partners it is fully rational that individuals use the development of the nominal exchange rate when evaluating the pros and cons of

membership. In particular, a highly variable exchange rate creates uncertainty in the Swedish economy; uncertainty that would be lowered if Sweden would adopt the Euro. Giving up the domestic currency and monetary independence is not a "free lunch," however. It also implies a loss of policy instruments that can prevent from country-specific shocks affecting employment and growth. In the paper I use the variance in productivity to proxy for the "real uncertainty" in an economy.

Fig. 1. The Swedish EMU opinion and the nominal exchange rate SEK/EUR. Time period: April 1998- June 2002
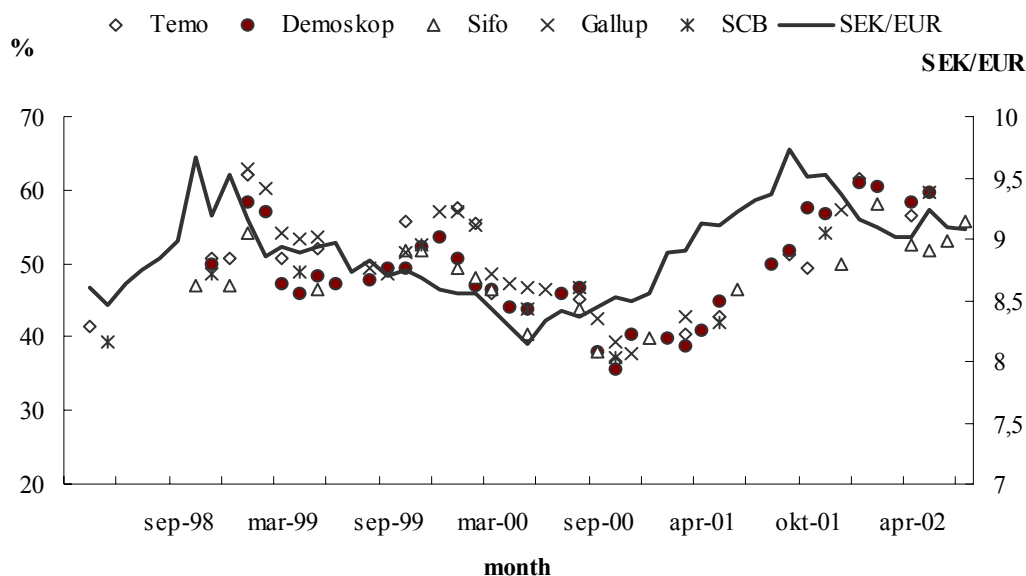
Note: Each poll represents the number of "YES" respondants as share of the those answering "YES" or "NO." People responding "DON'T KNOW" are excluded.

A second condition for explaning observed *fluctuations* in the mass support is that the information is "new." Crucial for the understanding of Paper I is that I assume only news to each voter's information set shape opinion fluctuations. There are many economical as well as psychological and political factors that affect how voters decide to vote. In the analysis, however, I assume that these are constant over this relatively short time period of five years. Empirically, they therefore show up in the constant.

By developing a model and applying it to a previously never used dataset on public opinion in Sweden, I find results that larger currency uncertainty increases the

support for Swedish membership.[1] The opposite is true for labor market uncertainty, where increased variability leads the opinion to be more skeptical to membership. Another country considering entrance in the EMU is the UK. The empirical results for the UK are, as expected, considerably weaker than for Sweden. This is in line with the theoretical model developed in Paper I, which predicts that the less exposed a country is to foreign trade, the less decisive the currency variability is for the decision to enter a monetary union. Similarly, the more flexible the wage setting, the less decisive the real uncertainty.

A second research topic I focus on stems from a common argument in the Swedish EMU debate, saying that a precondition for entrance is that the labor market is flexible "enough." One major concern with entering the monetary union is where adjustment to shocks should come if nominal exchange rates and monetary policy cannot handle it? Paper II of this thesis suggests that the answer is in wage setting. But the result is actually stronger than simply saying that adjustment should come via nominal wages. Rather, given standard assumptions on individual preferences the paper shows that the mere membership in a monetary union will induce more nominal wage flexibility. Thus, labor market flexibility should not be viewed as a prerequisite, as in the Swedish debate, but rather a consequence of membership. The model used in Paper II differ from most models of wage setting behavior. Instead I apply a model from the reseach program often called "New Open Economy Macroeconomics", initiated by Obstfeld and Rogoff (1995). The main field for using this research program has been to study the conduct of monetary policy. In Paper II of this thesis I use this general equilibrium approach to the study of wage setting.

In the model wage setters maximize utility by setting nominal wages either before shocks realize (*sticky*) or after (*flexible*). One key to the understanding of the paper is that the choice of setting nominal wages sticky or flexible has to made before shocks are realized. Given that individuals' preferences, including the degree of relative risk aversion, remain unchanged also after a movement into the monetary union, the changed economic environment will potentially make individuals undertake different decisions. It turns out the utility maximizing sticky wage is higher after entrance in the union, where the policy instruments available are fewer. This in turn reduces both mean real consumption and mean employment. Depending on how individuals

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[1]Since the best prediction of future currency uncertainty is the most recently experienced, I use the variance of the first difference of the log nominal exchange rate as one explanatory variable.

weigh consumption and supply of labor, then, the incentive to choose flexible wages might be strengthened by the entrance in the union.

Both the distributional consequence approach to the study of international economic policies, as well as the partisan theory of macroeconomic policies stem from the fact that an economy consists of heterogeneous agents. Primarily, the agents are heterogeneous with respect to income. In Paper III of this thesis I test a version of the Partisan theory of macroeconomic policy outcomes on Swedish data. Tests of models on politically induced business cycles most frequently have used data for the U.S., a country that only to a small extent is dependent on economic developments in the rest of the world, and therefore have more degrees of freedom to pursue partisan policies. In Paper III I present statistically significant results that the partisan theory is valid also for a small open economy like the Swedish. The stylized pattern of real growth over an electorate period in Sweden is partisan divergence during the first half of a period, in the sense that if a left-wing government wins the election then real growth increases and unemployment lowers, while the opposite is true if the election results in a right-wing government. The second half of the election period is characterized by partisan divergence. Hibbs' (1994) explanation for this pattern is that policymakers are uncertain about the natural rate of growth, and hence also the division between real growth and inflation from a policy-induced increase in aggregate demand. A left-wing administration, whose voters' income to a larger extent depend on low unemployment is then willing to pursue an expansionary policy at the risk of pushing real growth below the natural rate. The partisan convergence arises since left-wing governments initially increase aggregate demand to an extent that may lead to increased inflation, which make politicians downwards revise their growth target. The opposite pattern is true for right-wing governments initially targeting a growth rate lower than the natural rate. When reading Paper III of the thesis one should note that the way politicians affect aggregate demand is not explicitly modeled. Instead, I assume politicians can fully control aggregate demand, by either fiscal and/or monetary policy. The way this is done is a black-box in the model.

From my point of view, the main contributions of this thesis are, first, that it widens the understanding on what shapes public opinion on international economic policies over time. By developing a theoretical model and then apply it on a formerly never used data set on public opinion on the issue of EMU membership, Paper I ex-

plains a substantial amount of observed fluctuations in the mass electorate over time. Second, it contributes to the theoretical modeling of wage setting, by employing a model in which an individual's attitude towards risk affects mean wages.

Why, then, is this thesis worth reading? I hope there are many reasons, but one obvious reason is that the timing of the defense of this thesis is surprisingly fortunate, since in less than five months the Swedish voters will go to the ballot-boxes and cast their votes for or against membership in the EMU.[2]

REFERENCES

Alesina, Alberto and Robert J. Barro, (2002) "Currency Unions," *Quarterly Journal of Economics* 117(2): 409-436.

Gabel, Matthew (1999), "Divided Opinion, Common Currency: The Political Economy of Public Support for EMU." Working Paper, Department of Political Science, University of Kentucky.

Gärtner, Manfred (1997), "Who wants the euro - and why? Economic explanations of public attitudes towards a single European currency," *Public Choice* 93: 487-510.

Hibbs, Douglas A. (1994), "The Partisan Model of Macroeconomic Cycles: More Theory and Evidence from the United States," *Economics and Politics* 6: 1-23.

Obstfeld, Maurice and Kenneth Rogoff (1995), "Exchange Rate Dynamics Redux," *Journal of Political Economy* 103(3): 624-660.

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[2]Unfortunately, this same coincidence also makes the thesis to some extent sunk in less than five months from now :-)

Economic determinants of public opinion about joining the EMU in Sweden and in the UK.

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Abstract

Potential Swedish and/or British memberships in the third stage of the EMU (the currency union) will be determined in referenda. The opinion polls that precede these referenda show strong variability, in particular in the Swedish public opinion over the last five years. In this paper I derive a theoretical model and test it with opinion poll data to establish the economic factors driving the opinions. For Sweden, I find that an increased nominal exchange rate uncertainty makes the opinion more in favor of membership, while the opposite is true for employment uncertainty. In line with the theoretical model, the empirical results for the UK are weaker. The explanation is that the less exposed a country is to foreign trade, the less decisive is currency variability for movements in public support for membership. Similarly, the less rigid an economy is, the less decisive is the real uncertainty.

Keywords: Public opinion; Referenda; Monetary Union
JEL code: D72

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1   Introduction

The introduction of the the third stage of the European Economic and Monetary Union (EMU) on January 1, 1999 is with no doubt one of the most far-reaching integrating events on the European political arena ever. The EMU currently consists of 15 member states, of which 12 have formed a currency union, with a common currency and a single monetary authority. The two countries most likely to be the next to consider entrance in the third stage of the EMU are Sweden and the UK.[1] In both countries, policy makers have decided that the decision to join the currency union will be subject to a referendum.

The public opinion polls preceding these upcoming referenda reveal that public opinions differ considerably in the two countries. In Sweden, the opinion has been quite volatile, both for and against entrance in the union, while in the UK there has been a stable majority against an entrance in the Euro area. The aim of this paper is to explain the patterns of public opinions in Sweden and in the UK on the issue of membership in the monetary union. In particular, the ambition is to establish whether observed variability in the opinion data can be explained by voters' rational responses to economic factors. Depending on the characteristics of the Swedish and the British economies, the proposed economic factors will not affect public opinion in the two countries symmetrically and a second purpose with the paper is to understand why voters in Sweden and the UK rationally respond differently to movements in the relevant economic variables.[2]

1.1   Background

A starting point for analyzing public opinion on the EMU is the question why it was created. Broadly, the arguments for monetary integration can be either economic and/or political.

The common, though not undisputed view is that economic arguments are not strong enough to rationalize the creation of the EMU. Using the criteria from the

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[1]The third country in the EMU not having adopted the Euro is Denmark. I exclude Denmark from this study, since they had a referendum on membership during the sample period. Furthermore, Denmark is in the ERM2, which means that the Danish Krona is not floating but bilaterally fixed to the Euro.

[2]This research project started by analyzing only the Swedish opinion (Erlandsson, 2002a). I am grateful to Ken Scheve for pointing out to me that the model used in that paper works well for the Swedish opinion, but not for the UK. Therefore, I started to build on my old analysis to understand why this is. The result is this paper.

literature on optimal currency area[3] that goes back to the 1960's, most economists agree that in at least one aspect EMU is not an optimal currency area; labor mobility within the union is too low. Although the degree of asymmetry of shocks between EMU economies is a debated issue, it is widely accepted that labor mobility alone cannot compensate for the loss of stabilizing policy that follows from giving up monetary autonomy.

A parallel way of evaluating the economic reasons for the EMU is to imagine a social planner using economic variables to judge whether the EMU is welfare-increasing *per se*. The main argument for a currency union is reduced transaction costs. Moving to a single currency reduces not only the costs of currency conversion but also the exchange rate uncertainty, possibly inducing more trade and investment within the union. This economic benefit should be weighed against the economic cost that is connected to the loss of monetary autonomy in the individual countries. Thus far, the evidence that the net of benefits and costs is positive is generally not convincing. Therefore, few if any argue that the decision to form a monetary union would ever be made by a social planner. Instead, the process towards a common currency is mainly political.

When discussing the political arguments underlying the EMU, the discussion is more complex than weighing benefits and costs. The most common political argument is that a monetary union is a step towards a deeper political union, involving joint defense and foreign affairs. The reason for this, stressed by politicians, is to integrate the European countries to such an extent that a war on the European continent in the future is no longer possible. The choice of monetary policy as the first field to integrate is motivated by the fact that the political cost is lower than trying to integrate for example defense.

Wyplosz (1997) discusses another political economy argument for the creation of a currency union, often denoted the "impossible trilogy." Under the European Monetary System (EMS), started in 1979, the European currencies were bilaterally fixed. The introduction of the Single European Act in the late 1980s implied free movement of capital among the countries. Wyplosz then argues that free movement of capital and fixed exchange rates are not compatible with national independence of monetary policy. Instead, monetary policies in EEC countries were strongly restrained by the actions taken by the German Bundesbank. The problem was that

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[3]See Mundell's (1961) seminal work on optimal currency areas as well as McKinnon (1963).

the Bundesbank was legally forced only to consider the economic development in Germany when forming its policy. One way to get around this disproportionately large dependence on the Bundesbank was to replace it by the ECB.[4]

Assuming that the sources of the EMU are mainly political, an important question is how the potential economic costs from monetary integration will affect future and further integration. Feldstein (1997) argues that the EMU would be an economic liability in the sense that the fundamental differences among the member states, economical as well as political, causes the EMU to induce more conflicts among the member states, making future integration of, for example, foreign policy less likely.

One might think of a row of factors determining public opinion for or against membership in the EMU. As argued above, the EMU is primarily a political process heading towards deeper integration. The desirability of this deeper integration therefore should be one important determinant for how the British and Swedish voters will vote in the upcoming referenda. Furthermore, the introduction of the common currency and the common central bank is an institutional change that might induce changes in other areas of the economy possibly more relevant for the individual, including coordination of fiscal policy, changes in the wage formation and so on.

Some previous studies have analyzed static cross-country as well as within-country differences in public support for the EMU. Using public opinion data from 14 EU countries from the *Eurobarometer* in 1995, Gärtner (1997) finds strong evidence that public opinion was more in favor of the euro in countries that had a past record of high inflation and loose fiscal policy.[5] Gärtner's explanation for the result is that the net gain in a country from entering the EMU, thereby tying the hands of the politicians by the Maastricht convergence criteria, is larger the larger the inflation bias and the higher the government budget deficit are in a country. Gabel (1999) focuses on how the distributional consequences of a monetary union shape public support for the EMU. Using a data set of individual-level respondents between 1994 and 1995 from the *Eurobarometer*, Gabel finds that mass support for the common currency is higher in groups working in the traded sector of an econ-

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[4]The alternative would be to let exchange rates float, but that alternative has historically not been successful in Europe and according to Wyplosz, letting exchange rates float was *de facto* never a real alternative.

[5]Gärtner uses the average rate of inflation and the accumulated government debt between 1980 and 1996 in each country as explanatory variables.

omy. The reason is that those are the ones gaining most from reduced currency uncertainty. Accordingly, the public sector produces to a large extent non-tradable goods and services and, in addition, depends more on government spending, why those employed in the public sector tend to be less inclined to the idea of a common currency. Kaltenthaler and Anderson (2001) use cross-country opinion data from the *Eurobarometer* from 1994-1997 and find systematic evidence that confirm the self-interest hypothesis that citizens evaluate the question of a common currency based on economic calculus. The idea of a common currency is supported if it is expected to increase welfare. In addition, they find that support for the EMU is increasing in a country's experience in EU institutions and draw the conclusion that support is decreasing in what they call "national pride."

The stylized fact is that public opinion on, in particular, Swedish membership has been quite volatile. Assuming that, over this relatively short time period of five years, individual preferences for deeper integration, increased coordination in fiscal policy and other institutional aspects, as well as the public's perception of monetary and fiscal discipline are stable over time, these factors cannot explain observed *fluctuations* in public opinion. Instead, these opinion fluctuations depend on utility maximizing agents' reactions to unexpected movements in relevant economic variables. Assuming full rationality, the individuals at all occasions calculate the net present value of entering the EMU. Thus, changes in the net present value of entering the EMU, resulting in opinion fluctuations, are driven only by pure shocks to each agent's information set. In this paper, I will argue that this information set includes, in particular, the developments in the nominal exchange rates and in productivity.

1.2 Intuition

Formally, the third stage of the EMU implies that national currencies are replaced by the common Euro and that monetary policy previously governed by the national monetary authorities will be handed over to the common central bank. Therefore, reasoning strictly economically, the effect each individual voter has to consider when casting her vote for or against entrance in the monetary union is whether the expected individual utility will be higher or lower with a common currency and a common monetary policy. Equally this can be expressed in terms of net present value calculations on membership. If the net present value of membership is positive

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then the individual votes yes, if it is negative then she votes no.

Entrance in a monetary union implies that the exposure to nominal and real uncertainty will change. The basic argument is that sharing the same currency lowers the currency uncertainty in the part of trade undertaken with the countries in the monetary union. The uncertainty in real wages and real profits is therefore also reduced. If the monetary union currency is more volatile against other currencies than the present domestic currency, however, this would to some extent counteract the first effect by increasing the currency uncertainty in the part of trade that is done with countries outside the monetary union. The total direct effect of changing currencies, in the paper denoted "*Nominal Uncertainty*," will therefore critically depend on (i) the country's exposure to foreign trade, (ii) the amount of total foreign trade undertaken with monetary union member states and (iii) the volatility of the current domestic currency.

On the other hand, the common currency and the common monetary policy may potentially make employment more volatile. This effect, in the paper denoted "*Real uncertainty*," arises since without national currencies and national interest rates, the ability to insulate economic shocks from showing up in employment is reduced. For example, if the domestic economy (as long as it is not a member of the currency union) is hit by a country specific negative productivity shock, it is fully possible that this shock is counteracted by a depreciation of the currency. This depreciation lowers export prices and the productivity shock can to some extent then be neutralized, leaving the level of employment and production unaffected. If the domestic economy becomes a member of the monetary union, the possibility to absorb the shock with a depreciation of the domestic currency is no longer attainable. Therefore, the real uncertainty in the economy may increase once the country enters into the currency union. The importance of this increased real uncertainty depends on the characteristics of the domestic economy mentioned in (i)-(iii) above, but also on the amount of nominal rigidities present in the economy. Generally speaking, the more flexible the domestic economy, the less dependent the economy is on the exchange rate and on national monetary policy as shock absorbers. Therefore, we would expect that the importance of real uncertainty is more pronounced the more rigid the domestic economy is.

Based on these arguments, the main economic factors I claim drive the opinions in the two countries are variability in the nominal exchange rates and in productivity.

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1.3 Main results

The results presented in the paper are different for each of the two countries. For Sweden, a substantial part of the observed fluctuations in public opinion can be explained by the variability in the nominal exchange rate and in productiviy. The more volatile the Swedish Krona is against the Euro, the more in favor of a Swedish EMU membership Swedish voters are, while the opposite is true for labor market uncertainty, where the support for Swedish membership decreases with employment uncertainty. Further, the support in Sweden for membership in the currency union is higher the lower the value of the Swedish Krona (SEK) is against the Euro (EUR).

For the UK, the results are less clear-cut. Larger variance in the Pound/Euro nominal exchange rate does not significantly increase the support for EMU membership among British voters. My explanation for this is that the British Pound (GBP) has, over the time period used in this paper, been more stable against the US Dollar than has the Euro, and for the Brits a fluctuating exchange rate GBP/EUR is an indication of the weakness of the Euro, rather than of a weak Pound. The smaller the (negative) covariance between the nominal exchange rates GBP/EUR and EUR/USD, the less inclined the British voters are to vote for membership in the EMU. The UK economy is also more flexible than the Swedish, which might explain why we get no significant effect of the employment uncertainty on UK public support for the Euro.

Among the other explanatory variables tested in the paper is the outcome of the Danish referendum in September 2000, when the Danes decided not to enter the currency union.[6] This result lowered public support for membership in both Sweden and in the UK. The introduction of Euro bills and coins in January 2002 increased public support in both countries.

The paper is organized as follows: Section 2 provides the stylized facts of the two economies that help explain why the opinion patterns differ. In Section 3 a theoretical model is presented. This theoretical model is tested in the empirical Sections 4 to 5. Section 6 concludes.

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[6]The Danish referendum was a tight race and the outcome was highly unpredictable, why it is reasonalbe to argue that the outcome came as a shock to the individuals' information set. The same argument goes for the introduction of the Euro as a currency in January 2002, which success was surrounded by some uncertainty, although perhaps to a lesser extent. When the transition really worked smoothly, this can be interpreted as a positive shock.

2 Stylized facts

The British and the Swedish economies differ in many ways. In this paper, focus will be on four differences that are potentially important for the opinions' rational responses to the proposed explanatory variables: nominal exchange rates, trade patterns, country size and presence of nominal rigidities. Before deriving a theoretical model, I will present the stylized facts and discuss how the public opinions are affected, given the characteristics of the two countries.

2.1 The nominal exchange rates

Letting the Euro replace the national currencies has different consequences in the two economies. Figure 2.1 below illustrates the internal pattern of the nominal exchange rates between the Euro, the Swedish Krona and the British Pound, and the US Dollar over the last seven years.

Figure 2.1 The SEK, GBP and EUR nominal exchange rates against the USD
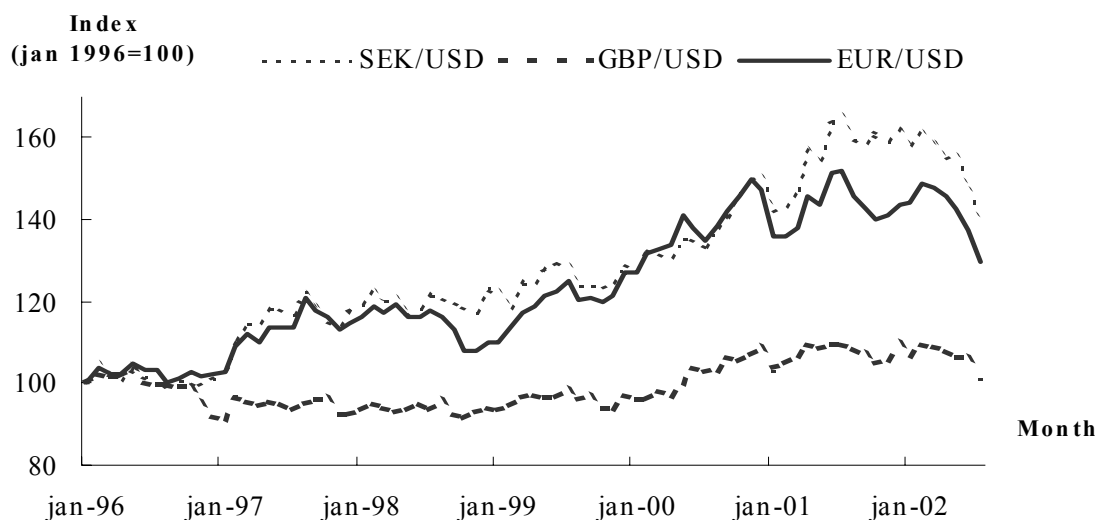
Source: Data from *Ecowin*. Daily closing rates.

Membership in the EMU implies a removal of the currency uncertainty for the UK citizens as far as trade with the EMU area (about 50% of total British foreign trade) is concerned. On the other hand, as is obvious from Figure 2.1, the relation

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between the British Pound and the Euro is that the Pound fluctuates less against the US Dollar than does the Euro. Assuming that a large part of the trade with the rest of the world is made in Dollars, abandoning the Pound for the Euro would therefore imply *more* currency uncertainty for the Brits in their non-EMU trade.

The situation is different in Sweden, where the relation between the Swedish Krona and the Euro is that the Euro is less volatile against the US Dollar than is the Krona. Therefore, joining the EMU would potentially be a "win-win" situation with less currency uncertainty both in the Swedish EMU and non-EMU trade. Table 2.1 shows the correlation between the nominal exchange rates SEK/EUR and EUR/USD and the corresponding correlation between GBP/EUR and EUR/USD.

Table 2.1 Correlations between nominal exchange rates

	Jan. 1996 - July 2002	Jan. 1998 - July 2002
$Corr\left(\frac{SEK}{EUR}, \frac{EUR}{USD}\right)$	0.390	0.050
$Corr\left(\frac{GBP}{EUR}, \frac{EUR}{USD}\right)$	-0.868	-0.903

Source: Data from *Ecowin*. Daily closing rates.

The purpose of Table 2.1 is to show that the Swedish Krona has on average depreciated (appreciated) against the Euro at the same time as the Euro has depreciated (appreciated) against the US Dollar. Things are different for the British Pound: The Pound appreciates (depreciates) against the Euro at the same time as the Euro depreciates (appreciates) against the US Dollar. The expectation, therefore, is that an appreciation of the Pound against the Euro is accompanied by a depreciation of the Euro against the Dollar.

2.2 Trade patterns and country size

Sweden and the UK differ in how exposed each of the economies is to foreign trade. Table 2.2 shows that Sweden relies more heavily on imports than the UK does. Imports as a share of GDP in Sweden is about 32% compared to the UK where the corresponding share is about 24%. As a consequence, the effect from currency uncertainty should be more pronounced on the Swedish opinion than on the opinion in the UK. Slightly more than 50% of the total Swedish imports are from the Euro area. In the UK, the figure is just below 50%.

Table 2.2 Imports over GDP (%), in
Sweden and in the UK, 1999.

	Sweden	the UK
Total	31.9	24.0
EMU	16.0	11.5

Source: UNSTATS variables 14540 and 14550.

Another potentially important difference is the fact that the UK economy is substantially larger than the Swedish. Monetary policy in the EMU is determined by the ECB based on the average economic development in the Euro area.[7] If the UK would adopt the common currency the British GDP would make up about 18% of total GDP in the EMU area. The corresponding figure for Sweden is only about 3%. Since the British economy is larger than the Swedish, the ECB would give more weight to the economic development in the UK than in Sweden.

2.3 Labor market flexibility

Sweden and the UK also differ when it comes to the amount of nominal rigidities present in the two economies. The UK labor market is generally seen as more flexible than the Swedish, in the sense that there are less rigidities and less regulations than in Sweden.[8] This in turn implies that the labor market in the UK is better equipped to absorb shocks hitting the economy.

In the currency union context discussed here, the implication of a more flexible labor market would be a lower cost in terms of real uncertainty from the common currency. The less flexible the labor markets, the more dependent the economy is on a flexible exchange rate or an accommodating policy. Therefore the potential cost from monetary integration is higher in Sweden, where the labor market contains more rigidities.

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[7]Formally, the Eurosystem's monetary policy target is price stability, defined as *"an increase in Harmonised Index of Consumer Prices (HICP) of below 2%."* In practice, it is less clear how different countries are weighted in the HICP, but in this paper I will assume that countries are weighed according to their economic size.

[8]See for example Groth and Johansson (2001) and Smith (2000).

3 A theoretical model

To get a deeper understanding of how differences in the key country characteristics presented in Section 2 affect the way public opinion responds to new information, I develop a stylized theoretical model. The purpose of the model is to explain theoretically what signs the estimated coefficients are expected to have in the empirical model.

3.1 Assumptions

Assume a three-country world, where the world economy consists of a Home economy, a Monetary Union (MU), and one country called "Rest of the World" (RW). All individuals are workers relying only on labor income. Citizens in the Home economy maximize expected utility by voting either for or against membership in the MU.

3.1.1 Sequence of events.

Assume the following sequence of events:[9]

(i)   Wage setters choose a wage schedule for the nominal wage.

(ii)   The productivity shocks are realized.

(iii)   The central bank sets monetary policy.

(iv)   Exchange rate shocks are realized.

Nominal wages are written in long term wage contracts to hold for at least one year. Since the amount of nominal rigidities in an economy potentially affects how large the effect of real uncertainty is on the opinion, I also allow a variable part of nominal wages to be indexed to productivity. This implies that the realized nominal wages are not fully known before the realization of the productivity shocks.

When choosing policy, the central bank is assumed to have full information on the productivity shock, but not on potential shocks to the nominal exchange rate.[10]

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[9]The sequence of events here is similar to the one in, for example, Calmfors and Johansson (2002).

[10]The development in producitivity is normally reported on a quarterly basis, while nominal exchange rates change continuously.

3.1.2 The Home consumer price level

Individuals in the Home economy consume both domestically produced goods and imports. Let the share of Home produced goods consumed domestically be given by the (constant) parameter γ. The consumer price level in the Home economy is given by[11]

$$p_t = \gamma p_{H,t} + (1 - \gamma) p_{F,t}, \tag{1}$$

where $p_{H,t}$ is the period t price of Home produced goods consumed in the Home economy, and where $p_{F,t}$ is the Home currency price of imports. The imported goods can be produced either in the Monetary Union (MU) or in the Rest of the World (RW), implying that the price level of imported goods, $p_{F,t}$ can be written

$$p_{F,t} = \psi p_{MU,t} + (1 - \psi) p_{RW,t}, \tag{2}$$

where the (constant) parameter ψ determines the share of all imports in the Home consumption basket produced in the Monetary Union. The Home currency price of imports from the MU and from the RW are denoted $p_{MU,t}$ and $p_{RW,t}$, respectively.

Let $\tilde{p}_{MU,t}$ denote the MU currency price of goods produced in the Monetary Union and $\tilde{p}_{RW,t}$ the RW currency price of goods produced in the Rest of the World. The (log) nominal exchange rates between the Home currency and the MU and RW currencies are denoted $s_{MU,t}$ and $s_{RW,t}$, respectively. We can then rewrite Equation (2) as

$$p_{F,t} = \psi \left(\tilde{p}_{MU,t} + s_{MU,t} \right) + (1 - \psi) \left(\tilde{p}_{RW,t} + s_{RW,t} \right). \tag{3}$$

Assuming no arbitrage, the exchange rate between Home and RW can be expressed as

$$s_{RW,t} = s_{MU,t} + s_{MR,t},$$

where $s_{MR,t}$ denotes the nominal exchange rate between the MU and the RW currencies. Using this in Equation (3), we may once more rewrite the price level of imported goods as

$$p_{F,t} = \psi \tilde{p}_{MU,t} + (1 - \psi) \tilde{p}_{RW,t} + s_{MU,t} + (1 - \psi) s_{MR,t}.$$

---

[11]By assuming γ constant, I disregard from the potential effect that entering a monetary union increases transactions between monetary union member states.

The nominal exchange rates s_{MU} and s_{MR} are assumed to follow the stochastic processes,

$$s_{MU,t} = s_{MU,t-1} + \phi_{MU,t} \quad \text{and} \quad s_{MR,t} = s_{MR,t-1} + \phi_{MR,t}, \tag{4}$$

where $\phi_{MU,t}$ and $\phi_{MR,t}$ are zero-mean shocks to the nominal exchange rates with variances $Var(\phi_{MU,t})$ and $Var(\phi_{MR,t})$. The covariance between the two exchange rate shocks is denoted $Cov(\phi_{MU,t}, \phi_{MR,t})$.

3.1.3 Production and wages

Labor demand in the Home economy $(l_{H,t})$ is given by

$$l_{H,t} = -(w_t - p_{H,t}) + \theta_{H,t}, \tag{5}$$

where w_t is the nominal wage for period t and $\theta_{H,t}$ is a zero-mean productivity shock with variance $Var(\theta_{H,t})$.

Nominal wages for period t are preset in period $t-1$. For simplicity, assume that the nominal wage is set to keep the real wage constant,[12] but also allow for the possibility that the nominal wage is to some extent indexed to the development in productivity. The realized nominal wage for period t can therefore be expressed

$$w_t = E_{t-1}p_t + \lambda\theta_{H,t}, \qquad 0 \leq \lambda \leq 1, \tag{6}$$

where $E_{t-1}p_t$ are the wage setters' $t-1$ expectations of the overall consumer price level in period t. Substituting (6) into (5) we can rewrite labor demand, which by definition equals total employment in the Home economy:

$$l_{H,t} = -E_{t-1}p_t + p_{H,t} + (1-\lambda)\theta_{H,t}. \tag{7}$$

3.1.4 Monetary policy

Assume that the Home monetary policy instrument is $p_{H,t}$. That is, the central bank can directly control the price level of domestically produced goods. The preference

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[12] Remember that the expected value of the productivity shock is zero.

of the monetary authority is described by the following loss function:

$$\Lambda_t^{CB} = E_t^{CB} \left[p_t^2 + \chi \left(l_{H,t} - l_{H,t}^* \right)^2 \right]$$
$$= \left[E_t^{CB} p_t \right]^2 + \chi \left(l_{H,t} - l_{H,t}^* \right)^2 + \sigma_{p,t}^2, \tag{8}$$

where the parameter χ measures the weight the central bank gives to employment stability and where $l_{H,t}^*$ represents the central bank's preferred level of employment. The central bank expectations operator, E_t^{CB}, enters since the central bank is assumed to neither know with certainty the realized value of the exchange rate shocks, and hence nor the realized overall consumer price level, p_t. Note, however, that since employment is given by Equation (7), the central bank knows with certainty the employment consequences of it's monetary policy. The term $\sigma_{p,t}^2$ denotes the forecasted variance of the overall consumer price level.

From the definition of the Home consumer price level (Equation [1]), $\frac{\partial p_t}{\partial p_{H,t}} = \gamma$. Also, from the employment Equation (7) we get the partial derivative $\frac{\partial l_{H,t}}{\partial p_{H,t}} = 1$. Therefore, minimizing Equation (8) with respect to the monetary policy instrument $p_{H,t}$, the Home central bank's first order condition is[13]

$$\gamma E_t^{CB} p_t + \chi \left(l_{H,t} - l_{H,t}^* \right) = 0. \tag{9}$$

By substituting in Equations (1) and (5) into the first order condition of the optimal policy rule, we have,

$$p_{H,t}^{opt} = \frac{\chi}{\gamma^2 + \chi} \left(w_t - \theta_{H,t} + l_{H,t}^* \right) - \frac{\gamma (1 - \gamma)}{\gamma^2 + \chi} E_t^{CB} p_{F,t}. \tag{10}$$

In Appendix B I show how, with wage setters rationally expecting this monetary policy rule, the optimal rule equivalently can be written as

---

[13]The variance term entering central bank loss function is not a function of $p_{H,t}$, and therefore does not enter the minimization problem. The expression for the variance of the price level is

$$Var (p_t) = E_t^{CB} \left[p_t - E_t^{CB} (p_t) \right]^2$$
$$= (1 - \gamma)^2 E_t^{CB} \left[\phi_{MU} + (1 - \psi) \phi_{MR} \right]^2.$$

$$p_{H,t}^{opt} = -\frac{\gamma(1-\gamma) - \chi(1-\gamma)}{\gamma^2 + \chi(1-\gamma)} E_{t-1} p_{F,t} - \frac{\chi(1-\lambda)}{\gamma^2 + \chi} \theta_{H,t} + \frac{\chi l_{H,t}^*}{\gamma^2 + \chi(1-\gamma)}. \quad (11)$$

Therefore, as long as the central bank attaches some weight to employment stability ($\chi > 0$), and as long as wages are not fully flexible ($\lambda < 1$), it is optimal for the central bank to counteract the productivity shock. If $\chi > 0$, the central bank would counteract a negative productivity shock by increasing the price level, thereby deflating real wages and reducing the effect on employment from the negative productivity shock.

3.1.5 Individual preferences.

For each individual, the decision to join a monetary union is a trade-off between nominal and real uncertainty. A convenient way to state this is to assume that each individual's preferences can be described by a loss function:[14]

$$\Lambda_t^i = E_{t-1} \left[\left(\Omega_t - \hat{\Omega}_t \right)^2 + \mu \left(l_{H,t} - \hat{l}_{H,t} \right)^2 \right], \quad (12)$$

where Ω_t denotes the realized real wage in period t. The terms $\hat{\Omega}_t$ and $\hat{l}_{H,t}$ denote the individual's period t target values for the real wage and employment, respectively, and μ is a parameter measuring the relative weight each individual puts on employment stability. With rational individuals and assuming away bargaining between wage setters and firms or the central bank, the targeted values equal the expected values: $\hat{\Omega}_t = E_{t-1}\Omega_t$ and $\hat{l}_{H,t} = E_{t-1}l_{H,t}$.

3.1.6 Monetary policy after Home has entered the MU

If the Home economy enters the monetary union, then monetary policy for the Home economy is set by a union-wide central bank. The policy instrument of this common central bank (CCB) is assumed to be the union-wide price level of goods produced within the union, $\tilde{p}_{MU,t}$.

The loss function of the CCB is similar to the one of the Home central bank:

---

[14]The expectations operator enters the expression since the nominal wages are set before the realization of the shocks. Here, I do not allow for the possibility that the nominal wage setting, in particular the incentive to index to productivity (the λ parameter), could change with membership in the union. For a discussion on wage flexibility and membership in a monetary union, see Erlandsson (2002b).

$$\Lambda_t^{CCB} = E_t^{CCB} \left[\left(p_{MU,t}^{cpi} \right)^2 + \chi_{MU} \left(l_{MU,t} - l_{MU,t}^* \right)^2 \right]$$

where $l_{MU,t}$ is union-wide employment and where $p_{MU,t}^{cpi}$ is the union-wide consumer price index, defined as

$$p_{MU,t}^{cpi} = \gamma_{MU} \tilde{p}_{MU,t} + (1 - \gamma_{MU}) p_{F,t}^{MU}.$$

The derivation of the optimal policy, the price level of domestically produced goods, is straightforward and similar to the derivation of $p_{H,t}^{opt}$ above:

$$\tilde{p}_{MU,t}^{opt} = \frac{\chi_{MU}}{\gamma_{MU}^2 + \chi_{MU}} \left(w_t - \theta_{MU,t} + l_{MU,t}^* \right) - \frac{\gamma_{MU} \left(1 - \gamma_{MU} \right)}{\gamma_{MU}^2 + \chi_{MU}} E_t^{CCB} p_{F,t}^{MU}, \qquad (13)$$

where $\theta_{MU,t}$ is the union-wide productivity shock.

3.2 Comparative statics

The purpose of this model is to illustrate how changes in economic variables may affect the individual's choice to vote for or against entrance in the monetary union. This will be done here by comparing the individual's loss under monetary independence to the monetary union case. Furthermore, the aim is to show how an individual's decision to vote for or against membership in the EMU is affected by the country characteristics presented in Section 2 and represented here by the parameters γ, ψ and λ.

3.2.1 Individual loss under monetary independence

Let the real wage for period t be given by $\Omega_t = w_t - p_t$. Substituting in the expression for the nominal wage (6), the realized real wage becomes

$$\Omega_t = - \left(p_t - E_{t-1} p_t \right) + \lambda \theta_{H,t}. \qquad (14)$$

From Equation (1), the difference between actual and expected price level is given by

$$p_t - E_{t-1} p_t = \gamma \left(p_{H,t} - E_{t-1} p_{H,t} \right) + (1 - \gamma) \left(p_{F,t} - E_{t-1} p_{F,t} \right). \qquad (15)$$

From the expression for optimal monetary policy, Equation (10), the difference $(p_{H,t} - E_{t-1}p_{H,t})$ is

$$
\begin{aligned}
(p_{H,t} - E_{t-1}p_{H,t}) &= -\frac{\chi(1-\lambda)}{\gamma^2 + \chi}\theta_{H,t} \\
&= -\delta(1-\lambda)\theta_{H,t}.
\end{aligned}
\tag{16}
$$

Note that if $\chi = 0$, then $p_{H,t} = E_{t-1}p_{H,t}$ and individuals can perfectly predict monetary policy, since then the central bank does not allow the productivity shock to show up in the domestic price level.

For simplicity, we will assume that Home individuals know with certainty the realized values of the MU and the RW productivity shocks, which in turn implies that $\tilde{p}_{MU,t} = E_{t-1}\tilde{p}_{MU,t}$ and $\tilde{p}_{RW,t} = E_{t-1}\tilde{p}_{RW,t}$. The unexpected part in the price level on imported goods $(p_{F,t} - E_{t-1}p_{F,t})$ is then fully due to the nominal exchange rate shocks,

$$
(p_{F,t} - E_{t-1}p_{F,t}) = \phi_{MU,t} + (1-\psi)\phi_{MR,t}.
\tag{17}
$$

Substituting Equations (15), (16) and (17) into (14), we obtain the following expression for the prediction error in real wages:

$$
\Omega_t - E_{t-1}\Omega_t = [\gamma\delta(1-\lambda) + \lambda]\theta_{H,t} - (1-\gamma)\left(\phi_{MU,t} + (1-\psi)\phi_{MR,t}\right).
\tag{18}
$$

The first part of the first right-hand side term in Equation (18) arises as the central bank chooses to accommodate the productivity shock with the parameter δ (see Equation [16]). This affects the prices of a share γ of the overall consumption basket. The second part of the first term is present only if the nominal wages are indexed to productivity. Note that since $\gamma\delta < 1$, the larger the λ, the larger the real wage prediction error (for a given productivity shock). The second term comes from the fact that prices on imported goods (a fraction $[1-\gamma]$ of the overall consumption basket) are subject to shocks to the nominal exchange rates.

Taking expectations of the expression for employment, Equation (7), we find that the prediction error in employment can be written as $(l_{H,t} - E_{t-1}l_{H,t}) = (p_{H,t} - E_{t-1}p_{H,t}) + (1-\lambda)\theta_{H,t}$. Then, again using Equation (16) above, this can be written simply

$$
(l_{H,t} - E_{t-1}l_{H,t}) = (1-\lambda)(1-\delta)\theta_{H,t}.
\tag{19}
$$

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Therefore the uncertainty in employment is a function of the Home productivity shock, weighted by the rate of accommodation of the central bank, δ and the degree of wage flexibility in nominal wages, λ. By setting δ as close to 1 as possible (note from Equation [16] that δ can never be larger than 1) the central bank can choose to stabilize employment. Also, the larger the part of the wages indexed to productivity (larger λ), the smaller the prediction error in employment.

Substituting the Equations (18) and (19) into the individual's loss function (12), we have:[15]

$$\left(\Lambda_t^i\right)^{no-MU} = E_{t-1}\left[\left(\Omega_t - E_{t-1}\Omega_t\right)^2 + \mu\left(l_{H,t} - E_{t-1}l_{H,t}\right)^2\right]$$

$$= E_{t-1}\left\{\left[\gamma\delta\left(1-\lambda\right)+\lambda\right]\theta_{H,t} - \left(1-\gamma\right)\left(\phi_{MU,t}+\left(1-\psi\right)\phi_{MR,t}\right)\right\}^2 +$$
$$+\mu E_{t-1}\left\{\left(1-\lambda\right)\left(1-\delta\right)\theta_{H,t}\right\}^2$$

$$= \Psi_1^N Var\left(\theta_{H,t}\right) + \Psi_2^N Var\left(\phi_{MU,t}\right) + \Psi_3^N Var\left(\phi_{MR,t}\right)$$
$$+\Psi_4^N Cov\left(\phi_{MU,t},\phi_{MR,t}\right), \qquad (20)$$

where the parameters in (20) are defined as

$$\Psi_1^{MI} = \left(\gamma\delta\left(1-\lambda\right)+\lambda\right)^2 + \mu\left(1-\lambda\right)^2\left(1-\delta\right)^2,$$
$$\Psi_2^{MI} = \left(1-\gamma\right)^2,$$
$$\Psi_3^{MI} = \left(1-\gamma\right)^2\left(1-\psi\right)^2,$$
$$\Psi_4^{MI} = 2\left(1-\gamma\right)^2\left(1-\psi\right).$$

3.2.2 Individual loss in a monetary union

When the Home economy enters the monetary union, monetary policy is no longer conducted by the national monetary authority, but instead by a union-wide authority. The optimal policy of this common central bank was derived in Equation (13) where the union-wide productivity shock $\theta_{MU,t}$ is a weighted average of the country-specific productivity shocks of the individual member states. To be particular, after the Home economy has entered, the union-wide productivity shock can be written as $\left(n\theta_{H,t} + \left(1-n\right)\theta_{NH,t}\right)$ where n is the size of the Home country relative to all other countries in the monetary union, NH. The import price on goods produced

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[15]Assuming that the covariance between the productivity shock and exchange rate shocks is zero.

outside the monetary union is now defined as

$$p_{F,t}^{MU} = \tilde{p}_{RW,t} + s_{MR,t}$$
$$= \tilde{p}_{RW,t} + s_{MR,t-1} + \phi_{MR,t}.$$

Before deriving expressions for the uncertainty in real wages and employment once the Home economy is a member of the monetary union, we need to find an expression for the Home consumer price index within the monetary union. Starting from the original expression (1) and using the fact that now, with a common currency, $p_{H,t} = \tilde{p}_{MU,t}$, it is possible to derive the following expression for the Home consumer price index within the monetary union:

$$(p_t)^{MU} = (\gamma + (1-\gamma)\psi)\tilde{p}_{MU,t} + (1-\gamma)(1-\psi)\left(\tilde{p}_{RW,t} + s_{MR,t-1} + \phi_{MR,t}\right),$$

since $(1-\gamma)\psi$ is the share of all goods consumed in Home that is produced within the currency union. Thus, the expectational error in the consumer price index is given by

$$(p_t - E_{t-1}p_t)^{MU} = (\gamma + \psi(1-\gamma))(\tilde{p}_{MU,t} - E_{t-1}\tilde{p}_{MU,t}) +$$
$$+ (1-\gamma)(1-\psi)\phi_{MR,t},$$

assuming, as above, that $\tilde{p}_{RW,t} = E_{t-1}\tilde{p}_{RW,t}$. Note also that the simplifying assumption that the only shock to productivity unknown to Home individuals is the country specific part, $\theta_{H,t}$, implies that $\theta_{NH,t} - E_{t-1}\theta_{NH,t} = 0$. Therefore,

$$\tilde{p}_{MU,t} - E_{t-1}\tilde{p}_{MU,t} = -\frac{(1-\lambda)\chi_{MU}}{\gamma_{MU}^2 + \chi_{MU}}n\theta_{H,t}$$
$$= -\delta_{MU}n\theta_{H,t}.$$

Substituting in the derived expression for $(p_t - E_{t-1}p_t)$ into the real wage expression (14) gives

$$(\Omega_t - E_{t-1}\Omega_t)^{MU} = (\gamma + \psi(1-\gamma))\delta_{MU}n\theta_{H,t} + \lambda\theta_{H,t} - (1-\gamma)(1-\psi)\phi_{MR,t}.$$

Employment in the Home economy, once it is a member of the monetary union, is given by $(l_{H,t})^{MU} = -E_{t-1}p_t + p_{MU,t} + (1-\lambda)\theta_{H,t}$. The difference between realized

and expected employment when the Home economy is a member in the monetary union is therefore given as,

$$(l_{H,t} - E_{t-1}l_{H,t})^{MU} = (p_{MU,t} - E_{t-1}p_{MU,t}) + (1-\lambda)\,\theta_{H,t}$$
$$= [(1-\lambda) - \delta_{MU}n]\,\theta_{H,t}.$$

Substituting the derived expressions for $(\Omega_t - E_{t-1}\Omega_t)^{MU}$ and $(l_{H,t} - E_{t-1}l_{H,t})^{MU}$ into the individual loss function, it is now possible to derive the following expression for individual loss in a monetary union:

$$\left(\Lambda_t^i\right)^{MU} = E_{t-1}\left[\left((\Omega_t - E_{t-1}\Omega_t)^{MU}\right)^2 + \mu\left((l_{H,t} - E_{t-1}l_{H,t})^{MU}\right)^2\right]$$

$$= E_{t-1}\left\{(\gamma + \psi(1-\gamma))\,\delta_{MU}n\theta_{H,t} + \lambda\theta_{H,t} - (1-\gamma)(1-\psi)\,\phi_{MR,t}\right\}^2$$
$$+ \mu E_{t-1}\left\{((1-\lambda) - \delta_{MU}n)\,\theta_{H,t}\right\}^2$$

$$= \Psi_1^{MU}Var\left(\theta_{H,t}\right) + \Psi_2^{MU}Var\left(\phi_{MR,t}\right), \tag{21}$$

where the parameters in (21) are defined as

$$\Psi_1^{MU} = [((\gamma + \psi(1-\gamma))\,\delta_{MU}n) + \lambda]^2 + \mu\,[(1-\lambda) - \delta_{MU}n]^2\,,$$
$$\Psi_2^{MU} = (1-\gamma)^2\,(1-\psi)^2\,.$$

3.2.3   Comparing the two cases

Therefore, theoretically, when voting for or against membership in a monetary union, an individual compares the respective loss functions, and a condition for voting "yes" is that the loss from entering the union is smaller than the loss from staying monetary independent: $\Lambda^{MI} - \Lambda^{MU} > 0$. Using the expressions derived above, this condition for voting *for* entrance in the union becomes

$$0 < \left(\Lambda_t^i\right)^{MI} - \left(\Lambda_t^i\right)^{MU}$$

$$\Leftrightarrow$$

$$0 < \Psi_1 Var\left(\theta_{H,t}\right) + \Psi_2 Var\left(\phi_{MU,t}\right) + \Psi_3 Cov\left(\phi_{MU,t}, \phi_{MR,t}\right), \tag{22}$$

where $\Psi_1 = \Psi_1^{MI} - \Psi_1^{MU}$, $\Psi_2 = \Psi_2^{MI}$ and $\Psi_3 = \Psi_4^{MI}$. Note that the parameters in front of the term $Var\left(\phi_{MR,t}\right)$ are cancelled out. In the next part we will see how this

decision rule is affected by differences in the key parameters: share of domestically produced goods in total consumption (γ), nominal wage indexation (λ) and country size (n).

3.3   Calibration of the results.

In the empirical part ahead, we will estimate the reduced form of the entry condition as stated in Equation (22) to examine how the public opinions respond to developments in certain economic variables. The theoretical model derived above is a structural model, and by using the specific country characteristics presented in Section 2, we can employ this structural model to calibrate the parameters Ψ_i, which in Section 5 of the paper will be estimated empirically.

The values of the three parameters γ, ψ and n were presented and discussed in Section 2 and are displayed in the top half of Table 3.1. Below, in the same table, these values are used to calculate the expected values of the reduced form coefficients Ψ_2 and Ψ_3.

Table 3.1 Calibrations of Ψ_2 and Ψ_3.

Parameter	UK	Sweden
γ	0.76	0.68
ψ	0.48	0.50
n	0.18	0.03
Coefficient		
Ψ_2	0.057	0.102
Ψ_3	0.060	0.102

Since the UK is less dependent on imports, the expected effect of currency variability on the British opinion is less pronounced than on the Swedish opinion.

The exact values of the parameters λ and δ (determining the sign of Ψ_1) are not observable. There is a large body of literature on the degree of wage flexibility in different economies, and existing evidence shows that wages in the UK are more flexible than in Sweden. We therefore assume that $\lambda^{UK} > \lambda^{Swe}$. The absolute numbers of λ^{UK} and λ^{Swe} we do not know, and in the calibrations below I will show the value of Ψ_1 for different numbers on λ.

Neither can the absolute value on the parameter χ, determining the weight the central bank puts on employment stability, be stated with certainty. Remember that, from Equation (16), $\delta = \frac{\chi}{\gamma^2 + \chi}$. Since γ differs between Sweden and the UK,

an assumption that the CB puts equal weight on the real economy $\left(\chi^{UK} = \chi^{Swe}\right)$ would still give different values for the parameter δ, as shown in Table 3.2 below:

Table 3.2 The central bank parameter δ.

χ	0.1	0.5	1.0	2.0
δ^{UK} $(\gamma = 0.76)$	0.15	0.46	0.63	0.78
δ^{Swe} $(\gamma = 0.68)$	0.18	0.52	0.68	0.81

Using these, and assuming that $\mu = 1$,[16] Table 3.3 shows calibrations of the parameter Ψ_1 for possible combinations of central bank preferences (χ) and nominal wage flexibility (λ):

Table 3.3 The expected value of Ψ_1 for different combinations of χ and λ.

	The UK				Sweden			
λ	0	0.2	0.4	0.6	0	0.2	0.4	0.6
χ								
0.1	-0.202	-0.102	-0.032	0.009	-0.299	-0.242	-0.288	-0.439
0.5	-0.423	-0.183	-0.021	0.064	-0.614	-0.443	-0.402	-0.489
1.0	-0.419	-0.148	0.030	0.114	-0.644	-0.463	-0.412	-0.494
2.0	-0.351	-0.076	0.096	0.166	-0.612	-0.442	-0.401	-0.489

Thus, we can expect that the parameter Ψ_1 enters negatively in an estimation for Sweden, but possibly positively in the UK estimation. The other parameters (Ψ_2 and Ψ_3) are expected to enter with a positive sign with generally higher absolute values for Sweden than for the UK.

4   The data

4.1   The dependent variable

The Swedish opinion poll data I use in this study is collected by five different opinion institutes. As is obvious in Figure 4.1 below, the Swedish opinion has shown strong variability over the period of April 1998 to June 2002. In the figure, the respondents who answered *Don't know* are excluded, and each data point hence shows the share of all *Yes* and *No* respondents in favor of a Swedish membership.

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[16] See the empirical results in Section 5.

Figure 4.1 The Swedish EMU opinion from April 1998 to June 2002.
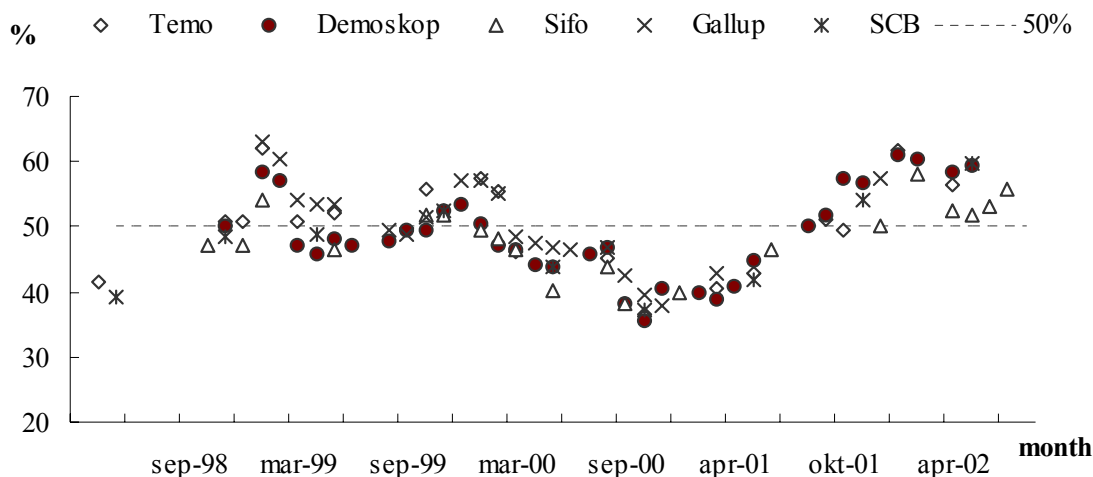
I have included only those polls where it is possible to find information on the exact time period for the interviews. The overall pattern is similar for the different institutes. In all, I have 37 usable observations from Demoskop. The corresponding numbers from TEMO, Gallup and SIFO are 18, 23 and 20 observations, respectively, while Statistics Sweden (SCB) has undertaken opinion polls twice every year.[17] All together, I have 107 observations for the Swedish opinion.

The question asked in the opinion polls was:[18]

In the EU a monetary union has been formed - the EMU - with a common currency, the Euro. If today there were a referendum on Swedish membership in the EMU, would you vote yes or no to Sweden entering into the EMU?

Generally, the method used in each poll was telephone interviews with a representative sample of about 1,000 Swedes aged 18-89. The collection period varied between two and fourteen days. The exception was Statistics Sweden, each time making about 7,000 interviews over three weeks.

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[17] The first observation I use from Statistics Sweden is from May 1998. In all, I have 9 observations from Statistics Sweden.

[18] There are some variants on this question. See Appendix E for a description.

The public opinion polls I use for the UK were collected by two opinion institutes, ICM and Mori. From January 1998 to July 2002, I have 71 opinion polls in my sample: 34 from MORI and 37 undertaken by ICM.

Figure 4.2 The British EMU opinion from April 1998 to June 2002.
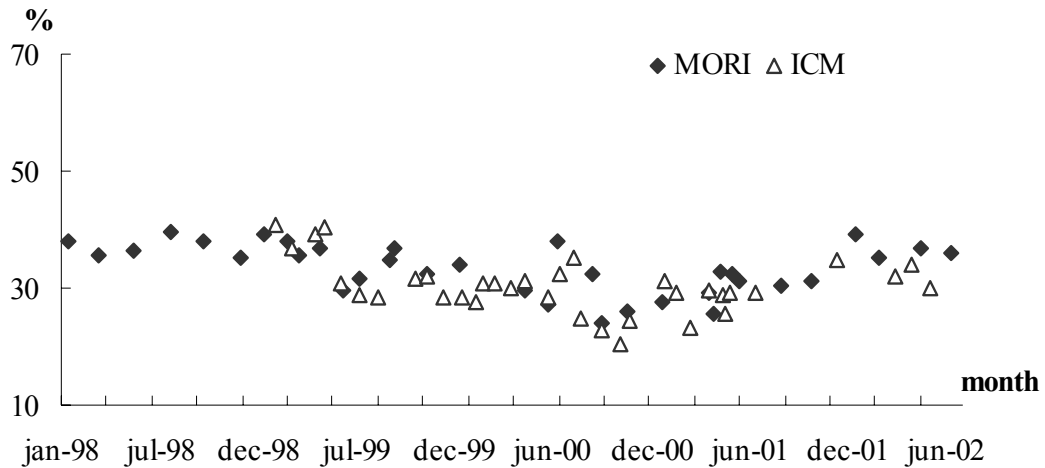
Figure 4.2 shows that over the sample period, there has been a strong and stable majority against British membership in the currency union. On no occation has the number of yes respondents exceeded the number of no respondents. In comparison with the Swedish data, the UK opinion data contains less variability and it is harder to distinguish a clear pattern in the opinion.

4.2   Explanatory variables

The main explanatory variables from the theoretical model were exchange rate covariance and variances, and the variance in productivity. To measure the currency uncertainty, I first calculate the variance of the first difference of the daily change of the log nominal exchange rates EUR/SEK and EUR/GBP, respectively. Since this is approximately a measure of the variance in the percentage change, the coefficients are comparable for Sweden and for the UK. The covariance terms are calculated similarly as the covariance of the first difference of the daily change of the log nominal exchange rates SEK/EUR and EUR/USD, and GBP/EUR and EUR/USD,

respectively.[19]

A measure of real uncertainty should corrrespond to the variance in the variable $\theta_{H,t}$ in Equation (10). Productivity measures are reported only on a quarterly basis, which would give me too few observations. Instead, I calculate the difference between the realized and expected[20] rate of unemployment, $v_t = u_t - E_{t-1}(u_t)$, and use the variance of this difference, $Var(v_t)$, as a measure of real uncertainty.[21] Unemployment rates are reported every month in both Sweden and the UK.

It is an empirical question of how long of a period back in time to base the variances on. For the UK, the number of months giving the best fit of the data is nine. The corresponding value for Sweden is 19 months. The fact that the horizon is longer in Sweden is intuitively correct, since the Swedish economy, as mentioned above is more rigid than the British.[22] For example, if the collection period were 14-20 January 2000, the variance of the nominal exchange rate for Sweden would have been calculated from daily observations 19 months back from January 13, and

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[19]Formally, for Sweden:

$$Cov\left(\Delta_t \ln\left\{\frac{SEK}{EUR}\right\}, \Delta_t \ln\left\{\frac{EUR}{USD}\right\}\right),$$

where $\Delta_t \ln\left\{\frac{SEK}{EUR}\right\} = \ln\left\{\frac{SEK_t}{EUR_t}\right\} - \ln\left\{\frac{SEK_{t-1}}{EUR_{t-1}}\right\}$. The time period t is one day. The corresponding calculation for the UK is identical.

[20]The expected rate of unemployment is calculated as

$$E(u_t) = \hat{\beta}_{0,t} + \hat{\beta}_{1,t}Trend + \sum_{i=1}^{12}\hat{\beta}_{i,t}u_{t-i},$$

where the parameters $\hat{\beta}_{i,t}$ are estimated using 48 months rolling regressions. See Appendix C for a discussion on a model consistent empirical measure of the variable $\theta_{H,t}$ in the theoretical model.

[21]An underlying assumption is that the productiviy variance follows a unit root process, so that the best prediction of tomorrow's variance is the variance of today. A Dickey-Fuller test on the productivity variance estimate for Sweden gives the following result (with t-statistics in parenthesis):

$$\Delta Var\left(\theta_t^{SWE}\right) = \underset{(1.06)}{0.0041} - \underset{(-2.18)}{0.06944}Var\left(\theta_{t-1}^{SWE}\right)$$

The 95% confidence interval critical value with 50 observations (I have 54) is -2.93, why we cannot reject the null of a unit root. A similar exercise for the UK yields the result:

$$\Delta Var\left(\theta_t^{UK}\right) = \underset{(1.37)}{0.0004} - \underset{(-1.90)}{0.1193}Var\left(\theta_{t-1}^{UK}\right)$$

[22]Groth and Johansson (2001) report that the average length of a wage contract in the UK is less than or equal to one year. The corresponding figure for Sweden lies between one and three years. See Appendix F for further sensitivity analysis.

the variance of productivity would have been based on monthly observations from June 1998 to December 1999.

The level of the nominal exchange rates did not come out as explanatory variables in the theoretical illustration above. Still, the levels of $\frac{SEK}{EUR}$, $\frac{GBP}{EUR}$ and $\frac{EUR}{USD}$ do affect real wages and hence the present and future consumption possibilities for an individual, which is why I test them as potential explanatory variables.

Entrance in the currency area implies that the nominal interest rates in Sweden and the UK will be more or less harmonized with the EMU interest rate. I therefore try the interest rate spread (defined as $i_t - i_t^*$, where i_t is the Swedish/British long-run nominal interest rate and i_t^* is the EMU counterpart) as an explanatory variable.[23] The expected effect is that a positive spread would increase the propensity to vote yes, since entrance in the EMU would force the domestic nominal interest rate to adjust to the EMU level.

Among the particular political and economic events that might affect the opinions, two events stand out as the most important. Firstly, the Danish referendum on September 28, 2000, when the Danes by a small margin decided not to join the EMU led to a big fall in the support for Swedish and also UK membership. From Figures 4.1 and 4.2 it is obvious that this effect was not temporary. By non-linearly estimating the decaying effect of the Danish referendum on the opinions in Sweden and in the UK,[24] this variable is defined in Sweden as $DK_{mj}^{Swe} = (0.806)^m$, where m is the number of months that had passed since the referendum in Denmark for each particular poll j. The corresponding non-linearly estimated decay effect in the UK is given by $DK_{mj}^{UK} = (0.539)^m$.

A similar effect is apparent for January 2002, when the Euro replaced national currencies in twelve countries. By estimating a similar non-linear function as for the DK variable, I find that the time dependent effect of the introduction of the introduction of Euro bills and coins is best matched by the decaying variable

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[23]The data I have used is the daily closing rate of a five year government bond issued in Sweden, the UK and the EMU, respectively. For the time period before the year 2001, I used the five year German government bond as a proxy for the EMU.

[24]The estimation of the effect of the Danish referendum is simply to non-linearly estimate the equation

$$YS_j = \beta_{j,k} F_{j,k} + \beta_{DK} (X)^m,$$

where YS_j is the share of all individuals responding yes in each poll j (undecided respondents excluded), $F_{j,k}$ is a vector of the k main explanatory variables (cf. Equation (26) ahead), X is the decay factor to be estimated and m is defined in the text. $m = 0$ corresponds to October 2000.

$Euro_{nj}^{Swe} = (0.676)^n$ and $Euro_{nj}^{UK} = (0.358)^n$ for Sweden and the UK, respectively, with n being the number of months that had passed since January 2002 for each particular poll j. ($n = 0$ corresponds to January 2002.)

The different opinion institutes may differ in the way they interpret the answers from the respondents. I therefore use dummy variables for each institute to prevent this from affecting the economic results.[25]

5   Empirical results

5.1   An empirical model

In the theoretical part above, it was shown that an increase in the currency uncertainty would increase the incentive for a voter to vote for membership in the monetary union, while the opposite is true for increased employment uncertainty. Based on this, a general formulation of an evaluation function determining how individuals value economic factors for and against EMU is

$$f\left(X_j\right) = b_0 + b_1 Var\left(\Delta s_j\right) + b_2 Cov\left(\Delta s_j, \Delta s_j^*\right) + b_3 Var\left(\upsilon_j\right) + b_4 Z_j, \qquad (23)$$

where $Var\left(\Delta s_j\right)$ is the variance of the daily change in the log nominal exchange rates SEK/EUR or GBP/EUR and $Cov\left(\Delta s_j, \Delta s_j^*\right)$ is the covariance between the daily change in the log nominal exchange rates SEK/EUR and EUR/USD or GBP/EUR and EUR/USD.[26] $Var\left(\upsilon_j\right)$ is the variance of the unpredicted part of unemployment, and Z_j is a vector of additional explanatory variables.

The question asked in the polls forces people to make a discrete, qualitative choice. A voter's preference, however, is not a discrete "yes" or "no;" but instead a continuous function of the economic outcomes. To solve this, each individual i's unobserved propensity in poll j to support membership in the EMU is indexed by YES_{ij}^* and is determined stochastically by

$$YES_{ij}^* = f\left(X_j\right) - \varepsilon_{ij}, \qquad (24)$$

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[25] These are not reported, but are available upon request.

[26] The theoretical model predicted that the term $Var\left(\frac{EUR}{USD}\right)$ would not affect the opinion. A potential test of the theoretical model would be to add a term $b_4 Var\left(\Delta s_j^*\right)$ in Equation (23) and test if the parameter $b_4 = 0$. Due to the close to perfect correlation between $Var\left(\frac{EUR}{USD}\right)$ and $Cov\left(\frac{SEK}{EUR}, \frac{EUR}{USD}\right)$, however, I choose to not include $Var\left(\frac{EUR}{USD}\right)$ in the estimations. See Appendix D for the correlations between the dependent currency variables.

where $f(X_j)$ is the evaluation function given by (23) and where ε_{ij} are random events (specific to each individual at each poll) decreasing the support for membership.

Since YES_{ij}^* is an unobserved variable, it cannot be used as a dependent variable. Instead, I introduce the observed binary variable YES_{ij}, where $YES_{ij} = 1$ if individual i responds "yes" in opinion poll j; otherwise $YES_{ij} = 0$. In the regressions it is assumed that the individuals react homogenously to the economic variables, $f(X_j)$. Introducing a threshold, τ, the variable YES_{ij} is defined as

$$YES_{ij} = \begin{cases} 1 \text{ if } YES_{ij}^* = f(X_j) - \varepsilon_{ij} \geq \tau \\ 0 \text{ if } YES_{ij}^* = f(X_j) - \varepsilon_{ij} < \tau \end{cases}. \tag{25}$$

It is assumed that the random events ε_{ij} are drawn from a uniform distribution,[27] evenly distributed between $a + \bar{\varepsilon}_j$ and $c + \bar{\varepsilon}_j$, where $a < 0$ and $c > 0$ are constants and where $\bar{\varepsilon}_j$ is the conditional mean of ε_{ij} at each opinion poll j. The cumulative distribution of the random events can therefore be written as

$$F(\varepsilon_{ij}) = \begin{cases} 0 & \text{for } \varepsilon_{ij} < a + \bar{\varepsilon}_j \\ \frac{\varepsilon_{ij} - (a + \bar{\varepsilon}_j)}{c - a} & \text{for } a + \bar{\varepsilon}_j \leq \varepsilon_{ij} \leq c + \bar{\varepsilon}_j \\ 1 & \text{for } \varepsilon_{ij} > c + \bar{\varepsilon}_j \end{cases}.$$

Using only the intermediate values for $F(\varepsilon_{ij})$ and Equation (25), we can write the linear vote probability function as

$$\begin{aligned} Prob(YES_{ij} = 1) &= Prob(\varepsilon_{ij} \leq f(X_j) - \tau) \\ &= F(f(X_j) - \tau) \\ &= \frac{-a + f(X_j) - \tau - \bar{\varepsilon}_j}{c - a}. \end{aligned}$$

Aggregating over the voters i to find $\frac{1}{N}\sum_{i=1}^{N} YES_{ij} = YES_j$ and using Equation (24), we obtain

$$YES_j = -\frac{a + \tau}{c - a} + \frac{f(X_j)}{c - a} - \frac{\bar{\varepsilon}_j}{c - a}.$$

Finally, writing the dependent variable as a percentage share, the model to estimate

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[27]Over the relevant range of outcomes for the dependent variable YES_{ij}^*, 30-55%, the uniform distribution is similar to for example the normal or logistic distributions. For a discussion, see Fair (1978) or Hibbs (2000).

is obtained:

$$YS_j = \beta_0 + \beta_1 Var\left(\Delta s_j\right) + \beta_2 Cov\left(\Delta s_j, \Delta s_j^*\right) + \beta_3 Var\left(v_j\right) + \beta_4 Z_j + \epsilon_j, \quad (26)$$

where $YS_j = 100 * YES_j$, $\beta_0 = 100 * \left[-\frac{a+\tau-b_0}{c-a}\right]$, $\beta_1 = 100 * \frac{b_1}{c-a}$, $\beta_2 = 100 * \frac{b_2}{c-a}$, $\beta_3 = 100 * \frac{b_3}{c-a}$, $\beta_4 = 100 * \frac{b_4}{c-a}$ and $\epsilon_j = -\frac{\bar{\varepsilon}_j}{c-a}$.

5.2 The Swedish opinion

I start by estimating Equation (26) using the share of yes respondents out of all voters responding yes or no, as the dependent variable. The voters responding "don't know" are disregarded.[28]

The results in Regression (1) in Table 5.1 give empirical support to the theoretical predictions derived in Section 3. Both the exchange rate variance, the covariance between the nominal exchange rates SEK/EUR and EUR/USD and the productivity variance, enter significantly with the expected signs.

Larger nominal uncertainty increases the support for Swedish membership in the EMU. Using Regression (1) and Table D.3 in Appendix, a one standard deviation increase in the variance of percentage change of the nominal exchange rate SEK/EUR would increase the support for Swedish membership by about $1.40 \times 3.288 = 4.6\%$. The corresponding decrease in the support from increased unemployment risk is $-1.171 \times 4.920 = -5.8\%$. Hence, the Swedish public opinion on this issue seems slightly more sensitive to real than to nominal uncertainty, indicating a value just above 1 for the weight parameter μ in the individual loss function (12).

The intuition of the exchange rate result is straightforward. Entrance in the EMU implies that Sweden would have the same currency as its main trading partners. The currency uncertainty would therefore be lower in the EMU. On the contrary, an EMU membership also implies less possibilities to insulate productivity shocks from increasing the employment uncertainty. In periods with high productivity variance, therefore, the demand for monetary independence is higher, lowering the propensity

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[28]In the polls, the voters have the choice to answer "don't know." In the upcoming referenda, there will be only two alternatives, yes and no, but the number of non-participating voters might still affect the outcome of the referendum. An estimation of Equation (26) with the share of undecided voters in Sweden as the dependent variable, shows that there is a significant negative trend. The point estimate (t-value) is -0.0047 (-2.34), indicating that for each year about 0.5 percent fewer Swedes answer "don't know." None of the other explanatory variables turn out to be significant. For the UK, none of the explanatory variables significantly affect the share of undecided voters. The result of this regression is available upon request.

to vote for an entrance in the Euro area.

Table 5.1. Dependent variable: Yes share as part of the yes
and no votes. Time period: January 1998 - June 2002.

	Regression			
Variable	(1)	(2)	(3)	(4)
SEK/EUR variance	1.400	1.130	1.053	0.961
	(10.7)	(8.20)	(7.70)	(5.58)
Covariance$\left(\frac{SEK}{EUR}, \frac{EUR}{USD}\right)$	1.438	0.989	0.354	0.293
	(5.68)	(4.01)	(1.11)	(0.87)
100*Productivity variance	-1.171	-0.902	-0.888	-0.920
	(-8.65)	(-6.45)	(-5.24)	(-5.31)
Danish referendum		-4.86	-4.99	-4.52
		(-3.06)	(-3.25)	(-2.78)
Euro introduction		8.42	10.3	10.4
		(3.88)	(4.36)	(4.38)
log(SEK/EUR)			25.4	24.8
			(3.01)	(2.92)
log(EUR/USD)			-11.7	-14.8
			(-1.44)	(-1.67)
Interest rate spread (%)				1.60
				(0.88)
Constant	48.8	46.8	-12.9	-10.7
	(11.0)	(10.7)	(-0.64)	(-0.52)
$\bar{R}^2$	0.715	0.769	0.789	0.789
Number of observations	107	107	107	107

Note: t-statistics for the parameter estimates in parentheses.

In Regressions (2) to (4) other potential explanatory variables are added to
the baseline regression. The level of the exchange rate may affect the individual's
consumption possibilities. Regression (3) indicates that a 10% depreciation of the
Swedish Krona against the Euro increases the support for Swedish membership in the
EMU by about 2.5%. After a potential entrance in the union, the most important
exchange rate is between the Euro and the US Dollar. The result in Regression
(3), however, shows that the value of the Euro against the US Dollar does not
significantly affect Swedish support for membership. As seen in Regression (4), the
nominal interest rate spread does not affect public opinion.

To summarize: The theoretical predictions derived in Section 3 are supported us-
ing Swedish poll data. The main predictions, that increased nominal uncertainty in-

creases the support for membership and that larger real uncertainty lowers support, also pass an empirical test. The inclusion of other potential explanatory variables does not alter these results.

5.3 The British opinion

In the calibrations of the structural model in Section 3.3 we found that, based on the facts that the UK is a country less dependent on foreign trade with more flexible labor markets, we would expect the reduced form parameters in an empirical model to be less pronounced in the UK than in Sweden.

Table 5.2. Dependent variable: Yes share as part of the yes and no votes. Time period: January 1998 - July 2002

Variable	Regression			
	(1)	(2)	(3)	(4)
GBP/EUR variance	0.046	0.160	-0.042	0.172
	(0.26)	(1.00)	(-0.21)	(0.71)
Covariance $\left(\frac{GBP}{EUR}, \frac{EUR}{USD}\right)$	0.493	0.522	0.308	0.527
	(3.31)	(3.88)	(1.48)	(2.08)
100*Productivity variance	1.47	1.743	4.220	1.706
	(0.45)	(0.59)	(1.33)	(0.48)
Danish referendum		-7.33	-6.19	-7.33
		(-2.90)	(-2.43)	(-2.78)
Euro introduction		6.02	6.78	6.06
		(2.91)	(2.79)	(2.47)
log(GBP/Euro)			44.0	19.3
			(2.03)	(0.71)
log(Euro/USD)			10.5	-4.31
			(1.01)	(-0.30)
Interest rate spread				-2.56
				(-1.47)
Constant	40.9	38.5	58.0	50.0
	(24.9)	(23.8)	(5.77)	(4.42)
$\bar{R}^2$	0.510	0.600	0.614	0.622
Number of observations	71	71	71	71

Note: t-statistics for the parameter estimates in parentheses

This expectation is to some extent met. Increased volatility in the GBP/EUR nominal exchange rate does not significantly affect the support for EMU membership in the UK. A similar result is found for the productivity variance, which in none of

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the regressions below turn out to be significant. The only theoretically predicted variable that significantly moves the British opinion is the covariance between the GBP/EUR and EUR/USD nominal exchange rates. From the descriptive statistics in Appendix D this covariance is negative in all nine months subsamples, implying that the Brits expect that if their currency would appreciate against the Euro, then the Euro would depreciate against the USD at the same time. The lower this (negative) covariance, the fewer the number of Brits who support membership in the Euro area.

The effect of the Danish decision in September 2000 to stay monetary independent is as apparent in the UK as in Sweden. The same is true for the upward shift in opinion following the introduction of the Euro in January 2002, with both effects signficant also for the British opinion.

As above, an appreciation of the domestic currency against the Euro significantly decreases British support for entrance in the EMU. Neither the nominal exchange rate EUR/USD, nor the interest rate spread seems to affect the British opinion.

5.4 The opinion pattern in different Swedish income groups

Thus far I have assumed that all individuals have identical preferences. In particular, the parameter μ in Equation (12) does not vary between individuals. In reality, however, the support in Sweden for joining the third stage of the EMU differs in most demographic dimensions. Generally, men are more positive to membership than women, high income groups are more positive than low income groups, and so on. There is also a geographic aspect where people living in larger cities are more pro-EMU than people in the countryside.

An analysis of how different demographic groups may react differently to nominal and real uncertainty would optimally be based on individual data, which is not available. For some of the Demoskop polls on the Swedish opinion, however, I have gathered more detailed information. In 26 of the Demoskop polls the sample has been divided into three income categories: high, medium and low. In Table 6.1 below, I have estimated Equation (26) for the different income groups separately. The three regressions for different income groups confirm the stylized fact that high income earners generally are more in favor of a Swedish membership in the EMU than low income earners are.

Table 6.1 Dependent variable: Yes-share as part of the yes and no votes
by income class.Time period: February 1999 - September 2001.

	Regression		
Variable	*High*	*Medium*	*Low*
Exchange rate variance	0.889	1.945	1.487
	(1.38)	(4.52)	(4.09)
Covariance	1.748	0.599	1.645
	(1.64)	(0.83)	(2.69)
100*Productivity variance	-0.239	-1.804	-2.123
	(-0.40)	(-4.63)	(-6.45)
Constant	78.8	40.7	46.3
	(4.22)	(3.20)	(4.31)
$\bar{R}^2$	0.45	0.69	0.78
Number of observations	26	26	26

Note: t-statistics for the parameter estimates in parentheses.

By simply comparing coefficients, it seems that the richer you are, the less sensitive you are to real uncertainty. This is an expected result since the high income group generally has more wealth than low income earners, and thereby rely less heavily on labor income and are less exposed to real uncertainty. One would have expected an opposite pattern for the nominal uncertainty, but that result is not found in the data.

In the Table 6.2 below, I test the joint hypothesis that the high and low income groups react homogenously to "new" information; that is, I test the hypotheses that the parameters $\beta_i^{high} = \beta_i^{low}$, where i represents the different variables in the regression above.

Table 6.2 Test of significance that the parameters for high and low
income groups are identical

Parameter	Significance level
SEK/EUR variance	0.318
Covariance	0.574
Productivity variance	0.003

Hence, the high income group is significantly less sensitive to real uncertainty than the low income group.

6   Conclusions

In Sweden and in the UK, entrance in the EMU currency union will be decided in referenda. The polls preceding the Swedish referendum show substantial variability in the public opinion. In this paper I have derived a theoretical model to show how economic variables, in particular currency uncertainty and employment uncertainty, affect individuals' attitudes to a membership in the EMU.

Using opinion poll data, the empirical evidence for Sweden strongly support the results in the theoretical model. Larger currency uncertainty increases the support for Swedish membership. The opposite is true for labor market uncertainty, where increased variability leads the opinion to be more skeptical to membership. The opinion pattern in Sweden differs among different income groups, with low income earners being more sensitive to the employment uncertainty.

The empirical results for the UK are, as expected, considerably weaker than for Sweden. This is in line with the theoretical model, which predicted that the less exposed a country is to foreign trade, the less decisive the currency variability is for the decision to enter a monetary union. Similarly, the more flexible the wage setting, the less decisive the real uncertainty.

REFERENCES

Calmfors, Lars and Åsa Johansson (2002), "Nominal Wage Flexibility, Wage Indexation and Monetary Union," IIES Seminar Paper, No. 716

Erlandsson, Mattias (2002a), "Economic Determinants of Public Opinion About Joining the EMU: The Case of Sweden," Working Paper, Göteborg University.

Erlandsson, Mattias (2002b), "Nominal Wage Flexibility in a Monetary Union," Working Paper, Göteborg University.

Fair, Ray C. (1978), "The Effect of Economic Events on Votes for President," *The Review of Economics and Statistics*, 60: 159-173.

Feldstein, Martin (1997), "The Political Economy of the European Economic and Monetary Union: Political Sources of an Economic Liability," *Journal of Economic Perspectives*, 11: 23-42.

Gabel, Matthew (1999), "Divided Opinion, Common Currency: The Political Economy of Public Support for EMU." Working Paper, Department of Political Science, University of Kentucky.

Gärtner, Manfred (1997), "Who wants the euro - and why? Economic explanations of public attitudes towards a single European currency," *Public Choice* 93: 487-510.

Groth, Charlotta and Åsa Johansson (2001), "Bargaining Structure and Nominal Wage Flexibility," IIES Seminar Paper No. 709.

Hibbs, Douglas A. (2000), "Bread and Peace voting in U.S. presidential elections," *Public Choice*, 104: 149-180.

Kaltenthaler, Karl C. and Christopher J. Anderson (2001), "Europeans and their money: Explaining public support for the common European currency," *European Journal of Political Research*, 40: 139-170.

Mundell, Robert A. (1961), "A Theory of Optimal Currency Areas," *American Economic Review*, 50: 657-665.

McKinnon, Ronald (1963), "Optimal Currency Areas," *American Economic Review*, 53: 717-725.

Smith, Jennifer C. (2000), "Nominal Wage Rigidity in the United Kingdom," *The Economic Journal* 110: 176-195.

Wyplosz, Charles (1997), "EMU: Why and How It Might Happen," *Journal of Economic Perspectives*, 11: 3-22.

A   List of variables and parameters

p	Overall consumer price level in Home.
p_H	Home consumer price of Home produced goods.
p_F	Home consumer price of goods produced in MU or RW.
γ	Share of Home produced goods in total domestic consumption.
p_{MU}	Home currency price of imports from the MU.
p_{RW}	Home currency price of imports from the RW.
ψ	Share of all Home imports produced in the MU.
$\tilde{p}_{MU}$	MU currency price of goods produced in the MU.
$\tilde{p}_{RW}$	RW currency price of goods produced in the RW.
s_{MU}	The (log) nominal exchange rate between Home and the MU.
s_{RW}	The (log) nominal exchange rate between Home and the RW.
s_{MR}	The (log) nominal exchange rate between the MU and the RW.
ϕ_{MU}	Zero-mean shock to nominal exchange rate s_{MU}.
ϕ_{MR}	Zero-mean shock to nominal exchange rate s_{MR}.
l_H	Total employment in the Home economy.
w	Nominal wage in the Home economy.
θ_H	Zero-mean productivity shock in Home.
λ	Share of Home nominal wages indexed to productivity.
Λ^{CB}	Loss function of the Home central bank.
χ	A measure of the relative weight the central bank put on employment stability.
l_H^*	The Home central bank's employment target.
Λ^i	Loss function of individual i.
Ω	Real wage in the Home economy.
$\hat{\Omega}$	Wage setters' real wage target.
$\hat{l}_H$	Wage setters' employment target.
μ	A measure of the relative weight wage setters' put on employment stability.
Λ^{CCB}	Loss function of the common central bank.
p_{MU}^{cpi}	Overall consumer price level in the MU.
l_{MU}	Total employment in the MU.
γ_{MU}	Share of MU produced goods in total MU consumption.
l_{MU}^*	The MU central bank's employment target.
δ	Central bank parameter, defined as $\frac{\chi}{\gamma^2 + \chi}$

B   Monetary policy

Minimizing (8) with respect to $p_{H,t}$, the Home central bank's first order condition is

$$\frac{\partial \Lambda^{CB}}{\partial p_{H,t}} = E_t^{CB} \left[2 \frac{\partial p_t}{\partial p_{H,t}} p_t + 2\chi \frac{\partial l_{H,t}}{\partial p_{H,t}} \left(l_{H,t} - l_{H,t}^* \right) \right] = 0. \qquad \text{(B.1)}$$

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Therefore, substituting in $\frac{\partial p_t}{\partial p_{H,t}} = \gamma$ and $\frac{\partial l_{H,t}}{\partial p_{H,t}} = 1$ we can rewrite the first order condition (B.1) as

$$\gamma E_t^{CB} p_t + \chi \left(l_{H,t} - l_{H,t}^* \right) = 0.$$

Substituting in the expressions for $E_t^{CB} p_t$ and $l_{H,t}$, we get

$$
\begin{aligned}
0 =& \gamma \left[\gamma p_{H,t} + (1-\gamma) E_t^{CB} p_{F,t} \right] - \chi l_{H,t}^* + \chi l_{H,t} \\
=& \gamma \left[\gamma p_{H,t} + (1-\gamma) E_t^{CB} p_{F,t} \right] - \chi l_{H,t}^* + \\
& + \chi \left\{ p_{H,t} - \gamma E_{t-1} p_{H,t} - (1-\gamma) E_{t-1} p_{F,t} + (1-\lambda) \theta_{H,t} \right\}.
\end{aligned}
$$

Collecting terms,

$$
\begin{aligned}
\left[\gamma^2 + \chi \right] p_{H,t} =& \left[\chi (1-\gamma) - \gamma (1-\gamma) \right] E_{t-1} p_{F,t} + \\
& + \chi \gamma E_{t-1} p_{H,t} + \chi l_t^* - \chi (1-\lambda) \theta_{H,t}.
\end{aligned}
$$

where $E_{t-1} p_{H,t}$ is the wage setters expectations of the policy rule $p_{H,t}$. Therefore, the optimal rule to follow for the Home central bank is to set

$$
\begin{aligned}
p_{H,t} =& \frac{\chi (1-\gamma) - \gamma (1-\gamma)}{\gamma^2 + \chi} E_{t-1} p_{F,t} + \frac{\chi \gamma}{\gamma^2 + \chi} E_{t-1} p_{H,t} \\
& - \frac{\chi (1-\lambda)}{\gamma^2 + \chi} \theta_{H,t} + \frac{\chi l_{H,t}^*}{\gamma^2 + \chi}.
\end{aligned}
$$

Taking expectations and solving this for the term $E_{t-1} p_{H,t}$ gives:

$$E_{t-1} p_{H,t} = (1-\gamma) \frac{\chi - \gamma}{\gamma^2 + \chi (1-\gamma)} E_{t-1} p_{F,t} + \frac{\chi l_{H,t}^*}{\gamma^2 + \chi (1-\gamma)}.$$

Substituting this back into the expression for optimal policy one obtains Equation (11) in the main text.

C A model consistent measure of $Var \left(\theta_{H,t} \right)$

In order to find a model consistent measure of the variance of the productivity shock, start by taking the variance of the employment equation, (7). Since $E_{t-1} p_t$ is already

formed in period t, $Var\left(E_{t-1}p_t\right) = 0$, why we have:[29]

$$Var\left(l_{H,t}\right) = Var\left(p_{H,t}\right) + \left(1-\lambda\right)^2 Var\left(\theta_{H,t}\right) + \left(1-\lambda\right)Cov\left(p_{H,t},\theta_{H,t}\right)$$
$$= \left\{\delta^2\left(1-\lambda\right)^2 + \left(1-\lambda\right)^2 - \delta\left(1-\lambda\right)^2\right\}Var\left(\theta_{H,t}\right)$$
$$= \left(1-\lambda\right)^2\left\{1-\delta+\delta^2\right\}Var\left(\theta_{H,t}\right). \tag{C.1}$$

In Equation (7), $E_{t-1}\left(l_{H,t}\right) = 0$ (since the $t-1$ expected value of the right hand side equals 0). We have no figures on labor demand in an economy. However, note that if U_t is the total number of unemployed in period t and if L_t^s and L_t^d represent total labor supply and demand respectively, then

$$L_t^d = L_t^s - U_t.$$

Let $l_{H,t} = \log X_t$, then $E_{t-1}\left(X_t\right) = 1$. Then define $X_t = \frac{L_t^d}{L_t^s}$, why it must be the cast that $E_{t-1}\left(\frac{L_t^d}{L_t^s}\right) = 1$ and $E_{t-1}\left(U_t\right) = 0$. Finally, to find a measure of $Var\left(l_{H,t}\right)$ stated in terms of the rate of unemployment, u_t:

$$Var\left(l_{H,t}\right) = Var\left(\log\left(\frac{L_t^d}{L_t^s}\right)\right)$$
$$= Var\left(\log\left(1-\frac{U_t}{L_t^s}\right)\right)$$
$$= Var\left(\log\left(1-u_t\right)\right), \tag{C.2}$$

where u_t is the unemployment rate. Now, let $\alpha_t = \log\left(1-u_t\right) - E_{t-1}\left(\log\left(1-u_t\right)\right)$ be a random normally distributed variable with zero mean and variance $Var\left(\alpha_t\right)$.

---

[29] From the optimal policy equation, (10), the variance of $p_{H,t}$ must equal

$$Var\left(p_{H,t}\right) = E\left[p_{H,t} - E\left(p_{H,t}\right)\right]^2$$
$$= E\left[-\delta\left(1-\lambda\right)\theta_{H,t}\right]^2$$
$$= \left(\delta\left(1-\lambda\right)\right)^2 Var\left(\theta_{H,t}\right).$$

Similarly,

$$Cov\left(p_{H,t},\theta_{H,t}\right) = E\left[\left(p_{H,t} - E\left(p_{H,t}\right)\right)\left(\theta_{H,t} - E\left(\theta_{H,t}\right)\right)\right]$$
$$= E\left[\left(-\delta\left(1-\lambda\right)\theta_{H,t}\right)\left(\theta_{H,t}\right)\right]$$
$$= -\delta\left(1-\lambda\right)Var\left(\theta_{H,t}\right)$$

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Then we must have that

$$Var\left(\alpha_t\right) = E_{t-1}\left[\log\left(1-u_t\right) - E_{t-1}\left(\log\left(1-u_t\right)\right) - E_{t-1}\left(\alpha_t\right)\right]^2$$
$$= E_{t-1}\left[\log\left(1-u_t\right) - E_{t-1}\left(\log\left(1-u_t\right)\right)\right]^2$$
$$= Var\left(\log\left(1-u_t\right)\right).$$

Combining Equations (C.1) and (C.2), therefore, the truly model consistent mapping of the variable $Var\left(\theta_{H,t}\right)$ is

$$Var\left(\theta_{H,t}\right) = \frac{1}{\left(1 - \delta + \delta_2^2\right)\left(1-\lambda\right)^2}Var\left(\alpha_t\right).$$

In the estimations, I have used the intuitively simpler approach $Var\left(\upsilon_t\right)$ where $\upsilon_t = u_t - E_{t-1}\left(u_t\right)$. The figure below shows that the patterns of $Var\left(\upsilon_t\right)$ and $Var\left(\alpha_t\right)$ are similar and differ primarily in the scaling of the variables.
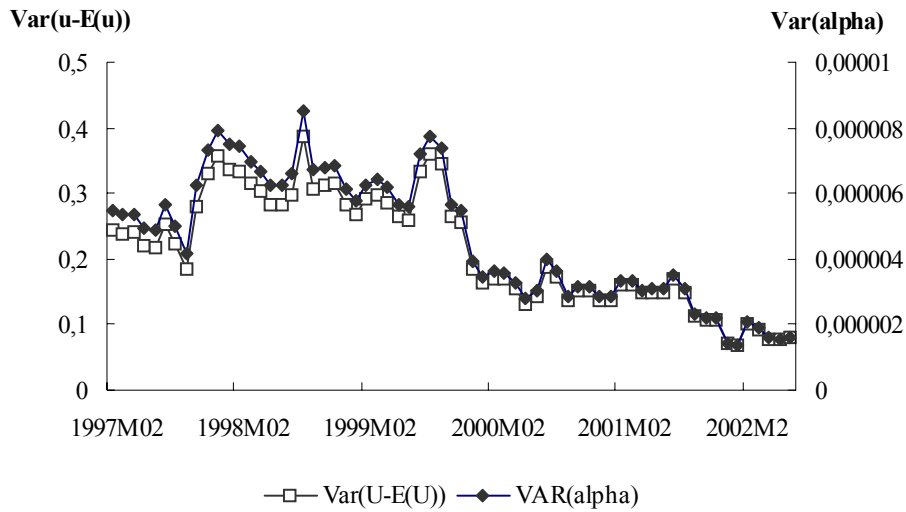
D   Descriptive statistics

The correlations between the UK nominal exchange rates:

Table D.1 Correlation matrix for the UK. January 1998 - June 2002

	$Var\left(\frac{GBP}{EUR}\right)$	$Var\left(\frac{EUR}{USD}\right)$	$Cov\left(\frac{GBP}{EUR},\frac{EUR}{USD}\right)$
$Var\left(\frac{GBP}{EUR}\right)$	1.00	0.852	-0.866
$Var\left(\frac{EUR}{USD}\right)$		1.00	-0.978
$Cov\left(\frac{GBP}{EUR},\frac{EUR}{USD}\right)$			1.00

The corresponding matrix for Sweden:

Table D.2 Correlation matrix for Sweden. January 1998 - June 2002

	$Var\left(\frac{SEK}{EUR}\right)$	$Var\left(\frac{EUR}{USD}\right)$	$Cov\left(\frac{SEK}{EUR},\frac{EUR}{USD}\right)$
$Var\left(\frac{SEK}{EUR}\right)$	1.00	-0.152	0.133
$Var\left(\frac{EUR}{USD}\right)$		1.00	-0.808
$Cov\left(\frac{SEK}{EUR},\frac{EUR}{USD}\right)$			1.00

Table D.3 Some descriptive statistics for Sweden.

Variable	Obs	Mean	Std Dev	Min	Max
SEK/EURO variance	1202	16.696	3.288	11.30	21.07
covariance $\left(\frac{SEK}{EUR},\frac{EUR}{USD}\right)$	1202	-8.220	2.458	-12.50	-3.04
productivity variance	1195	11.071	4.920	3.458	22.79
yes	107	39.891	6.1216	27.80	53.00
no	107	41.165	6.251	28.00	56.00
undecided	107	18.786	5.993	10.00	30.00
log(SEK/EUR)	1199	2.185	0.041	2.088	2.297
log(EUR/USD)	1199	0.015	0.102	-0.203	0.191
unemployment	1192	5.073	1.131	3.378	7.965
interest rate spread	1200	0.436	0.282	-0.20	1.05

Table D.4 Some descriptive statistics for the UK.

Variable	Obs	Mean	Std. Dev.	Min	Max
GBP/EURO variance	1202	25.72	7.369	14.019	43.007
covariance $\left(\frac{GBP}{EUR}, \frac{EUR}{USD}\right)$	1202	-21.37	7.417	-36.126	-7.035
productivity variance	1195	0.357	0.207	0.099	0.866
yes	71	27.44	3.779	18.00	36.00
no	71	58.38	5.365	49.00	71.00
undecided	71	14.03	2.863	6.00	20.00
log(SEK/EUR)	1199	-0.448	0.0476	-0.558	-0.330
log(EUR/USD)	1199	0.015	0.102	-0.203	0.191
unemployment	1192	5.66	0.4956	4.90	6.40
interest rate spread	1199	1.006	0.444	0.30	1.92

E Question asked

Demoskop, Sifo, Gallup and SCB all used the question cited in the text. The only exception is Temo, which up until February 2000 used the question:

Sweden is one of the countries that are members of the EU, but not in the European Monetary Union, EMU. Do you think it would be good or bad for Sweden to be in EMU.

After February 2000, Temo used the same question as the other institutes.

F Sensitivity analysis

For Sweden, I have chosen to base the variances on 19 months back in time. That is the number of months giving the highest explanatory power of the model. For lengths between 6 and 24 months, however, all main explanatory variables enters significantly with the expected signs. Figure F.1 shows the explanatory power of the model, calculating the variances on different number of months back in time:

Figure F.1 Explanatory power, using different lengths forthe variance terms.
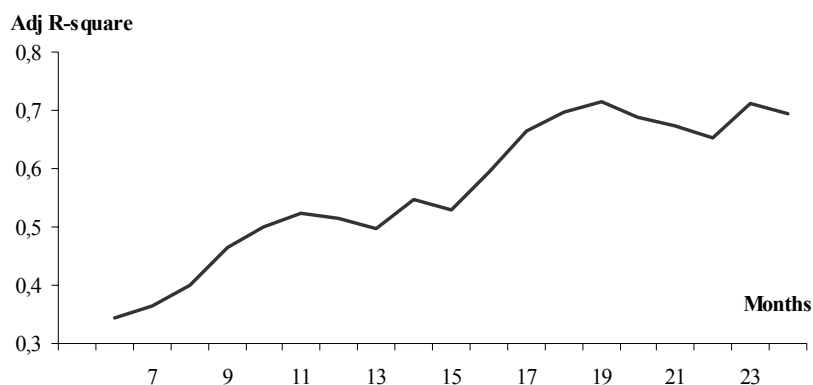
The results are less stable for the UK. The explanatory power of the model peaks at nine months and then it falls considerably. For all number of months 6 to 15 months the main explanatory variables are consistent, with the covariance term entering significantly positively and the other two terms without significance. For the remaining months we have:

Table F.1. Sensitivity analysis. The UK

	Number of months								
Variable	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)
Ex. var.	-0.33	-0.20	-0.03	-0.19	-0.43	-0.07	0.41	0.43	-0.08
	(-1.17)	(-0.66)	(-0.08)	(-0.5)	(-1.08)	(-0.15)	(0.84)	(0.86)	(-0.15)
Cov.	0.27	0.32	0.40	0.32	0.19	0.36	0.58	0.57	0.29
	(1.53)	(1.68)	(1.91)	(1.45)	(0.85)	(1.46)	(2.17)	(2.07)	(0.95)
U.var.	13.6	10.9	7.66	13.6	23.7	17.7	9.46	9.51	26.7
	(2.16)	(1.57)	(1.03)	(1.70)	(2.58)	(1.79)	(0.84)	(0.79)	(1.87)
Const.	40.9	39.7	37.8	38.0	38.2	34.3	29.6	28.6	29.5
	(2.55)	(14.0)	(12.0)	(10.7)	(10.5)	(8.39)	(7.00)	(6.51)	(6.55)
$\bar{R}^2$	0.38	0.35	0.31	0.31	0.34	0.32	0.30	0.28	0.32

Note: *t*-statistics for the parameter estimates in parentheses

Thus, the model is not stable for 16 to 24 months. On the other hand, the explanatory power of the above regressions are lower than for the models in the "stable region". I therefore conclude that the best I can do is to use the model specification already used.

Nominal Wage Flexibility in a Monetary Union.

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Abstract

Membership in a monetary union reduces the possibilities of counteracting fluctuations in productivity by monetary policy. One condition for entrance not to lead to adverse unemployment performance is that wages are flexible with respect to productivity. In this paper I show that, depending on workers' risk aversion, the incentive for workers to choose more flexible nominal wages may increase after entering a monetary union. The reason is that the abolishment of exchange rates and the common monetary policy increases wage setters utility maximizing preset nominal wages. Assuming that individuals' preferences do not change, the institutional change in monetary policy may induce wage setters to increase wage flexibility.

Keywords: New open-economy macroeconomics; Nominal wage flexibility; Optimal wage setting; Monetary unification

JEL code: F41, J30

1 Introduction

Membership in a monetary union affects many aspects of the entering economies. One of the most frequently discussed topics is the employment consequences of an entrance. During recent years many papers have been written with the objective of capturing the effect that the creation of a monetary union has on average wage pressure in the economies involved, and hence on the equilibrium level of unemployment.[1] Given that labor mobility cannot compensate for the loss of stabilization tools inherent in joining a currency union, the presence of possibly asymmetric productivity shocks calls for yet another condition: that wage setting becomes more flexible. The purpose of this paper is to examine the hypothesis that the gain for workers from a more flexible wage setting, where the nominal wage is connected to productivity, is actually higher within a monetary union than outside. That is, we want to study how wage formation should adjust, given the institutional settings and limitations governing monetary policy.[2] The degree of stickiness in nominal wages is therefore endogenous to monetary policy and, in particular, to the exchange rate regime.

The underlying idea comes from the observation that entrance in a monetary union implies a shift in the sharing of risks connected to wage setting between workers and firms. The common currency reduces the real wage risk that has to be carried by workers. On the other hand, entrance in a currency union may increase the risks connected to fluctuations in productivity; after all, with a national currency and a national central bank, it is possible to use monetary policy to counteract country-specific productivity shocks. Whether this increased productivity risk has to be carried by workers or firms depends on how the labor contracts are written. The most relevant case is when nominal wages are determined in long-term contracts, while employment is unilaterally determined by the firms after the realizations of the productivity shocks. The productivity risk is then carried by the workers, since firms can adjust their labor demand after the shocks have realized. It is this case that will be analyzed here in a stochastic general equilibrium model.[3]

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[1] See for example Iversen and Soskice (1998) and Cukierman and Lippi (2000).

[2] Hence, the interaction between wage setters and the central bank does not have the nature of an "inflation game" and the intention is not to, given the institutional feature of the wage setting system, find any optimal degree of conservatism of the central bank, that has been the case in most earlier studies. See for example Cukierman and Lippi (2000).

[3] If long-term contracts determine both nominal wages and employment, then the productivity

By analyzing wage formation in a stochastic general equilibrium framework, this paper aims at combining two lines in the literature. The modeling framework, a utility based open economy model with nominal rigidities entering through wages, builds on earlier contributions by, for example, Obstfeld and Rogoff (2000, 2002), Corsetti and Pesenti (2001) and Sutherland (2001). One advantage of using this framework is that the model is possible to solve analytically and, hence, we can explicitly study the welfare consequences of different ways of setting nominal wages. Also, the model incorporates individuals' attitudes towards risks. This implies that when choosing the optimal nominal wage, the individuals will possibly not set the wage to its certainty-equivalent value, but instead consider the risks involved.

The second line of research connected to this paper studies the interaction between monetary regime and wage setting. Recent contributions in the broadening area are surveyed in Calmfors (2001a). Earlier work modeling wage formation as endogenous to monetary policy includes Holden (2001), who uses the idea when he analyzes how the optimal degree of co-ordination among wage setters may change depending on the degree of conservatism of the central bank. In the context of a monetary union, Siebert and Sutherland (1999) study the changed incentives among policy makers to undertake labor market reform before and after a country has joined a monetary union. They find that the more uncorrelated shocks are among the member states, the stronger the policy makers' incentives to increase labor market flexibility. If shocks are to a large extent correlated, however, monetary union membership may lower the incentives for reforms. Similar results are obtained by Saint-Paul and Bentolila (2000). Calmfors (2001b) concludes that the incentive for politically induced labor market reform is strengthened by membership in the EMU provided the entering country does not experience an inflation bias in monetary policy. If such a bias exists, the incentive for reform tends to be weakened by EMU membership. More similar to the present paper, in the sense that focus is on the changed incentives among wage setters and not among politicians, is Calmfors and Johansson (2002). By utilizing a stylized small open economy model they conclude that membership in a monetary union would increase the incentive for nominal wage indexation. Also, joining a monetary union would induce wage setters to reduce the length of the nominal wage contracts.

The contribution of this paper is, at least, threefold: First, the main result is

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risk is carried by the firms. That case is not discussed in this paper.

that the incentive for workers to choose flexible wages in the sense that wages are set after the realization of productivity shocks changes if the economy enters a monetary union. The direction of the change critically depends on the individuals' preferences and on the size of the entering economy. Second, it contributes to the theoretical study of wage setting, by employing an explicitly microfounded macroeconomic model, where individuals' attitudes towards risk are decisive for the way in which wages are written. In particular, one result of the paper is that if nominal wages are set before the realization of shocks, wage setters will choose a higher nominal wage after entrance in a monetary union. Third, the model shows that the modeling framework of the so-called "new open economy macroeconomics" can be used not only to study optimal policy, but also to study optimal individual behavior.

This paper is organized as follows. Section 2 and 3 present the stochastic general equilibrium model. The main results are derived in Section 4. Section 5 discusses the results and gives proposals for extensions of the model. The paper ends with the concluding Section 6.
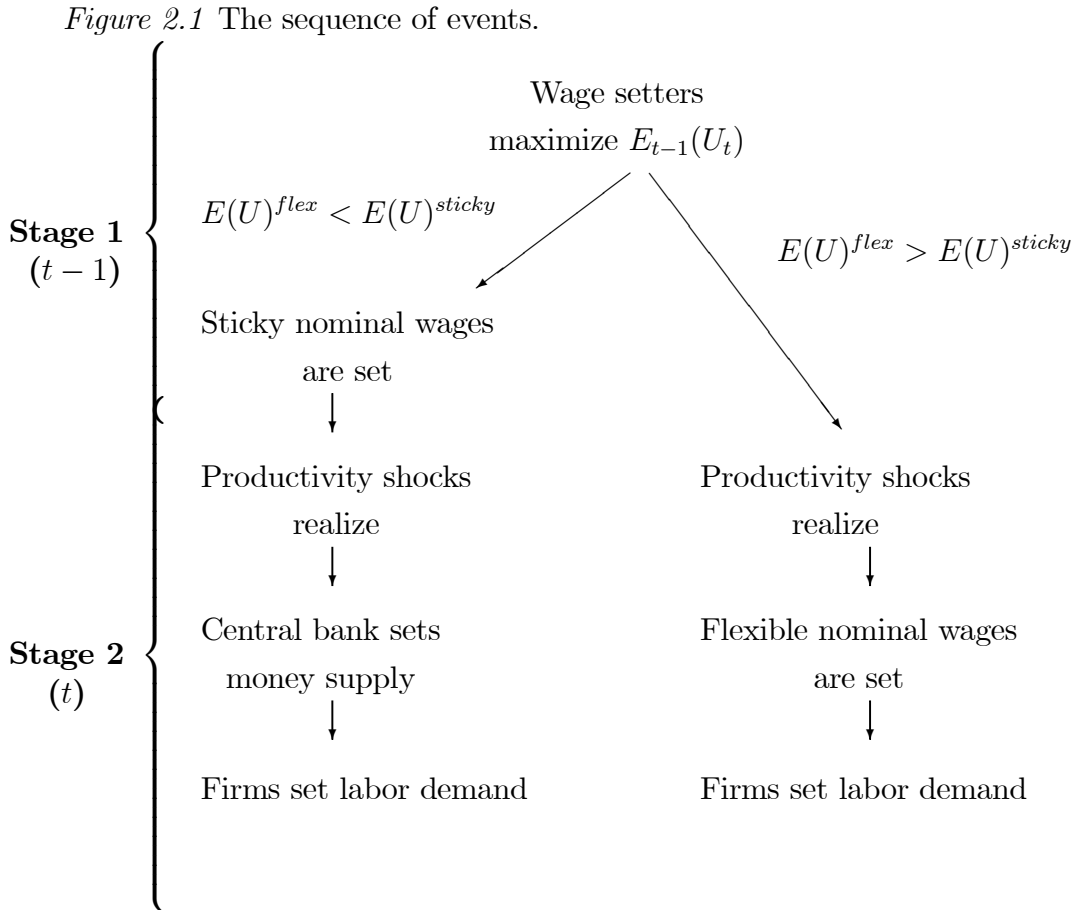
2 A Stochastic General Equilibrium Model

2.1 Assumptions

The prime objective of this paper is to study the consequences for wage setting in an economy that considers entering a monetary union (MU). We therefore assume a two-country world, consisting of the Home economy and the MU economy. Utility maximizing individuals in this single period model are indexed i and i^* over the unit interval, where $i \in (0, n]$ are residents in the Home country and where $i^* \in (n, 1]$ are MU residents. Each individual supplies differentiated labor input and maximizes utility by setting its nominal wage. Each monopolistically competitive firm produces a specific final good out of the differentiated labor input. There are two sectors in both economies: one producing nontraded and one producing traded goods. Home and MU nontradables are indexed $z \in [0, 1]$ and $z^* \in [0, 1]$, respectively. Tradable goods, indexed j, are produced in both economies. For convenience, let Home tradables be indexed on the interval $(0, n]$, while MU tradables are indexed on the interval $(n, 1]$. Money supply in each economy is set by a central bank.

In the model, two sequences of events are compared. They differ with respect to the time of signing the wage contracts. Nominal wages, set by the individuals

are either preset *(sticky)* one period in advance or *flexible* in the sense that nominal wages are set after the realization of the productivity shocks.[4] Note, however, that this implies that the choice to set sticky or flexible wages is made before the shocks realize. The sequence of events in the model is illustrated in Figure 2.1 below.

Figure 2.1 The sequence of events.

Wage setters
maximize $E_{t-1}(U_t)$

Stage 1
$(t-1)$

$E(U)^{flex} < E(U)^{sticky}$

$E(U)^{flex} > E(U)^{sticky}$

Sticky nominal wages
are set

Productivity shocks
realize

Productivity shocks
realize

Stage 2
(t)

Central bank sets
money supply

Flexible nominal wages
are set

Firms set labor demand

Firms set labor demand

Employment is determined by the firms after the productivity and monetary shocks have realized. Workers supply the amount of labor demanded by the firms at either the preset or the flexible nominal wage. With flexible wages, individuals know the realized values of the shocks and can choose their nominal wage optimally.

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[4]The assumption that *all* nominal wages are set one period in advance is a simplification. Sutherland (2001) assumes that a given fraction of all wages are set one period in advance, while the remaining part is flexible. A yet more realistic assumption would be to assume that nominal wages are set in staggered long-term contracts, but that would render an intractable model for our purposes. For a microfounded general equilibrium model with overlapping nominal contracts, see Bergin and Feenstra (2001).

In the case of preset nominal wages, however, it might be the case that unexpected productivity disturbances result in the firms demanding a different level of employment than the level that is *ex ante* optimal for the individual at the posted wage, leading the economy away from the competitive equilibrium.

There are two types of shocks in the model: productivity shocks and monetary shocks. As is common in microfounded macroeconomic models, the productivity shock is modeled as an exogenous shock to the disutility an individual experiences from supplying labor. The standard alternative is to model the productivity shock as a technological shift in the production function, but for the purpose of this paper the formulation used in Equation (3) below is superior in some ways: The fast diffusion of technology makes it reasonable to think that the level of technology does not differ among the industrialized countries considered here. Instead other factors, such as the general knowledge level of the population or fiscal policy and taxation may be as relevant and, most importantly, asymmetric between countries. In fact, even for example the general health condition of the population may induce asymmetric affects on the willingness to supply labor.

The monetary shocks are then modeled as response rules to the productivity shocks.

2.1.1 Firms

Each Home firm is a price taker on the labor market and is indexed according to the good it produces. For example, a Home firm j operating in the traded sector is a monopolistic producer of output $Y_H(j)$, using differentiated labor input $L_H(i,j)$ with the production function given by

$$Y_H(j) = L_H(j) \quad \text{where} \quad L_H(j) = \left(\int_0^n L_H(i,j)^{\frac{\phi-1}{\phi}} di \right)^{\frac{\phi}{\phi-1}}. \tag{1}$$

In (1), $L_H(i,j)$ is labor input of type i used by firm j operating in sector H, and $\phi > 1$ is the constant elasticity of substitution between the different types of labor input. A firm operating in the nontraded sector has a similar production function (with subscript N and index z instead of H and j). Since productivity is assumed not to differ between the traded and the nontraded sectors, nominal wages are equal in the two sectors. Aggregating over the individual nominal wages gives the minimum

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wage of producing one unit of output as

$$W = \left(\int_0^n W(i)^{1-\phi} di \right)^{\frac{1}{1-\phi}}.$$

For a given nominal wage, the demand for labor of type i is found by letting the marginal cost of acquiring one more unit of labor input of type i equal the predetermined wage of this input, $W(i)$. The resulting firm j demand for labor of type i is given by the standard

$$L_H(i,j) = \left(\frac{W(i)}{W} \right)^{-\phi} Y_H(j). \tag{2}$$

It is assumed that $\phi > 1$, implying that the demand for individual i's labor is inversely related to the ratio of the nominal wage chosen by individual i to the aggregate wage, W. The population and production structures are summarized in Table 2.1:

Table 2.1: Country sizes and production.

Country	Country size	Population	Production	
			Non-tradable sector	Tradable sector
Home	n	$i \in (0, n]$	$Y_N(z)$, $z \in (0, 1)$	$Y_H(j)$, $j \in (0, n]$
MU	$1 - n$	$i^* \in (n, 1]$	$Y_N^*(z^*)$, $z^* \in (0, 1)$	$Y_{MU}^*(j^*)$, $j^* \in (n, 1]$

2.1.2 Individual utility

A Home individual of type i obtains utility from consumption and disutility from working. As is convenient in microfounded macroeconomic models, individuals also obtain utility from holding real balances $\left(\frac{M}{P} \right)$.[5] The utility function for a Home individual i is therefore assumed to be given by

$$U(i) = \frac{1}{1 - \delta} C(i)^{1-\delta} + \chi \log \frac{M(i)}{P} - KL(i), \tag{3}$$

---

[5] Individuals obtain utility from holding money instead of interest bearing assets due to reduced transactions costs. This is a commonly used, but seldomly well justified way of introducing money in this type of models. Feenstra (1986), however, shows the functional equivalence between the money in the utility function formulation (used here) and models where money enters the budget constraint as a liquidity cost.

where $C(i)$ is real consumption and $L(i)$ is labor supply of individual i. P is the nominal price index associated with C. Throughout the model P will be referred to as the Home price level. The parameters $\delta > 0$ and $\chi > 0$ are assumed to be equal across individuals and across countries, with δ being the coefficient of relative risk aversion. $K > 0$ is an exogenous shock to the willingness of supplying labor that in this model will represent a productivity shock. The nominal budget constraint for individual i over the period is given by

$$M(i) + PC(i) = M_0(i) + PT + W(i)L(i), \tag{4}$$

where $W(i)$ is the nominal wage for worker i, $M_0(i)$ is initial nominal money holdings and T is a lump-sum tax transfer to the individual from the government. It is assumed that the government budget is always on balance, so that the per capita tax transfer equals

$$T = \frac{M(i) - M_0(i)}{P}.$$

2.1.3 Prices and Demand

Overall real consumption for a Home individual, C, is an index of tradable and non-tradable products:

$$C = C_T^\gamma C_N^{1-\gamma}, \qquad\qquad 0 < \gamma < 1 \tag{5}$$

Home preferences over tradable products are given by

$$C_T = C_H^n C_{MU}^{1-n},$$

where the consumption subindexes for C_H, C_{MU} and C_N are defined as analogous to (1) with a constant and identical elasticity $\theta > 1$.[6] The overall price index associated with C is defined as $P = P_T^\gamma P_N^{1-\gamma}$. The price index for tradable consumption C_T is $P_T = P_H^n P_{MU}^{1-n}$, where price indexes for Home and Foreign tradable goods, respectively, are defined as

$$P_H = \left[\left(\frac{1}{n}\right)\int_0^n P(j)^{1-\theta}dj\right]^{\frac{1}{1-\theta}} \quad \text{and} \quad P_{MU} = \left[\left(\frac{1}{1-n}\right)\int_n^1 P(j)^{1-\theta}dj\right]^{\frac{1}{1-\theta}}.$$

---

[6]The full expressions and the following derivations are presented in Appendix A.1.

It is assumed that the law of one price holds for all individual tradable goods. Combined with the assumption that Home and Foreign residents have identical preferences, it implies that the power purchasing parity must hold for the consumer prices in the two countries so that, for example, the Home currency price of tradables produced in MU is,

$$P_{MU} = SP_{MU}^*,$$

where S is the nominal exchange rate. The derivations of total demand for a typical Home produced tradable good h, $C(h)$, and a representative MU produced tradable good m, $C(m)$, are standard. The resulting demands for $C(h)$ and $C(m)$ are, respectively,

$$C(h) = \left(\frac{P(h)}{P_H}\right)^{-\theta} \left(\frac{P_H}{P}\right)^{-1} C^W \quad \text{and} \quad C(m) = \left(\frac{P(m)}{P_{MU}}\right)^{-\theta} \left(\frac{P_{MU}}{P}\right)^{-1} C^W. \quad (6)$$

where $C^W \equiv nC + (1-n)C^*$ is world *per capita* consumption. Demand preferences are summarized in Table 2.2:

Table 2.2 Demand.

Country		Consumption bundles	
	Total	Tradables	Non tradables
Home	C	$C_H(j)$, $j \in (0, n]$	$C_N(z)$, $z \in (0, 1)$
		$C_{MU}(j^*)$, $j^* \in (n, 1]$	
MU	C^*	$C_H^*(j)$, $j \in (0, n]$	$C_N^*(z^*)$, $z^* \in (0, 1)$
		$C_{MU}^*(j^*)$, $j^* \in (n, 1]$	

2.1.4 Goods market clearing

In single-period general equilibrium models, goods markets always clear. Taking account of the differing populations in the two countries, total output supply of tradables equals total demand when

$$n[nP_T C_T + (1-n)SP_T^* C_T^*] = nP_H Y_H,$$
$$(1-n)[nP_T C_T + (1-n)SP_T^* C_T^*] = (1-n)P_{MU} Y_{MU}^* .$$

Combining these conditions implies that the following relation must hold:

$$Y_H P_H = Y_{MU} P_{MU}.$$

The domestic markets for non-tradables clear when demand equals domestic supply: $C_N = Y_N$ and $C_N^* = Y_N^*$. These market clearing conditions for non-tradables imply that $P_T C_T = P_H Y_H$ and $S P_T^* C_T^* = P_{MU} Y_{MU}$ and hence, in equilibrium, per capita consumption of tradables are always equal in the two countries:

$$C_T = C_T^*. \tag{7}$$

The consumption of non-tradable goods, however, do not have to be equal in the two countries, and hence C and C^* do not have to be equal. However, when we use the price of tradables as a numeraire and define the total spending measured in units of tradables as

$$Z = C_T + \left(\frac{P_N}{P_T} \right) C_N,$$

then it is possible to show that the total per capita spendings measured in units of tradables are equal in the two economies:[7]

$$Z = Z^*. \tag{8}$$

2.2 Equilibrium

Individuals maximize utility by setting the nominal wage. At the end of period $t-1$ each individual has to choose between setting the nominal wage sticky or flexible. In the sticky wage equilibrium, wage setters write contracts at the end of period $t-1$ determining the nominal wages $W(i)$ and $W^*(i)$ in period t. Since it is assumed that wage setters are not allowed to change the wage for period t after the productivity shocks have realized, each wage setter choosing to set a preset nominal wage sets a wage that hedges towards the uncertainty the individual faces. This uncertainty

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[7]In Appendix A.1 the following expressions are derived:

$$C_T = \gamma \left(\frac{P_T}{P} \right)^{-1} C \quad \text{and} \quad C_N = (1 - \gamma) \left(\frac{P_N}{P} \right)^{-1} C,$$

where C is defined in Equation (5). Therefore, by dividing the expression for C_T by C_N, one obtains $\frac{P_N}{P_T} = \left(\frac{1-\gamma}{\gamma} \right) \frac{C_T}{C_N}$ and hence $Z = \frac{C_T}{\gamma}$. The same exercise for MU gives $Z^* = \frac{C_T^*}{\gamma}$ and hence, by Equation (7), $Z = Z^*$.

is fully captured by the exogenous productivity shocks and the response from the monetary authority these productivity shocks may trigger. The shocks change the individuals' optimal levels of consumption and labor supply. When nominal wages are flexible the individuals are free to change their behavior instantaneously. After the productivity shocks have realized, workers supply the amount of labor demanded by firms,[8] and the monetary authority sets money supply as a response to these productivity shocks, with the objective of maximizing the utility of the representative individual. Prices in the model are allowed to be fully flexible.

2.2.1 Wage setting by the individuals

With preset wages, a Home individual i sets the nominal wage for period t in period $t-1$ in order to maximize expected utility. The maximization of (3) subject to the budget constraint (4) gives the first order conditions for optimal nominal wage as

$$E\left\{KL(i)\right\} = \left(\frac{\phi-1}{\phi}\right) W(i) E\left\{\frac{1}{P}\frac{L(i)}{C(i)^{\delta}}\right\}. \tag{9}$$

In (9) the expectations operator, E, is defined as $E(X) = E(X_t|I_{t-1})$, where X_t is any stochastic variable and where I_{t-1} is the information set available to the agents in period $t-1$. This first order condition for optimal preset wages says that the *ex ante* expected disutility from supplying labor (the left hand side) must equal the expected utility the individual obtains from higher wage revenue (the right hand side).

2.2.2 Equilibrium money demand

Real money balances enter directly into the individual utility function. Individual money demand in optimum is then found by maximizing Equation (3) with respect to real money balances, $\frac{M(i)}{P}$, subject to the budget constraint (4). The resulting expression for optimal holding of real balances is

$$\frac{M(i)}{P} = \chi C(i)^{\delta}. \tag{10}$$

---

[8]As discussed in Corsetti and Pesenti (2001) the assumption that workers supply the amount of labor that is profit maximizing for the firms at the decided nominal wage is relevant for sufficiently small shocks. For large shocks it may be the case that the disutility from working at the ongoing nominal wage exceeds the marginal utility obtained from wage income.

It is through this relation the central bank can affect the economy, by setting the nominal money supply, M.

2.2.3 Price setting

It is assumed that firms operate in an environment characterized by monopolistic competition. In Appendix A.2 I show the standard result, that the profit maximizing price for a representative Home firm j is to set the price as a mark-up over the wage the firm has to pay to the workers in the firm: $P(j) = \left(\frac{\theta}{\theta-1}\right) W(j)$. Assuming symmetry among firms and individuals, the price levels of domestically produced goods in the Home and Foreign countries, respectively, can be written as[9]

$$P_H = P_N = \left(\frac{\theta}{\theta - 1}\right) W \quad \text{and} \quad P_F^* = P_N^* = \left(\frac{\theta}{\theta - 1}\right) W^*. \tag{11}$$

In the case of sticky wages the overall price levels in the two countries can be affected by monetary policy through fluctuations in the nominal exchange rate.

2.3 Solutions for utility

One of the advantages of using a microfounded stochastic general equilibrium model is that the model allows for explicitly deriving expressions for expected welfare under different monetary regimes. Therefore, it is possible to analytically determine what consequence entrance into a monetary union has for the incentives of wage setters to choose flexible nominal wages.

In order to derive the expected welfare from the two possible wage setting alternatives, we have to find a tractable expression for societal welfare.[10] By using the expressions for Home and MU spending, $PC = P_T Z$ and $P^* C^* = P_T^* Z^*$,[11] and the

---

[9]Further, the assumption that the law of one price holds implies that

$$P_H^* = \frac{1}{S}\left(\frac{\theta}{\theta-1}\right) W = \frac{P_H}{S} \quad \text{and} \quad P_F = S\left(\frac{\theta}{\theta-1}\right) W^*.$$

[10]Note that with identical individuals the aggregation of individual utilities to a societal welfare measure becomes trivial, and possibly even superfluous. I, however, follow the standard notion in this literature and use welfare and utility interchangeably.

[11]Since

$$PC = P_H Y_H + P_N Y_N$$
$$= P_T C_T + P_N C_N = P_T \left(C_T + \frac{P_N}{P_T} C_N\right) = P_T Z.$$

optimal price equations in (11), total per capita consumption in Home and MU can be written[12]

$$C = \left(\frac{W^*S}{W}\right)^{(1-n)(1-\gamma)} Z, \qquad C^* = \left(\frac{W^*S}{W}\right)^{-n(1-\gamma)} Z^*. \qquad (12)$$

Furthermore, using the first order conditions for sticky nominal wages (9) and the Home budget constraint $P_H Y_H + P_N Y_N = P_H L = PC$ it is possible to express the disutility from working in terms of per capita consumption as

$$E\{KL\} = \frac{(\theta-1)(\phi-1)}{\theta\phi} E\{C^{1-\delta}\} \quad \text{and} \quad E\{K^*L^*\} = \frac{(\theta-1)(\phi-1)}{\theta\phi} E\{C^{*(1-\delta)}\}. \qquad (13)$$

The direct utility obtained from expenditure on liquidity services is small relative to that on real consumption. As in, for example, Obstfeld and Rogoff (2000, 2002), we therefore assume that the utility obtained from holding real money is negligible ($\chi \to 0$). Substituting Equation (13) into the equation for expected utility for a Home individual (3), then gives

$$E(U) = E\left\{\frac{C^{1-\delta}}{1-\delta} - KL\right\} = \Psi E\{C^{1-\delta}\},$$

where the term $\Psi \equiv \left(\frac{\theta\phi-(1-\delta)(\theta-1)(\phi-1)}{\theta\phi(1-\delta)}\right)$ arises due to the assumed monopoly power of individuals in wage setting and of firms in price setting. By Equation (12), expected welfare in the Home country can therefore be expressed in terms of relative prices and normalized spending:

$$E(U) = \Psi E\left\{\left(\frac{W^*S}{W}\right)^{(1-n)(1-\gamma)(1-\delta)} Z^{1-\delta}\right\}. \qquad (14)$$

Similarly, the expected utility for an individual in Foreign is given by:

$$E(U^*) = \Psi E\left\{\left(\frac{W^*S}{W}\right)^{-n(1-\gamma)(1-\delta)} Z^{1-\delta}\right\}. \qquad (15)$$

These two expressions show that the division of consumption goods into tradables

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[12] The full derivations of Equations (12) and (13) are shown in Appendix A.3

and non-tradables introduces the terms of trade (and hence the nominal exchange rate) as a factor determining expected welfare.

Lemma 1 *Given that some goods are non-tradables* $(\gamma < 1)$, *the terms of trade is a determinant for welfare in the Home and MU economies. Further, the smaller the Home economy is relative to the Monetary Union, the relatively more important is the terms of trade as a determinant of expected welfare in the Home economy.*

Proof. The terms of trade can be written

$$\frac{P_F^* S}{P_H} = \frac{W^* S}{W}.$$

The result follows directly from substituting this into Equations (14) and (15) above, assuming that $n < 0.5$. ∎

Note that when all goods are tradables $(\gamma = 1)$, then international risk sharing is complete and welfare is determined solely by expected spending. The term Ψ is not affected by whether nominal wages are preset or flexible, since increased wage flexibility in this model does not correspond to increased competitiveness in the labor market.

To close the model and to find a channel for monetary policy to have an impact on expected welfare, we then have to find explicit expressions for the terms of trade, $\frac{W^* S}{W}$, and normalized spending, Z, as functions of the exogenous variables.

2.3.1 Expected welfare with flexible wages

We start with the benchmark case when wages are flexible, implying that monetary policy is neutral. In Appendix A.3.1 the following expressions for the terms of trade and for spending are derived, defining the flexible wages equilibrium:

$$\left(\frac{W^* S}{W}\right)^{flex} = \left(\frac{K}{K^*}\right)^{-\frac{1}{1-(1-\gamma)(1-\delta)}} \tag{16}$$

and

$$Z^{flex} = \left[\frac{(\phi - 1)(\theta - 1)}{\phi \theta K^n K^{*(1-n)}}\right]^{\frac{1}{\delta}}, \tag{17}$$

where superscript *flex* represents the flexible wages equilibrium value of a variable.

The model contains two types of shocks: productivity shocks (K) and monetary shocks (M). It is assumed that these shocks are log-normally distributed. If $\kappa \equiv \log K$ and $m \equiv \log M$, then $\kappa \sim N\left(0, \sigma_\kappa^2\right)$ and $m \sim N\left(0, \sigma_m^2\right)$. This assumption is convenient for a couple of reasons. It assures that in the model "level" productivity (K) and monetary expansion (M) only take positive values, and it makes it possible to derive an explicit closed-form solution. In the coming analysis, it will be assumed that mean productivity is equal in the two economies: $E\kappa = E\kappa^*$. Further, when analyzing two-country models, it is useful to divide the productivity shocks into an idiosyncratic part that measures the difference between the countries, and a common, worldwide shock.

Definition *The common productivity shock is defined as a weighted average of the shocks in each country,*

$$K_w = K^n \left(K^*\right)^{1-n} \quad \Leftrightarrow \quad \kappa_w \equiv n\kappa + (1-n)\kappa^*,$$

while the idiosyncratic or country-specific productivity shock is defined as the difference between the productivity shocks in each economy,

$$K_i = \frac{K}{K^*} \quad \Leftrightarrow \quad \kappa_i \equiv \kappa - \kappa^*.$$

Note that since $K > 1$ implies a higher than expected aversion with the Home individuals to supply labor (a negative productivity shock), $\kappa_i > 0$ refers to the case when the Home economy is hit by a negative idiosyncratic productivity shock. The assumption that $E\kappa = E\kappa^*$ implies that $E\kappa_i = 0$.

Substituting (16) and (17) into Equation (14), expected utility with flexible nominal wages equals

$$E(U)^{flex} = \Psi \left[\frac{(\phi - 1)(\theta - 1)}{\phi\theta}\right]^{\frac{1-\delta}{\delta}} \exp\left\{-\frac{(1-\delta) E\kappa}{\delta} + \frac{(1-\delta)^2}{2\delta^2}\sigma_{\kappa_w}^2 \right.$$

$$\left. + \frac{(1-n)^2 (1-\gamma)^2 (1-\delta)^2}{2\left[1 - (1-\gamma)(1-\delta)\right]^2}\sigma_{\kappa_i}^2\right\}$$

$$= \Psi \exp\left\{\frac{(1-\delta)\omega}{\delta} + \frac{(1-\delta)^2}{2\delta^2}\sigma_{\kappa_w}^2 + \frac{(1-n)^2 (1-\gamma)^2 (1-\delta)^2}{2\left[1 - (1-\gamma)(1-\delta)\right]^2}\sigma_{\kappa_i}^2\right\},$$

$$(18)$$

where ω is a constant.[13] Therefore, since neither spending, z, nor the nominal exchange rate, s, enter the expression for welfare under wage flexibility, from (18) it follows that with perfectly flexible wages, monetary policy cannot improve upon expected welfare. Nominal wages are set after the realization of the productivity and monetary shock, and hence there are no wage contracts stopping the workers from optimally supplying their desired level of labor *ex post*. Remember that the expectations operator enters (18) since the individual has to choose to set wages flexible already in period $t - 1$.

2.3.2 Expected welfare with sticky wages

Given that the exogenous variables in the model are log-normally distributed, expected spending, Ez, and expected terms of trade, $E\tau$, will be log-normally distributed as well. With the definition $E\tau \equiv w^* - w + Es$ for the expected log terms of trade, we can write a Home individual's expected utility with sticky wages (Equation [14]) as

$$
E(U)^{sticky} = \Psi \exp \left\{ (1 - \delta) \, Ez + (1 - n)(1 - \gamma) \, (1 - \delta) \, E\tau + \frac{(1 - \delta)^2}{2} \sigma_z^2 \right.
$$
$$
\left. + \frac{(1 - n)^2 (1 - \gamma)^2 \, (1 - \delta)^2}{2} \sigma_s^2 + (1 - n)(1 - \gamma) \, (1 - \delta)^2 \, \sigma_{sz} \right\}, \quad (19)
$$

where $\sigma_\tau^2 = \sigma_s^2$ and $\sigma_{\tau z} = \sigma_{sz}$ since nominal wages are now fixed. In order to undertake explicit comparative welfare analysis, we therefore need to solve for mean log terms of trade, $E\tau$, and mean log spending measured in units of tradables, Ez.[14]

By the symmetry of the production functions for tradables and non-tradables (1) it follows that total labor demand in Home is $L = Y_H + Y_N$. Also, remember that from the national income constraint, $PC = P_H Y_H + P_N Y_N$, why it is possible to write labor demand as

$$
L = \frac{P}{P_H} C = \frac{P_T}{P_H} Z = \left(\frac{W^* S}{W} \right)^{1-n} Z. \quad (20)
$$

---

[13] Specifically,
$$
\omega \equiv \left\{ \log \left[\frac{(\phi - 1) \, (\theta - 1)}{\phi \theta} \right] - E\kappa \right\}.
$$

[14] All calculations underlying the results in Section 2.3.2 are shown in Appendix A.3.2.

Using Equations (12) and (20) we can rewrite the Home wage first order condition (9) as

$$\left(\frac{W}{W^*}\right)^{(1-n)[1-(1-\gamma)(1-\delta)]} = \left(\frac{\phi\theta}{(\phi-1)(\theta-1)}\right)\frac{E\left\{KS^{(1-n)}Z\right\}}{E\left\{S^{(1-n)(1-\gamma)(1-\delta)}Z^{1-\delta}\right\}}. \qquad (21)$$

Combining this with the MU counterpart to this expression[15] we get the following sticky wages equilibrium condition:

$$\left(\frac{W}{W^*}\right)^{1-(1-\gamma)(1-\delta)} = \frac{E\left\{KS^{(1-n)}Z\right\}E\left\{S^{-n(1-\gamma)(1-\delta)}Z^{1-\delta}\right\}}{E\left\{K^*S^{-n}Z\right\}E\left\{S^{(1-n)(1-\gamma)(1-\delta)}Z^{1-\delta}\right\}}. \qquad (22)$$

By using Equations (21) and (22), it is indeed possible to find a simultaneous solution for $E\tau$ and Ez. A log-linearization of Equation (22) gives $E\tau$ as[16]

$$E\tau = \frac{-1}{1-(1-\gamma)(1-\delta)}\left\{\frac{1}{2}\left(\sigma_\kappa^2 - \sigma_{\kappa^*}^2\right) + \sigma_{\kappa_w s} + (1-2n)\,\sigma_{\kappa_i s} + \sigma_{\kappa_i z} +\right.$$
$$\left.\left[1-(1-\gamma)(1-\delta)^2\right]\sigma_{sz} + \frac{(1-2n)}{2}\left[1-(1-\gamma)^2(1-\delta)^2\right]\sigma_s^2\right\}. \qquad (23)$$

By taking the log of (21) and then combining it with (23) we obtain an expression for expected spending when wages are set one period in advance:

$$Ez = \frac{1}{\delta}\left\{\omega - \frac{1}{2}\left(n\sigma_\kappa^2 + (1-n)\,\sigma_{\kappa^*}^2\right) - \frac{1-(1-\delta)^2}{2}\sigma_z^2 - \sigma_{\kappa_w z}\right.$$
$$\left. -n(1-n)\sigma_{\kappa_i s} - \frac{n(1-n)}{2}\left[1-(1-\gamma)^2(1-\delta)^2\right]\sigma_s^2\right\}, \qquad (24)$$

where ω is defined in Footnote 13.

Equations (23) and (24) are derived from the first order condition for preset wages. To understand the intuition underlying these equilibrium values for $E\tau$ and

---

[15] The MU counterpart to Equation (21) is given by

$$\left(\frac{W}{W^*}\right)^{-n[1-(1-\gamma)(1-\delta)]} = \left(\frac{\phi\theta}{(\phi-1)(\theta-1)}\right)\frac{E\left\{K^*S^{-n}Z\right\}}{E\left\{S^{-n(1-\gamma)(1-\delta)}Z^{1-\delta}\right\}}.$$

[16] Since the idiosyncratic productivity shock is given by $K_i = \frac{K}{K^*}$, the covariance between K_i and any variable X can be expressed as $\sigma_{\kappa_i x} = \sigma_{\kappa x} - \sigma_{\kappa^* x}$ Similarly, since $K_w = K^n K^{*(1-n)}$, we can write the covariance between K^w and X as $\sigma_{\kappa_w x} = n\sigma_{\kappa x} + (1-n)\,\sigma_{\kappa^* x}$. For further calculations with the productivity terms, see Appendix A.3.3.

Ez take, for example, the term $\sigma_{\kappa_i z}$ in Equation (23). This term represents the covariance between the country specific productivity shock and spending (measured in units of tradables). If world spending is high at the same time as the Home economy is hit by a negative productivity shock ($\sigma_{\kappa_i z} > 0$), then expected marginal utility from consumption is low exactly when the expected marginal utility loss from supplying labor is high, inducing the Home wage setters to set a higher nominal wage (lowering the value of $E\tau$). Similarly, if the term $\sigma_{\kappa_i s}$ is positive and the Home economy is relatively small ($n < \frac{1}{2}$) then, by Equation (23), Home individuals would increase nominal wages since real wages are low and total demand for Home produced tradables is high at the same time as the disutility from effort is unexpectedly high. By Equation (24), this increase in Home nominal wages in turn increases producer prices in Home, thereby lowering the value of mean (real) spending.[17]

Substituting these derived expressions for $E\tau$ and Ez in Equation (19)[18] it is possible to express expected utility with preset wages as a function of variances and covariances of the productivity shocks and the two variables z and s. In the next Section we will see how, in a sticky wage equilibrium, monetary policy affects the variances and covariances involved in Equations (23) and (24) and thereby also mean wages and prices.

3   Monetary Policy

The specification of the model makes it possible to undertake explicit welfare analysis of alternative monetary regimes. In the present paper I will use this property of the model and examine the welfare consequences from two different wage setting schedules in a country that enters into a monetary union.

The benchmark case for monetary policy in most single-period general equilibrium models is a situation where the central banks target the allocations that would have been the outcome under complete wage flexibility.[19] The presence of nominal

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[17]Note that if the Home economy makes up a small fraction of the total world economy ($n \to 0$), the effect from an increase in Home wages on mean spending vanishes.

[18]The full expression for $E(U)^{sticky}$ is quite messy and not particularly illustrating. It can be obtained from the author upon request.

[19]One might consider other strategies for monetary policy, for example, that the central banks seeks to maximize expected utility of a representative individual. Equilibrium in the model is then given by the Nash equilibrium. Since the objective with this paper is to study the behavior of wage setters, I will only consider the simplest (in terms of algebra) rule for monetary policy: Target the flexible equilibrium.

rigidities in an economy may result in unexpected disturbances moving the economy away from equilibrium.[20] The working instrument to bring the economy back to an *ex post* equilibrium is monetary policy. The case when discretionary monetary policy is used to create monetary surprises in order to boost the economy away from some natural rate of growth or unemployment, is not considered. Instead, focus will be on monetary rules, where monetary policy is a tool to compensate for the productivity shocks.

The objective of the Home monetary authority is to target the outcome that would occur without wage rigidities. That allocation is identical to the competitive equilibrium, but for the distortions arising from the monopolistic competition in wage and price setting. The operative target for the absolute majority of independent central banks is price stability. In a multi-period version of a utility-based model like the one in this paper, Woodford (2002) shows the functional equivalence between an utility-maximizing and an inflation targeting central bank.[21]

In order to study how monetary policy can influence the sticky wages equilibrium *ex post*, we have to find expressions for the post-shocks values of realized spending and the nominal exchange rate. These are derived from the individual first order conditions with respect to holding of nominal (or real) money, Equation (10) and its MU counterpart. By taking an average of the two, realized spending can be expressed as

$$ z = \frac{1}{\delta} \left(nm + (1 - n) m^* \right) - \frac{1}{\delta} \left(nw + (1 - n)w^* \right) - \frac{1}{\delta} \log \left(\frac{\theta}{\theta - 1} \right) - \frac{1}{\delta} \log \chi, \quad (25) $$

where it is assumed that $\chi = \chi^*$. The realized nominal exchange rate is derived in a similar fashion by calculating the difference between the Home and MU versions of (10), giving us

$$ s = \frac{m - m^*}{1 - (1 - \gamma)(1 - \delta)} + \frac{(1 - \gamma)(1 - \delta)}{1 - (1 - \gamma)(1 - \delta)} (w - w^*). \quad (26) $$

---

[20]The model in this paper also includes distortions that arise due to monopolies in the labor and product markets. We assume that it is not the task of the monetary authority to compensate for these distortions.

[21]The key is to use a second order Taylor approximation in order to obtain a Phillips curve of the New Keynesian style. See also for example Benigno (2001). Cavalleri (2001) analyzes the impact of trade openness on inflation in a non-stochastic framework where the central bank, in addition to maximize welfare of the individuals is assumed attach some weight to inflation targeting.

Since nominal wages (and hence also domestic producer prices) are fixed, monetary policy in the two economies can affect the nominal exchange rate by setting m and m^*. Next, we will solve for optimal monetary policy under two different institutional regimes: monetary independence and monetary union.

3.1 Monetary Independence

Let a hatted variable represent the surprise part of the variable: $\hat{m} \equiv m - Em$. Equalizing the log versions of the flexible nominal exchange rate outcome (given by Equation [16]) to the outcome under wage rigidity (Equation [26]), we obtain the following condition that must hold for equalization of the flexible to the sticky solution:

$$\hat{\kappa}^* - \hat{\kappa} = \hat{m}^* - \hat{m}, \tag{27}$$

since in Equation (26), $\hat{w}^* = \hat{w} = 0$. Similarly, equalizing the innovation in realized spending in the sticky and the flexible case, Equations (17) and (25), gives a second condition:

$$-n\hat{\kappa} - (1-n)\hat{\kappa}^* = n\hat{m} + (1-n)\hat{m}^*. \tag{28}$$

To simplify notation, we use the definitions of the common and idiosyncratic productivity shocks above and write the monetary policy feedback rules as

$$\hat{m} = -\beta_i \hat{\kappa}_i - \beta_w \hat{\kappa}_w, \tag{29}$$

and

$$\hat{m}^* = \beta_i^* \hat{\kappa}_i - \beta_w^* \hat{\kappa}_w, \tag{30}$$

where β_i and β_w (β_i^* and β_w^*) are parameters describing monetary policy in Home (MU). Combining the two conditions (27) and (28), it is straightforward to solve for the monetary feedback rules that the two central banks should adopt to assure that the sticky wage allocations equal the flexible wage allocations *ex post*. In terms of the monetary policy parameters in (29) and (30), we can describe the optimal monetary policy rules for the Home and MU central banks as

$$\beta_w = \beta_w^* = 1 \tag{31}$$

$$\beta_i = (1-n), \quad \beta_i^* = n. \tag{32}$$

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Since n represents the size of the Home economy, the smaller the Home economy in relation to the MU economy, the more the Home central bank should accommodate and the less the Foreign central bank should respond the idiosyncratic productivity shocks.

3.2 Monetary union

The ultimate objective is to compare the monetary independence case to the monetary union. When the Home economy has entered into the monetary union, the common central bank (CCB) has to decide upon a rule for union-wide money supply. Since a monetary union implies a common currency, the nominal exchange rate can no longer be used as an adjustment mechanism for the relative prices. In this section we will redo the same analysis as in Section 3.1, but now with the nominal exchange rate fixed. For simplicity, assume that $S = 1$. First, note that with the nominal exchange rate fixed, the flexible wage allocations (corresponding to Equations [16] and [17]) are

$$\left(\frac{W^*}{W}\right)^{flex} = \left(\frac{K^*}{K}\right)^{\frac{1}{1-(1-\gamma)(1-\delta)}} \tag{33}$$

and

$$Z^{flex} = \left[\frac{(\phi-1)(\theta-1)}{\phi\theta K^n K^{*(1-n)}}\right]^{\frac{1}{\delta}}. \tag{34}$$

Together these equations define the flexible wage equilibrium in a monetary union. The *ex post* level of normalized spending when wages are preset in a monetary union is, from (25), given by:

$$z = \frac{1}{\delta}m^{CCB} - \frac{1}{\delta}\left(nw + (1-n)w^*\right) - \frac{1}{\delta}\log\left(\frac{\theta}{\theta-1}\right) - \frac{1}{\delta}\log\chi, \tag{35}$$

where m^{CCB} denotes union-wide money supply after the Home economy has entered the union. Taking the logs of (34) and equalizing it to the sticky allocation given by (35), we get the following simple rule governing monetary policy in a monetary union:

$$\hat{m}^{CCB} = -\left(n\,\hat{\kappa} + (1-n)\,\hat{\kappa}^*\right) = -\hat{\kappa}_w. \tag{36}$$

Therefore, in a monetary union the CCB will only accommodate the common productivity shock. Since, in a monetary union there are no longer any nominal exchange rates available, there is no longer any instrument available for the central

banks to compensate for the possible asymmetry of productivity shocks; the competitive equilibrium is no longer attainable in the case when wages are preset:

Lemma 2 *Given the existence of idiosyncratic productivity shocks, the flexible equilibrium is not attainable in a monetary union when wages are preset.*

Proof. We have seen that the rule for monetary policy which always restores the competitive equilibrium (the flexible solution) *ex post* is given by $\beta_w = \beta_w^* = 1$, $\beta_i = 1 - n$ and $\beta_i^* = n$. In a monetary union, the exchange rates are fixed. Hence, the nominal exchange rate can no longer move in order to restore equilibrium in the presence of idiosyncratic productivity shocks. Therefore, when the nominal wages are set before the realization of the shocks, the nominal exchange rates can no longer adjust the relative prices; adjustments that are necessary in the case of idiosyncratic productivity shocks hitting the union economy. ■

4 Utility comparisons

The objective of the paper is to study if the incentive for wage setters to choose flexible wages changes once a country enters a monetary union. The way to answer this question within this model is to compare the expected utilities from flexible and sticky wages outside and inside a monetary union, respectively.

After denoting the difference in Home individual's expected utility between the flexible and the sticky equilibria as

$$\Delta \equiv \frac{E(U)^{flex}}{E(U)^{sticky}}, \tag{37}$$

we can compare its value when the Home economy is not a member of the monetary union, Δ^{MI}, to the value when Home has entered, Δ^{MU}.

Consider first the case with monetary independence, Δ^{MI}. Note that by using the expressions for the monetary feed-back rules, (29) and (30), and the optimal monetary policy rules, (31) and (32), the innovations to the nominal exchange rate and to normalized spending, $\hat{s}$ and $\hat{z}$, can be expressed as functions of the produc-

tivity shocks as,[22]

$$\hat{s} = -\frac{\hat{\kappa}_i}{1 - (1 - \gamma)(1 - \delta)} \tag{38}$$

$$\hat{z} = -\frac{\hat{\kappa}_w}{\delta}. \tag{39}$$

Therefore, the variances and covariances entering the expression for expected utility will equal

$$\sigma_{\kappa_w z} = -\frac{1}{\delta}\sigma^2_{\kappa_w}, \qquad \sigma^2_z = \frac{1}{\delta^2}\sigma^2_{\kappa_w}, \quad \sigma_{\kappa_i s} = -\frac{1}{1 - (1 - \gamma)(1 - \delta)}\sigma^2_{\kappa_i},$$

$$\sigma^2_s = \frac{1}{[1 - (1 - \gamma)(1 - \delta)]^2}\sigma^2_{\kappa_i}, \quad \sigma_{\kappa_i z} = \sigma_{\kappa_w s} = \sigma_{sz} = 0.$$

Hence, the optimal monetary policy feed-back rules yield, for example, that the post shocks realized value of the covariance $\sigma_{\kappa_i s}$ will be negative. This implies that if the disutility of working is unexpectedly high for Home individuals, this shock will be accommodated by an appreciation of the nominal exchange rate, shifting demand to MU produced goods, thereby lowering labor demand in Home. With monetary policy rule-based, individuals know the realized value of $\sigma_{\kappa_i s} (< 0)$ when setting wages. Since this term will lower Home labor supply if the disutility of supplying labor is unexpectedly high, Home individuals will not have to hedge towards this productivity risk when setting the nominal wage. This will, by Equations (23) and (24), lead to lower nominal wages in Home (higher $E\tau$). Also, lower nominal wages in the Home economy lower prices leading to higher mean world real spending (higher Ez). If, on the other hand, κ_i is unexpectedly high and this has to be compensated for by the nominal exchange rate, this will also increase the variance in the nominal exchange rate and in the Home price level, leading Home individuals to increase the nominal wage.

Using these values for the endogenous variances and covariances, it is possible

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[22]Written in terms of the the monetary policy parameters β_w, β_i, β^*_w and β^*_i:

$$\hat{s} = -\left[\frac{\beta_i + \beta^*_i}{1 - (1 - \gamma)(1 - \delta)}\right]\hat{\kappa}_i - \left[\frac{\beta_w - \beta^*_w}{1 - (1 - \gamma)(1 - \delta)}\right]\hat{\kappa}_w$$

$$\hat{z} = -\left[\frac{n\beta_i - (1 - n)\beta^*_i}{\delta}\right]\hat{\kappa}_i - \left[\frac{n\beta_w + (1 - n)\beta^*_w}{\delta}\right]\hat{\kappa}_w.$$

to rewrite $E\tau$ and Ez (Equations [23] and [24]) under monetary independence (MI) as,

$$E\tau^{MI} = \frac{-1}{1-(1-\gamma)(1-\delta)} \left\{ \frac{1}{2} \left(\sigma_\kappa^2 - \sigma_{\kappa^*}^2 \right) - \frac{(1-2n)}{2} \sigma_{\kappa_i}^2 \right\}, \qquad (40)$$

$$Ez^{MI} = \frac{1}{\delta} \left\{ \omega - \frac{1}{2} \left(n\sigma_\kappa^2 + (1-n)\,\sigma_{\kappa^*}^2 \right) + \frac{1}{2}\sigma_{\kappa_w}^2 + \frac{n(1-n)}{2}\sigma_{\kappa_i}^2 \right\}. \qquad (41)$$

In Equation (40) the last term $\left(\frac{(1-2n)}{2}\sigma_{\kappa_i}^2 \right)$ is the sum of two effects discussed above. If $\kappa_i < 1$, the Home central bank increases money supply, why the nominal exchange rate depreciates. This induces Home individuals to lower their wages. On the other hand, Home individuals will want to hedge against the exchange rate variations triggered by the productivity shocks. Equation (40) reveals that as long as the Home economy is small $n < 0.5$ implying, by Lemma 1, that the nominal exchange rate is an important determinant of Home expected utility the sum of these two effects is lower Home wages (higher $E\tau$). By Equation (41), the lower nominal wages in Home will increase mean per capita real spending. Note, however, that if the Home country is very small in relation to the MU ($n \to 0$), the effect on real spending will be negligible.

If the Home economy enters the monetary union, monetary policy is given by Equation (36). Further, the nominal exchange rate is fixed (assume $S = 1$), so that $\sigma_s^2 = \sigma_{\kappa_i s} = \sigma_{\kappa_w s} = 0$. The expressions for $E\tau$ and Ez in a monetary union are then found as

$$E\tau^{MU} = \frac{-1}{1-(1-\gamma)(1-\delta)} \left\{ \frac{1}{2} \left(\sigma_\kappa^2 - \sigma_{\kappa^*}^2 \right) \right\}, \qquad (42)$$

$$Ez^{MU} = \frac{1}{\delta} \left\{ \omega - \frac{1}{2} \left(n\sigma_\kappa^2 + (1-n)\,\sigma_{\kappa^*}^2 \right) + \frac{1}{2}\sigma_{\kappa_w}^2 \right\}. \qquad (43)$$

Since in a monetary union monetary policy cannot change relative prices in response to idiosyncratic productivity shocks, Home individuals will, by Equations (40) and (42), choose to set a higher preset nominal wage after entrance in the union.

Proposition 3 *After entrance in a monetary union, wage setters in a small entering economy will choose a higher preset nominal wage.*

Proof. By Equations (40) and (42), $E\tau^{MI} > E\tau^{MU}$, implying that utility maximizing preset nominal wages in the Home economy are higher after entrance in the monetary union. ∎

Hence, if individuals choose to set nominal wages also after entrance, they will increase their nominal wage demands, thereby lowering mean employment but also mean real spending. Whether or not the individuals actually choose to set nominal wages sticky after entrance depend on individual preferences, and in particular on the degree of relative risk aversion, δ.

By using Equations (18), (19), (40) and (41) in the expression for the expected utility difference between setting wages sticky or flexible, Equation (37), one obtains the following difference when Home is not a member of the monetary union:

$$
\begin{aligned}
\Delta^{MI} &= \frac{E\left(U\right)^{flex}}{E\left(U\right)^{sticky,MI}} \\
&= E\left(U\right)^{flex} \Psi^{-1} \exp\left\{ -\frac{(1-\delta)\,\omega}{\delta} + \frac{(1-\delta)}{2\delta}\left(n\sigma_\kappa^2 + (1-n)\,\sigma_{\kappa^*}^2\right) - \frac{(1-\delta)}{2\delta}\sigma_{\kappa_w}^2 \right. \\
&\quad \left. -\frac{n(1-n)\,(1-\delta)}{2\delta}\sigma_{\kappa_i}^2 + \frac{(1-n)(1-\gamma)\,(1-\delta)}{2\left[1-(1-\gamma)(1-\delta)\right]}\left[\left(\sigma_\kappa^2 - \sigma_{\kappa^*}^2\right) - (1-2n)\,\sigma_{\kappa_i}^2\right] \right. \\
&\quad \left. -\frac{(1-\delta)^2}{2\delta^2}\sigma_{\kappa_w}^2 - \frac{(1-n)^2(1-\gamma)^2\,(1-\delta)^2}{2\left[1-(1-\gamma)(1-\delta)\right]^2}\sigma_{\kappa_i}^2 \right\}.
\end{aligned}
\tag{44}
$$

Given that the individuals' preferences and that the structure of the productivity shocks does not change, expected welfare with flexible wages, $E\left(U\right)^{flex}$ is not affected by the move from monetary independence to monetary union. The corresponding difference once the Home economy enters the union is then given by

$$
\begin{aligned}
\Delta^{MU} &= \frac{E\left(U\right)^{flex}}{E\left(U\right)^{sticky,MU}} \\
&= \Delta^{MI} \exp\left\{ \frac{(1-n)(1-\gamma)\,(1-\delta)\,(1-2n)}{2\left[1-(1-\gamma)(1-\delta)\right]}\sigma_{\kappa_i}^2 + \frac{n(1-n)\,(1-\delta)}{2\delta}\sigma_{\kappa_i}^2 \right. \\
&\quad \left. \frac{(1-n)^2(1-\gamma)^2\,(1-\delta)^2}{2\left[1-(1-\gamma)(1-\delta)\right]^2}\sigma_{\kappa_i}^2 \right\} \\
&= \Delta^{MI} \exp\left\{\Omega\right\}.
\end{aligned}
\tag{45}
$$

In Equation (45), the first term inside the square brackets is present since higher nominal wages in the Home economy after entrance affects the terms of trade. This decreases expected utility from sticky wages and thereby increases Δ^{MU}. The second term arises since these higher nominal wages in the Home economy increases

the world price level, reducing real consumption (measured in units of tradables). The third term originates from the expression for expected utility with preset wages, Equation (19). In presence of cross-country differences in the aversion against supplying labor ($\kappa_i \neq 0$) it is optimal that the terms of trade adjusts. The third term in square brackets then captures the desired variance in the nominal exchange rate under wage stickiness.

By Equations (44) and (45) it is therefore possible to express the difference between Δ^{MI} and Δ^{MU} as

$$\Delta^{MI} - \Delta^{MU} = \Delta^{MI} \left(1 - \exp\{\Omega\} \right) \tag{46}$$

Remember that, for example Δ^{MI} denotes the $t-1$ expected difference in utility from writing sticky as compared to flexible wages when the Home country is monetary independent. If, therefore, $\Delta^{MI} - \Delta^{MU} < 0$ this corresponds to a situation where the potential loss in expected utility from setting preset nominal wages is higher after entrance in the monetary union than it was before entrance.

From Equation (46), the critical part is to determine the sign of Ω. If $\Omega > 0$, then $\exp\{\Omega\} > 1$ and the incentive for to choose flexible wages increases after entrance. If, on the other hand, $\Omega < 0$, then $\exp\{\Omega\} < 1$ and we get the opposite result: $\Delta^{MI} > \Delta^{MU}$ why the incentive to choose flexible wages decreases.

Proposition 4 *Entrance in a monetary union implies a change in incentives for wage setters to choose to set flexible nominal wages. Whether the incentive increases or decreases depends critically on the relative risk aversion.*

(i) *If $0 < \delta < 1$, the loss in expected utility from choosing preset instead of flexible nominal wages would be higher if the country would enter into a monetary union $\left(\Delta^{MI} - \Delta^{MU} < 0 \right)$.*

(ii) *If $\delta > 1$, the loss in expected utility from choosing preset instead of flexible nominal wages would be lower if the country would enter into a monetary union $\left(\Delta^{MI} - \Delta^{MU} > 0 \right)$.*

Proof. Start from Equation (46). It turns out that the most illustrative way to show the result is by doing simple numerical simulations of the model. In Table 4.1

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below I have simulated Equation (46) for different values of the relative risk aversion (δ) and of relative size of the Home economy (n). As long as $\delta < 1$, the utility loss from choosing preset wages is larger in a monetary union, and hence the incentive for workers to choose wage flexibility is higher. For $\delta > 1$, the result is the opposite. ∎

Table 4.1 shows numerically the value of $(1 - \exp\{\Omega\})$ for different values of δ and n. In the calculations I have assumed that $\gamma = 0.6$ and that $\sigma^2_{\kappa_i} = 0.1$.[23]

Table 4.1. The value of $(1 - \exp\{\Omega\})$.

	n			
δ	**0.05**	**0.10**	**0.20**	**0.50**
0.2	-0.031	-0.026	-0.019	-0.003
0.5	-0.014	-0.012	-0.008	-0.001
0.9	-0.002	-0.002	-0.001	-0.00002
1	0	0	0	0
2	0.008	0.007	0.004	-0.001
4	0.010	0.008	0.004	-0.0037

What explains this result? From Proposition 3 we know that membership in a monetary union will lead individuals to set higher preset wages. For example, by Equations (41) and (43) this in turn affects the mean value of real spending measured in units of tradables. Expected utility under sticky wages is proportional to $EZ^{1-\delta} = \exp\left\{(1-\delta)Ez + \frac{(1-\delta)^2}{2}\sigma^2_z\right\}$. Using Equation (41), we have

$$\frac{EZ^{1-\delta}}{\partial \sigma^2_{\kappa_i}} = \frac{n(1-n)(1-\delta)}{2\delta}EZ^{1-\delta}$$

which is positive only as long as $\delta < 1$. Therefore, for $\delta < 1$, expected utility is, via real spending increasing in the variance of the idiosyncratic productivity shock, $\sigma^2_{\kappa_i}$. The higher Home nominal wages in a monetary union implies a reduction in real spending as long as $0 < \delta < 1$. This lowers also expected utility. Further, by Equation (17), with flexible wages, real spending is not affected by the difference is productivity.[24] Therefore, as long as $0 < \delta < 1$ the increase in preset Home nominal

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[23] Those are the values used by Obstfeld and Rogoff (2002).

[24] From Equation (17), certainty-equivalent log spending is $Ez = \frac{1}{\delta}\left[\log\left\{\frac{(\phi-1)(\theta-1)}{\phi\theta}\right\} - E\kappa\right]$

wages reduces expected utility why wage setters instead have an incentive to choose flexible wages. Accordingly for $\delta > 1$ the incentive to set preset wages increases.

The first term in the square brackets of Equation (45) comes from the effect of monetary union membership on the terms of trade. The intuition is similar as above.

The model in this paper is generalized to allow for non-equally sized countries. The results in Table 4.1 indicate that country size does not determine the sign of the difference $\Delta^{non-MU} - \Delta^{MU}$, but that it does affect the magnitude.

Corollary 5 *For the relevant values $0.05 < n < 0.20$, the difference $\Delta^{MI} - \Delta^{MU}$ is marginally affected by country size. Note, however, that the main results are generally more pronounced given that the countries are not of equal size. The conclusion is that country size is of some importance, and ignoring this by assuming $n = 0.50$ may bias the results.*

5   Discussion

I regard the most important contribution of this paper to be that it introduces a new approach to studying wage setting, by employing an explicitly microfounded macroeconomic model, where individuals' attitudes towards risk are decisive for the way in which wages are set.

In the literature, the most commonly discussed ways to increase nominal wage flexibility are either to include indexation clauses in the wage contracts, or to shorten the contract lengths. Although not aiming to explicitly study the optimal length of wage contracts, the spirit of this paper has more in common with the contract length literature. The model does not incorporate any costs from increasing nominal wage flexibility. Note, however, that the gain in expected utility from increasing wage flexibility after monetary union membership for values $0.5 < \delta < 1$ decreases with country size. Introducing a "physical" cost connected to wage flexibility could therefore produce the outcome that wage flexibility increases when the Home country is sufficiently small, while the opposite is true when the Home country is larger.

The shock structure of the model and the assumption of rule based monetary policy imply that the paper has little in common with the wage indexation literature. One possible way to include demand shocks in the model is to extend the model

by including fiscal policy.[25] An independent fiscal policy in a monetary union could either have the rule of an alternative stabilizing tool and thereby possibly decrease the need for wage flexibility or, alternatively, one could incorporate demand shocks into the model by assuming opportunistic fiscal policy. With demand shocks present, the study of wage indexation would be possible.

The present model assumes identical individuals and trade unions are therefore redundant. Calmfors (2001a) argues that the movement to a monetary union most probably increases the incentive for nominal wage flexibility. The actual outcome, however, critically depend on the coordination of wage bargaining institutions. According to Calmfors a necessary condition for nominal wage flexibility to increase is that wage bargaining coordination increases as well. Initially that might be the case but that scenario is not sustainable since in the longer run monetary unification will induce forces of decentralization and deunionisation. An interesting extension of the model in this paper would be to assume that agents are heterogenous with respect to, for example, initial wealth or risk aversion. This would create a rationale for unions.

Finally, monetary policy is modeled here in the simplest possible way. Alternative policies of the central banks are that they either cooperatively or non-cooperatively maximize welfare. With the Home country being relatively small, the result in Lemma 1 could give scope for a "beggar-thy-neighbor" strategy, where the Home central bank would set monetary policy to move the nominal exchange rate in a favorable way for the Home individuals. This alternative strategy is not explicitly dealt with here, since it would merely strengthen the results obtained under central banks targeting the flexible outcome. If the Home central bank acts to utilize the nominal wage contracts to maximize Home welfare, the increase in incentives to choose nominal wage flexibility after a monetary union would be even stronger.

6   Conclusions

One implication of the creation of a monetary union is that monetary policy becomes impotent as an instrument to prevent idiosyncratic productivity shocks from sending the economy into disequilibrium. In the present paper, I have shown that this, depending on agents' risk aversions, implies a changed incentive for wage setters to set

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[25]For suggestions on how to incorporate fiscal policy into the "new open-economy macroeconomics" framework, see Obstfeld and Rogoff (1998) or Corsetti and Pesenti (2001).

wages that follow the fluctuations in productivity. In the stochastic general equilibrium model with sticky wages (originally developed by Obstfeld and Rogoff [2000]) used here, the national central bank in the small entering Home economy optimally acts procyclically to idiosyncratic productivity shocks. When, then, Home economy enters the monetary union, this possibility disappears leading to idiosyncratic shocks forcing workers to supply non-optimal amounts of labor given the contracted nominal wage.

An important question in the discussion about monetary unions is whether idiosyncratic productivity should lead to real or nominal fluctuations. The results derived in this paper show that entrance in a monetary union most probably implies a stronger incentive to increase nominal flexibility for the agents carrying the risk connected to real fluctuations.

REFERENCES

Benigno, Pierpaolo (2001), "Optimal Monetary Policy in a Currency Union," unpublished, New York University

Bergin, Paul R. and Robert C. Feenstra (2001), "Pricing-to-market, staggered contacts, and real exchange rate persistence," *Journal of International Economics* 54(2): 333-359

Calmfors, Lars (2001a), "Wages and Wage-Bargaining Institutions in the EMU - A Survey of the Issues," *Empirica* 28: 325-351

Calmfors, Lars (2001b), "Unemployment, Labor Market Reform, and Monetary Union," *Journal of Labor Economics* 19(2): 265-289.

Calmfors, Lars and Åsa Johansson (2002), "Nominal Wage Flexibility, Wage Indexation and Monetary Union," IIES Seminar Paper No. 716

Cavallari, Lilia (2001), "Inflation and Openness with Non-Atomistic Wage Setters," *Scottish Journal of Political Economy* 48(2): 210-225.

Corsetti, Giancarlo and Paolo Pesenti (2001), "Welfare and Macroeconomic Interdependence," *Quarterly Journal of Economics* 116(2): 421-445

Cukierman, Alex and Fransesco Lippi (2000), "Central Bank Independence, Centralization of Wage Bargaining, Inflation and Unemployment - Theory and Some Evidence," *European Economic Review* 43: 1395-1434.

Feenstra, Robert C. (1986), "Functional Equivalence Between Liquidity Costs and the Utility of Money," *Journal of Monetary Economics* 17: 271-291.

Holden, Steinar (2001), "Monetary regime and the co-ordination of wage setting," unpublished, Olso University.

Iversen, Torben and David Soskice (1998), "Multiple Wage Bargaining Systems in the Single European Currency Area," *Oxford Review of Economic Policy* 14: 110-124.

Obstfeld, Maurice and Kenneth Rogoff (1998), "Risk and Exchange Rates", NBER Working Paper 6694.

Obstfeld, Maurice and Kenneth Rogoff (2000), "New Directions for Stochastic Open Economy Models," *Journal of International Economics* 50: 117-153.

Obstfeld, Maurice and Kenneth Rogoff (2002), "Global Implications of Self-Oriented National Monetary Rules," *Quarterly Journal of Economics* 117(2): 503-36.

Saint-Paul, Gilles and Samuel Bentolila (2000), "Will EMU Increase Eurosclerosis?" UPF Working Paper Ref. 449

Siebert, Anne and Alan J Sutherland (2000), "Monetary Union and Labor Market Reform," *Journal of International Economics* 51: 421-435.

Sutherland, Alan J (2001), "Inflation Targeting in a Small Open Economy," CEPR Discussion Paper 2726.

A Demand and prices

A.1 Demand

All consumption subindexes are symmetric and defined as

$$C_H = \left[\left(\frac{1}{n}\right)\int_0^n C(j)^{\frac{\theta-1}{\theta}}dj\right]^{\frac{\theta}{\theta-1}}$$

$$C_F = \left[\left(\frac{1}{1-n}\right)\int_n^1 C(j)^{\frac{\theta-1}{\theta}}dj\right]^{\frac{\theta}{\theta-1}}$$

$$C_N = \left[\int_0^1 C(z)^{\frac{\theta-1}{\theta}}dz\right]^{\frac{\theta}{\theta-1}},$$

where θ is the constant elasticity of substitution among goods produced in different firms within a country.

The demand functions in (6) are derived in the following way. First, find the demand for tradables. Starting from the aggregate consumption index,

$$C = C_T^\gamma C_N^{1-\gamma}. \tag{A.1}$$

Maximizing (A.1) subject to the budget constraint, $X = P_T C_T + P_N C_N$, where X is any fixed total nominal expenditure on goods. by setting up a Lagrangean, L:

$$L = C + \lambda\left[X - P_T C_T - P_N C_N\right].$$

The first order conditions for maximizing this Lagrangean with respect to C_T and C_N are

$$\frac{\partial L}{\partial C_T} = \gamma\frac{C}{C_T} - \lambda P_T, \qquad \frac{\partial L}{\partial C_N} = (1-\gamma)\frac{C}{C_N} - \lambda P_N.$$

Solving for λ in the first one gives $\lambda = \gamma\frac{C}{C_T P_T}$. Hence

$$(1-\gamma)\frac{C}{C_N} - \gamma\frac{P_N C}{C_T PT} = 0 \Leftrightarrow (1-\gamma)C_T = \gamma\left[\frac{P_N}{P_T}C_N + C_T\right].$$

We can therefore make use of the definition of X and write

$$C_T = \gamma\left[\frac{P_N}{P_T}C_N + C_T\right] = \gamma\left[\frac{E}{P_T}\right] = \gamma\left[\frac{PC}{P_T}\right] = \gamma\left[\frac{P_T}{P}\right]^{-1}C.$$

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Similarly, the demand for Home non-tradables is given by

$$C_N = (1 - \gamma) \left[\frac{P_N}{P} \right]^{-1} C.$$

Using the same method, but starting from the index describing Home individuals' preferences for Home and MU produced tradables,

$$C_T = C_H^n C_F^{1-n}.$$

The demands for the composite Home and Foreign goods are given by

$$C_H = n \left[\frac{P_H}{P} \right]^{-1} C, \quad C_F = (1 - n) \left[\frac{P_F}{P} \right]^{-1} C. \tag{A.2}$$

Under the subutility functions defined above, cost minimization by individuals[26] gives that the Home demand for a particular output of firm h and Foreign demand for a particular good f an expression similar to the one resulting from profit maximization by the firms

$$C(h) = \frac{1}{n} \left(\frac{P(h)}{P_H} \right)^{-\theta} C_H, \quad C(f) = \frac{1}{1 - n} \left(\frac{P(f)}{P_F} \right)^{-\theta} C_F. \tag{A.3}$$

Combining the equations in (A.2) and (A.3), the total demand for a good produced by Home firm h and by Foreign firm f, respectively, can be written as

$$C(h) = \left(\frac{P(h)}{P_H} \right)^{-\theta} \left(\frac{P_H}{P} \right)^{-1} C, \quad C(f) = \left(\frac{P(f)}{P_F} \right)^{-\theta} \left(\frac{P_F}{P} \right)^{-1} C.$$

Defining the total world demand $C^W \equiv nC + (1 - n) C^*$, the two expressions for worldwide demand facing the two representative firms are

$$C(h) = \left(\frac{P(h)}{P_H} \right)^{-\theta} \left(\frac{P_H}{P} \right)^{-1} C^W, \quad C(f) = \left(\frac{P(f)}{P_F} \right)^{-\theta} \left(\frac{P_F}{P} \right)^{-1} C^W,$$

which are the expressions found in the main text.

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[26]This cost minimization is found by letting $\frac{\partial C(h)}{\partial C_H} = \frac{P(h)}{P_H}$.

A.2 Optimal price setting

The problem for the profit maximizing, monopolistically competitive Home firm in maximizing profits given demand is

$$\max_{P(h)} \left[\frac{P(h)}{P} - \frac{W}{P} \right] \left(\frac{P(h)}{P_H} \right)^{-\theta} \left(\frac{P_H}{P} \right)^{-1} C^W,$$

where we have used that $Y(h) = L(h) = C(h)$. The first order conditions reduce to

$$(1 - \theta) P(h)^{-\theta} P_H^{\theta-1} C^W + \theta W P(h)^{-\theta-1} P_H^{\theta-1} C^W = 0.$$

Simplifying and rearranging, we get the result that the optimal price set by firm j in the Home country is

$$P(h) = \left(\frac{\theta}{\theta - 1} \right) W.$$

In a symmetric equilibrium, the price levels for domestically produced goods in Home and MU are $P_H = \left(\frac{\theta}{\theta-1} \right) W$ and $P_F^* = \left(\frac{\theta}{\theta-1} \right) W^*$.

A.3 Solutions for utility:

Derivation of Equation (12):

$$C = \frac{P_T}{P} Z = P_T^{1-\gamma} P_N^{-(1-\gamma)} Z = \left(P_H^n P_F^{(1-n)} \right)^{(1-\gamma)} P_N^{-(1-\gamma)}$$

$$= \left(\frac{\theta}{\theta - 1} \right)^{-(1-n)(1-\gamma)} W^{-(1-n)(1-\gamma)} \left(\frac{\theta}{\theta - 1} \right)^{(1-n)(1-\gamma)} (W^* S)^{(1-n)(1-\gamma)} Z$$

$$= \left(\frac{W^* S}{W} \right)^{(1-n)(1-\gamma)} Z.$$

Derivation of Equation (13): From the Home budget constraint, $P_H (Y_H + Y_N) = P_H L = PC$. Hence, using the Home first order conditions for wage setting, we can write

$$E \{KL\} = \left(\frac{\phi - 1}{\phi} \right) W E \left\{ \frac{1}{P} \frac{L}{C^\delta} \right\}$$

$$= \left(\frac{\phi - 1}{\phi} \right) W E \left\{ \frac{1}{P} \frac{P}{P_H} C^{1-\delta} \right\} = \left(\frac{(\phi - 1)(\theta - 1)}{\phi \theta} \right) E \left\{ C^{1-\delta} \right\}.$$

A.3.1 Expected welfare with flexible wages

Express the Home price level as:

$$P = P_T^\gamma P_N^{1-\gamma} = P_H^{\gamma n} P_F^{\gamma(1-n)} P_N^{1-\gamma}$$

$$= \left[\left(\frac{\theta}{\theta-1}\right) W\right]^{1-\gamma+n\gamma} \left[\left(\frac{\theta}{\theta-1}\right) W^* S\right]^{\gamma(1-n)}$$

$$= \left(\frac{\theta}{\theta-1}\right) W \left(\frac{W^* S}{W}\right)^{\gamma(1-n)}.$$

Similarly, the MU price level can be expressed as $P^* = \left(\frac{\theta}{\theta-1}\right) W^* \left(\frac{W}{SW^*}\right)^{n\gamma}$. The first-order conditions for wage setting in the case of flexible wages is

$$\frac{W}{PC^\delta} = \left(\frac{\phi}{\phi-1}\right) K \Leftrightarrow \frac{W}{P^{1-\delta} P_H^\delta} = \left(\frac{\phi}{\phi-1}\right) KL^\delta.$$

Using the derived expression for P above, we can rewrite this expression as

$$\left(\frac{W^* S}{W}\right)^{-(1-\delta)(1-n)\gamma} = \left(\frac{\phi\theta K}{(\phi-1)(\theta-1)}\right) L^\delta. \tag{A.4}$$

Similarly, using the MU budget constraint $C^* = \frac{P_F^*}{P^*} L^*$, the MU counterpart to (A.4) is

$$\left(\frac{W^* S}{W}\right)^{n(1-\delta)\gamma} = \left(\frac{\phi\theta K^*}{(\phi-1)(\theta-1)}\right) (L^*)^\delta. \tag{A.5}$$

To complete the solution of the model, we have to use a relation between L and Z and between L^* and Z. Again turning to the resource constraint, we see that $P_T Z = PC = P_H L$. Hence

$$L = \frac{P_T}{P_H} Z = \frac{P_H^n P_F^{1-n}}{P_H} Z = \left(\frac{W^* S}{W}\right)^{1-n} Z. \tag{A.6}$$

The MU counterpart to this is

$$L^* = \left(\frac{W^* S}{W}\right)^{-n} Z. \tag{A.7}$$

Substituting (A.6) into (A.4) the flexible equilibrium spending level, measured in units of tradables, can be expressed as

$$Z = \left[\frac{\phi\theta K}{(\phi-1)(\theta-1)} \right]^{-\frac{1}{\delta}} \left(\frac{W^*S}{W} \right)^{-\frac{(1-n)[1-(1-\gamma)(1-\delta)]}{\delta}}. \tag{A.8}$$

Now, substituting (A.7) into (A.5) and using the above expression for $Z = Z^*$, we obtain the Expressions (16) and (17) in the main text. Substituting (16) and (17) into (14) gives an expression for expected welfare when wages are flexible as Equation (18) in the text.

A.3.2 Expected welfare with sticky wages

Start by deriving the Expressions (21) and (22) in the main text. Substituting the expressions $L = \left(\frac{W^*S}{W} \right)^{1-n} Z$, $C = \frac{P_H}{P} L$ and $P = \left(\frac{\theta}{\theta-1} \right) W \left(\frac{W^*S}{S} \right)^{\gamma(1-n)}$ into the first order conditions for nominal wage setting, we get:

$$E \left\{ K \left(\frac{W^*S}{W} \right)^{1-n} Z \right\} = \left(\frac{\phi-1}{\phi} \right) W E \left\{ \frac{\left(\frac{W^*S}{W} \right)^{(1-\delta)(1-n)} Z^{1-\delta}}{\left(\frac{\theta}{\theta-1} \right) W \left(\frac{W^*S}{W} \right)^{\gamma(1-n)(1-\delta)}} \right\}.$$

Simplifying this expression one obtains Expression (21) in the text.

The derivation of Equation (23): Taking the logs of Equation (22) gives

$$\begin{aligned}
[1-(1-\gamma)(1-\delta)] \left(w - w^* \right) = {}& E\kappa + (1-n)Es + Ez- \\
& - n(1-\gamma)(1-\delta)Es + (1-\delta)Ez - E\kappa^* + nEs - Ez- \\
& - (1-n)(1-\gamma)(1-\delta)Es - (1-\delta)Ez + (1-n)\sigma_{\kappa s} + \sigma_{\kappa z} \\
& + (1-n)\sigma_{sz} - n(1-\gamma)(1-\delta)^2\sigma_{sz} + n\sigma_{\kappa^*s} - \sigma_{\kappa^*z} + n\sigma_{sz} \\
& - (1-n)(1-\gamma)(1-\delta)^2\sigma_{sz} + \frac{1}{2}\sigma_\kappa^2 + \frac{(1-n)^2}{2}\sigma_s^2 + \frac{1}{2}\sigma_z^2 \\
& + \frac{n^2(1-\gamma)^2(1-\delta)^2}{2}\sigma_s^2 + \frac{(1-\delta)^2}{2}\sigma_z^2 - \frac{1}{2}\sigma_{\kappa^*}^2 - \frac{n^2}{2}\sigma_s^2 - \frac{1}{2}\sigma_z^2 \\
& - \frac{(1-n)^2(1-\gamma)^2(1-\delta)^2}{2}\sigma_s^2 - \frac{(1-\delta)^2}{2}\sigma_z^2.
\end{aligned}$$

Remember that $E\kappa = E\kappa^*$ and that $E(w^*+s-w) = E\tau$. Therefore, we can simplify

the expression above as

$$- \left[1 - (1-\gamma)(1-\delta)\right] E\tau = \frac{1}{2}\left(\sigma_\kappa^2 - \sigma_{\kappa^*}^2\right) + (1-n)\,\sigma_{\kappa s} + n\sigma_{\kappa^* s} + \sigma_{\kappa z} - \sigma_{\kappa^* z}$$

$$\left[1 - (1-\gamma)(1-\delta)^2\right]\sigma_{sz} + \frac{(1-2n)}{2}\left[1 - (1-\gamma)^2(1-\delta)^2\right]\sigma_s^2, \qquad (A.9)$$

which is the same as Equation (23) in the main text. Similarly, log-linearizing Expression (21) in the text gives

$$(1-n)\left[1 - (1-\gamma)(1-\delta)\right](w - w^*) =$$
$$\log\left[\frac{\phi\theta}{(\phi-1)(\theta-1)}\right] + E\kappa + (1-n)\left[1 - (1-\gamma)(1-\delta)\right]Es + \delta Ez +$$
$$\frac{1}{2}\sigma_\kappa^2 + \frac{(1-n)^2}{2}\left[1 - (1-\gamma)^2(1-\delta)^2\right]\sigma_s^2 + \frac{1 - (1-\delta)^2}{2}\sigma_z^2 +$$
$$+ (1-n)\sigma_{\kappa s} + \sigma_{\kappa z} + (1-n)\left[1 - (1-\gamma)(1-\delta)^2\right]\sigma_{sz}.$$

Substituting in the expression for the expected log terms of trade (A.9) and simplifying, one obtains Expression (25).

A.3.3 The productivity shocks

From the *definitions* of the common and idiosyncratic productivity shocks, note that we can express the MU and Home productivity shocks as

$$K^* = \frac{K_w}{(K_i)^n} \quad \text{and} \quad K = K_w\,(K_i)^{1-n}.$$

Therefore, for example $KS = K_w\,(K_i)^{1-n}\,S$ and $K^*S = \frac{K_w}{(K_i)^n}S$, which is why we must have that

$$\sigma_{\kappa s} = \sigma_{\kappa_w s} + (1-n)\,\sigma_{\kappa_i s} \quad \text{and} \quad \sigma_{\kappa^* s} = \sigma_{\kappa_w s} - n\sigma_{\kappa_i s}.$$

Partisan differences in Swedish macroeconomic policy

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Abstract

The purpose of this paper is to trace partisan differences among Swedish governments during the period 1958-2000. According to the Partisan Theory of macroeconomic policy left-wing governments are relatively more concerned with the performance of the real side of the economy (real output and unemployment) as compared to right-wing governments, that place a higher weight on the nominal variables (inflation). Left-wing governments would therefore pursue more expansionary aggregate demand policy, and thereby be willing to risk a higher inflation, in order to improve real economic performance. In this paper we apply the model developed in Hibbs (1994) on Swedish data. Our empirical results support the partisan theory, showing that, ceteris paribus, aggregate demand policy under left-wing governments is relatively more expansionary than under right-wing governments, even if the expansionary policy sometimes leads to higher inflation.

1   Introduction

A whole new field of economics opened up once Nordhaus (1975) wrote "The political business cycle." The central assumptions of the Nordhaus model is that voters are myopic and that party policies are not determined by partisan differences. Rather, a governing party capitalizes on voters' myopia and runs the economic policy in a way that will maximize the probability of being re-elected. Consequently as an election nears the economy should be characterized by increasing growth and falling inflation, while having the opposite effect in periods immediately following the election. Therefore, the pure existence of elections generate economic fluctuations. In opposition to this view, Hibbs (1977) presents a model in which parties also behave "ideologically." Winning elections is important, but only to the degree that it enables the party to "implement policies favoring their core constituencies" (Hibbs [1992], p.34). This contrasting theory is called the Partisan Theory.

The foundation of the Partisan Theory (PT) of macroeconomic policy lies in the stylized fact that parties are made up of different core constituencies. The differences in preferences among these constituencies are based heavily on distributional consequences of changes in inflation and unemployment. Generally, supporters of left-wing parties are less endowed with financial capital. Therefore they rely heavily on labor income. This makes the income of left-wing voters uncertain in periods of high unemployment. Right-wing voters on the other hand often possess financial capital, which makes them primarily interested in keeping the inflation down. Consequently, the left-wing party is, at least marginally, more interested in high growth (leading to high employment) while the right-wing party focuses primarily on keeping the inflation rate down. In the early models of political business cycles it was assumed that the economy worked along an almost stable Phillips curve in the inflation-unemployment space, and that politicians could pick a point along the curve that was consistent with the preferences of their core constituencies.

The Rational Partisan Theory (RPT) was developed by Chappell and Keetch (1986, 1988) and by Alesina and Sachs (1988) as a revision of the original PT to fit into the framework of rational expectations (RE). The original PT model was based on adaptive expectations, which allowed a backward sloping long-run Phillips curve (LRPC). In the RE paradigm, the LRPC is vertical. All attempts to increase aggregate demand by increasing government spending result in increased inflation. Chappell and Keech (1986) tested the RPT by applying ideas of long-term wage

contracts. They found that in a model with fixed and known party objectives, the presence of long-term unindexed nominal wage contracts with the contract period crossing an election, partisan influence on inflation and unemployment is possible due to uncertainty of the outcome of the election.

The empirical evidence that partisan effects exist on growth (and unemployment) and inflation is quite unanimous. Generally, partisan models outperform Nordhaus' political business cycle as an explanation for observed pattern of growth, unemployment and inflation over administration periods.[1]

Drazen (2000b) reviews the empirical studies of the Nordhaus model and concludes that the existence of an opportunistic PBC is generally rejected by U.S. data. This result carries over to data from developed economies outside the United States.[2]

Tests of the partisan theory, performed by Hibbs (1977, 1987) using U.S. postwar data on unemployment, growth, fiscal and monetary policy show strong support for the partisan theory. Alesina, Roubini and Cohen (1997) present calculations indicating that average real GDP growth during Democrat administrations from 1949-1994 was 4.2%. The same measure during Republican presidencies was 2.4%. The average inflation rate during the same period was 3.8% and 4.2% for Democrats and Republicans, respectively.

The big debate, though, is whether these observed partisan effects are transitory or permanent - that is, if the RPT is superior to the original PT. Alesina has, in different writings and with several co-authors, argued in favor of the RPT. For example, Alesina and Roubini (1992) test the RPT on a sample of 18 OECD countries, by regressing real output growth and the inflation rate, respectively, on lags of the dependent variable and a political variable accounting for the temporary partisan effect,[3] aim at showing that most partisan effects can be observed in the first half of an administration period. They find significant partisan effects in all their tests. The problem with the tests is, however, that they are not tests of the RPT, since they do not test the very core of the theory - the uncertainty associated with the outcome of the election.

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[1]Note that the two tracks are not mutually exclusive. Empirical evidence, however, tend to support partisan models.

[2]The numerous empirical empirical for the U.S. are summarized in Alt and Chrystal (1983) and in Alesina, Roubini and Cohen (1997). Paldam (1979), Lewis-Beck (1988) and Alesina, Roubini and Cohen (1997) are examples of studies using data from a larger sample of OECD countries.

[3]This political variable is most often constructed as a dummy taking $+1$ or -1 and it is then lagged N quarters ($N = 4, 6$ or 8), where $N = 0$ represents the change of government.

To test the core hypothesis of the RPT, it is necessary to account for the degree of uncertainty in the election outcome. Alesina, Roubini and Cohen (1997) convert pre-electoral polls into probabilities regarding the election outcome.[4] The uncertainty is then measured as a surprise, calculated as true voting outcome minus the probability of this outcome occurring. By including this in their regressions, Alesina et al. find that the surprise variable has significant effects on post-electoral growth and unemployment, with the expected signs. (A surprising left-wing election victory results in increased growth and lower unemployment.) Furthermore, the greater the surprise, the larger is the effect on the policy variable. The other central feature of the RPT is the existence of nominal inertia in wages. Carlsen (1998) utilizes a model first developed in Hibbs et al. (1996), in which probability series of voting outcomes are generated and combined with data regarding the duration and density of wage contracts in the U.S. Contrary to the findings of Alesina and Roubini these studies find no evidence supporting the RPT. On the contrary, the observed partisan pattern in the data can be explained by a simple partisan dummy taking the values +1/-1 for left- and right-wing governments. The amplitude of partisan differences in these studies is not affected by the degree of surprise in the election outcome.

The observed pattern of nominal spending and real output growth throughout the administration period is partisan divergence in the first half followed by convergence during the second half. Hibbs' (1994) explanation for this was that politicians are uncertain about the sustainable output growth path. Based on realized economic outcomes, politicians *ex post* continually upgrade their goals. Using data from the U.S., Hibbs' paper gives empirical evidence that this *ex post* learning extended PT can explain much of the observed pattern over the election periods. The Hibbs (1994) model thus contrasts the RPT explanation, where the observed paths were due to the uncertainty in the election outcome.

The empirical literature on partisan PBCs has to a large extent built on data from the United States. Exceptions include Alesina and Roubini (1992) and Alesina, Roubini and Cohen (1997) mentioned above. In a more recent contribution, Kiefer (2000) updates Alesina and Roubini's 18 OECD countries data sample forward to 1995. By comparing two models, one where agents form their expectations rationally

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[4]The work build on a technique developed by Cohen (1993), in which he attempts to quantify the degree of surprise in an election outcome by taking ideas from option pricing theory and applying them to poll data.

and one building on adaptive expectations, Kiefer's results suggest that the adaptive expectations version offers a better expanation to the observed pattern in the data than model assuming rational expectations. Veiga and Chappell (2002) presents evidence of partisan effects using unemployment data in 13 developed economies. In contrast to Kiefer (2000), however, their results provide more support for the RPT than for the traditional PT.

Empirical tests of partisan effects on economic outcome in Sweden have been sparse. As will be presented in Section 2, the observed pattern for inflation and real output growth in Sweden is partisan divergence during, in particular, the first year of an administration followed by convergence during the last two years. Carlsen and Pedersen (1999) include Sweden in their sample of seven countries when testing the RPT. They find partisan effects in Sweden, but these are not contingent on election surprises, and hence the results cannot explain the stylized fact of partisan convergence during the end of an administration. One reason for this lack of support for the RPT might be that the Swedish wage contract landscape has been dominated by synchronized contracts which typically have been renegotiated every year or every second year.[5] Fregert (1994) has summarized the Swedish wage negotiations from 1974 and on and by looking at these negotiations one can conclude that wage contracts in Sweden typically do not cross an election, and hence one fundamental assumption in the RPT model might be invalidated.[6] For policy instruments, rather than economic outcomes, Ohlsson and Vredin (1996) find partisan differences when they examine Swedish fiscal policy from 1970-1993. Revenues are generally higher under left-wing governments compared to right-wing governments. The same is true for expenditures, although to a lesser extent.

In this paper we will test for partisan differences in Swedish macroeconomic policy by applying the Hibbs' (1994) methodology on Swedish data. Sweden is a small open economy, and a prior expectation would be that the possibility to achieve partisan macroeconomic policy objectives is constrained by the heavy dependence on the international economy. In particular, the cost of high inflation is higher the

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[5]A potentially more important factor in determining the nominal inertia in an economy is the existence of price rigidities. To quantify price rigidities and to map a potentially staggered stucture in prices is, however, not feasible.

[6]In general, contracts have been renegotiated early in the calendar year following an election. Since elections in Sweden are held in September, it is reasonable to assume that the political consequences of a possible change in government will not show up before the turn of the calendar year.

more open an economy is, potentially lowering the willingness among politicians to pursue an expansionary aggregate demand policy at the risk of increasing inflation. As compared to Hibbs' original contribution, this model is extended also to study unemployment.

The main results of this paper are that using real output as the dependent variable, we find statistically significant partisan effects in Swedish macroeconomic policy outcomes. Uncertainty about economic outcomes, in particular how an aggregate demand expansion will be divided between growth of real output and inflation, makes politicians revise their output targets. The results for unemployment as dependent variable have the predicted signs, although the partisan difference is not significantly established.

The paper is organized as follows: Section 2 presents some stylized facts on how the important economic variables in Sweden have evolved during left- and right-wing governments, respectively. In Section 3, we present the theoretical models underlying the empirical results presented in Section 4. The paper ends with the concluding Section 5.

2 A preliminary look at the data

From 1958 to 2000 the dominating features of Sweden's economy were: (i) a consistently low *unemployment rate* up until the early 1990's, when a change in the monetary policy regime led to a rapid increase in the unemployment rate and (ii) an opposite general pattern for the *inflation rate*, which was high during most of the period up until the early 1990's and then fell substantially. This is illustrated in Figure 2.1. The two oil crises in the mid and late 1970's led to dramatic increases in the inflation rate. These adverse supply shocks, however, did not have any dramatic effect on Swedish unemployment which was consistently below 3.5% up until the early 1990's. The shift from left to right-wing governance in 1991 had large consequences for the Swedish economy. Not only did it imply a new government, it meant a change from the full-employment regime that had dominated the macroeconomic policy during the post-war period to a low-inflation regime. The pattern of real GDP growth follows the development of unemployment, although the effects on output from the change in monetary regime were less persistent than the unemployment effects.

Figure 2.1. Inflation, real growth and unemployment in Sweden from 1958-2000.
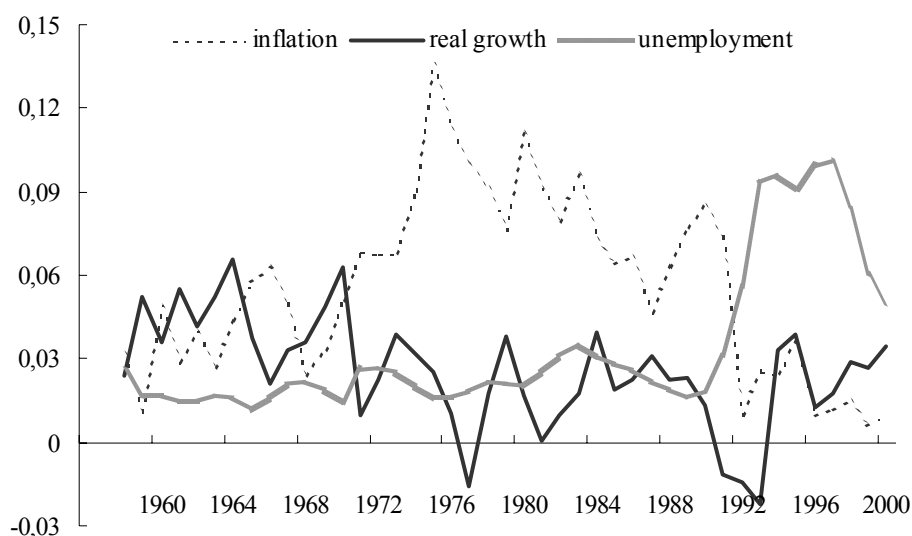
The data I will use for my empirical analysis in Section 4 cover the years 1958-2000. During this period Sweden had three periods of right-wing administration[7] and ten periods of left-wing governance. Figure 2.1 shows the development of inflation, real growth and unemployment in Sweden between 1958-2000. In Table 2.1 the same variables are averaged using the first, second and third years of an administration period.[8] Keeping in mind the potential problem with bias towards left-wing governments, the data gives clear indications of partisan patterns. Unemployment, on average, falls slightly for each year of left-wing administration, while it, on average, increases by more than one percent during the first year of right-wing governance. Right-wing governments generally inherit a high rate of inflation, but they manage to bring it down over the administration period.

The accumulated growth over the period of administration is considerably higher under left- compared to right-wing administrations. This preliminary glance at the data suggests that partisan differences in Sweden do exist, but it is less clear whether these differences concern the potential trade-off between inflation and unemployment

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[7]The right-wing parties held office from 1976-1982 and 1991-1994.

[8]After 1994, the term of office is four years. Before 1970, elections were held 1958, 1960, 1964 and 1968.

or the trade-off between inflation and real growth. In the remainder of this paper we will therefore put both alternatives to the test.

Table 2.1 Macroeconomic stylized facts by first to third year of left- and right-wing administrations, 1958-2000

Year	Real GDP growth	Inflation	Unemployment
LEFT-WING ADMINISTRATION			
First	3.34	4.84	3.16
Second	3.34	5.63	3.03
Third	2.17	5.96	3.17
Cumulative change	8.85	16.43	
RIGHT-WING ADMINISTRATION			
First	-0.50	7.61	3.13
Second	-0.30	7.07	4.67
Third	2.86	7.25	4.93
Cumulative change	2.06	21.93	

3 The model

3.1 Intuition

The main target variable for economic policy in Sweden has, at least up to 1992, been unemployment. This is true for left-wing as well as for right-wing governments. Keeping unemployment down, however, is not a "free lunch". One measure of the cost of keeping unemployment down is in terms of inflation. The hypothesis I want to test in this paper is whether it is possible to find partisan differences in Sweden in terms of this cost; specifically whether left-wing governments are more willing than right-wing governments to accept higher inflation as a "price" in order to bring down unemployment.

Early models describing political business cycles assume that preferences of political parties are stable over time and hence, not contingent on economic outcomes.

The model in this paper is very similar to the work originally presented in Hibbs (1994). The key feature of the model is that politicians are uncertain about the sustainable path for the growth of real output (potential output) and about the natural rate of unemployment. Therefore, they are uncertain about how an expansionary policy will be divided between the real (output and unemployment) and the nominal (inflation) side of the macroeconomy. Contingent on continuous updating of the expected economic outcomes, in particular on the effects of an expansionary economic policy, the model allows politicians to revise their objectives in every time period. I implement this idea by assuming that governments use time-varying parameter estimates based on 30 years rolling regressions.

3.2 The Macroeconomy

A structural equation for real output in the economy is assumed to be of the Lucas-form.[9] The trend-reverting log of real output (q) is driven by (politically induced) expansions in aggregate demand (Δy) and shocks. We have

$$q_t = \alpha(t) + \beta(t)T + \pi(t)\Delta y_t + \delta(t)q_{t-1} + \psi_0(t)z_t + \psi_1(t)z_{t-1} + \epsilon_t, \qquad (1)$$

where y denotes log nominal output, Δ is the first backward diffence and T is a time trend. Supply shocks[10] are captured by the variable z and the demand shocks, ϵ, are assumed to exhibit autoregressive persistence

$$\epsilon_t = \phi_i(t)\epsilon_{t-i} + v_t, \qquad\qquad i = 1, 2... \qquad (2)$$

The parameters in (1) and (2) are purposely written as time dependent, since the parameters are allowed to vary over time. The government is therefore uncertain about how a demand expansion will affect real output. It is assumed that the government generates guesses about correct parameter values by undertaking rolling regressions of Equations (1) and (2). In Section 3.3 below the policy target will be defined. The government tries to attain this target by aggregate demand management. That is by setting Δy_t. However, since the policymakers do not know the realized value of

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[9]For a derivation of this equation, see Lucas (1973).

[10]In the empirical work ahead we use the proportional change in the real price of oil defined as $[(\ln(OIL_t) - \ln(OIL_{t-1})) - (\ln(P_t) - \ln(P_{t-1}))]$, where OIL_t is the price of crude oil, in the domestic currency, and P_t is the GDP deflator. This relative price change is weighted by the change in net oil imports over real GDP.

the parameter $\pi(t)$, the government cannot with certainty predict how an increase in aggregate demand will affect real output. Inflation in the economy is given by the identity

$$\Delta p_t \equiv \Delta y_t - \Delta q_t, \tag{3}$$

where p_t is the log GDP deflator. Consequently, Δp_t, is the annual realized rate of inflation. The policymakers form their inflation expectations rationally by substituting (1) and (2), with best current estimates of the parameters ($\hat{\alpha}$, $\hat{\beta}$, $\hat{\pi}$, $\hat{\delta}$, $\hat{\psi}_0$, $\hat{\psi}_1$ and $\hat{\phi}_i$) and the optimizing rate of demand expansion Δy_t^*, into (3). This gives us the following expression for the rationally expected inflation (Δp_t^e)

$$
\begin{aligned}
\Delta p_t^e &= \Delta y_t^* - (\hat{q}_t - q_{t-1}) \\
&= (1 - \hat{\pi}(t))\Delta y_t^* + (1 - \hat{\delta}(t))q_{t-1} - (\hat{\alpha}(t) + \hat{\beta}(t)T + \hat{\psi}_1(t)z_{t-1} + \epsilon_t),
\end{aligned}
\tag{4}
$$

where a hat indicates that the parameter is estimated. In Equation (4) the estimated time-varying parameters are defined as $\hat{x}(t) = E(x_t|I_{t-1})$ where the vector I_{t-1} includes information of realized economic variables up to period $t-1$.[11] The supply shock in period t is not included in the determination of expected inflation, since we assume that $E(z_t|I_{t-1}) = 0$.

In Section 2 we saw that the party split in Swedish macroeconomic policy might just as well concern the trade-off between inflation and unemployment as the trade-off between inflation and real output. Using unemployment as the policy target variable is, however, trickier than using real output. There are several reasons for this: (i) data on unemployment are often less reliable, but the main difficulty is that (ii) the link from the policy instrument (i.e. increases in nominal spending) to unemployment may be either through increases in real output or through increased inflation (that is, if the Phillips curve is backward-sloping). Based on simple OLS estimations on Swedish data, we conclude that the most important determinant of unemployment is growth of real output. When the government forms its expectations of unemployment for the following period we therefore assume that it uses an Okun-like relationship

$$\hat{U}_t = \hat{\alpha}_u(t) + \hat{\eta}(t)\left(\hat{q}_t - q_{t-1}\right) + \hat{\gamma}(t)U_{t-1} + \hat{\chi}(t)\,PS_t, \tag{5}$$

---

[11] That is, the expected value of the parameters for period t are obtained by rolling regressions of equation (1) and (2) over the period $t-30$ to $t-1$.

where $\hat{U}_t$ is the estimated unemployment rate (measured in percentage points). The government can then affect the unemployment rate through real output growth by aggregate demand management. The variable PS_t is a dummy variable equal to 1 for the years 1993-2000, 0 otherwise, included to capture the policy shift that took place in the beginning of the 1990's.

3.3 Partisan objectives

In the following empirical estimations we will use both real output as well as unemployment as policy target variables. The specifications of the targets are similar.

3.3.1 Real output as the policy target variable

In the rich literature on partisan theory the variable most commonly used to measure the real side of the economy is the growth of real output. I assume that the government log real output target, q_t^T, for each period can be written

$$q_t^T = \hat{\alpha}(t) + \{\Pi_{left}(t)L_t + \Pi_{right}(t)(1 - L_t)\}\, \hat{\beta}(t)T + \hat{\pi}(t)\Delta y_t^* + \hat{\delta}(t)q_{t-1}, \quad (6)$$

where $\Pi_{left}(t)$ and $\Pi_{right}(t)$ are the time-varying partisan target variables and L_t is a binary variable equal to one during years of left-wing governance - zero otherwise. The time-varying partisan target variables are stated as multiples of the estimated trend growth rate of output, which allows the model to capture the fact that the output target of the party in office may vary depending on where in the business cycle the politicians anticipate the economy to be. These time-varying output targets are defined as

$$\Pi_j(t) = \beta_j^q + \beta_{p0}^q \Delta p_t^e + \sum_{i=0}^{\infty} \beta_{pi}^q \Delta p_{t-i-1}, \qquad j = left,\ right \qquad (7)$$

where the expected inflation, Δp_t^e, is generated according to Equation (4). The partisan target variables vary with the expected and realized rates of inflation, reflecting that in periods of high expected and/or realized inflation, the incumbent government may want to choose a lower target value for real output. All β^q's are parameters to be estimated in Section 4, where β_{left}^q and β_{right}^q are the "deep" parameters, reflecting the different partisan preferences. We expect at least one of β_{p0}^q or the β_{pi}^q's to be negative and, assuming that parties do not differ in their formation of inflation expectations, if partisan theory applies to Sweden it must be the case

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that $\beta_{left}^q > \beta_{right}^q$.

The government chooses an optimizing rate of aggregate demand expansion by minimizing its expected loss function

$$
\begin{aligned}
E(\Lambda_t^q) &= E(q_t - q_t^T)^2 \\
&= \sigma_{\hat{q}_t}^2 + (\hat{q}_t - q_t^T)^2,
\end{aligned} \tag{8}
$$

where $\sigma_{\hat{q}_t}^2$ is the one step ahead variance of forecast output.[12] Minimizing (8) subject (1), (2), (6) and (7) gives that the optimal rate of aggregate demand expansion, Δy_t^* can be written:

$$
\begin{aligned}
\Delta y_t^* = {} & \frac{\sigma_{\hat{\pi}}^2}{\Gamma(t)^2 + \sigma_{\hat{\pi}}^2} \Delta \bar{y}(t) + \frac{\Gamma(t)}{\Gamma(t)^2 + \sigma_{\hat{\pi}}^2} \left(q_t^T - \hat{q}_t \right)' \\
& - \frac{1}{\Gamma(t)^2 + \sigma_{\hat{\pi}}^2} \Big\{ \left(T - \bar{T} \right) \sigma_{\hat{\pi},\hat{\beta}} + (q_{t-1} - \bar{q}_{t-1}) \sigma_{\hat{\pi},\hat{\delta}} + \\
& \qquad (z_{t-1} - \bar{z}_{t-1}) \sigma_{\hat{\pi},\hat{\psi}} + \Sigma_i \left(\epsilon_{t-i} - \bar{\epsilon}_{t-i} \right) \sigma_{\hat{\pi},\hat{\phi}_i} \Big\}
\end{aligned} \tag{9}
$$

where $\Gamma(t) = \left[\beta_{p0}^q (\hat{\pi}(t) - 1)\hat{\beta}(t)T \right]$ and where $\left(q_t^T - \hat{q}_t \right)' = \left(q_t^T - \hat{q}_t \right) - \Gamma(t)\Delta y_t^*$. A bar indicates the mean of a variable.

3.3.2 Unemployment as the policy target variable

The next step is to formulate an unemployment policy target. Drazen (2000a) makes the assumption that the two parties differ in their estimates of the natural rate of unemployment, with a tendency of the left-wing party to underestimate the natural rate and a tendency of the right-wing party to overestimate it. I will take a similar approach and assume that the parties do not differ in the way they estimate the natural rate of unemployment, but that the left-wing party is more willing accept the risk of higher inflation to see if a natural rate lower than the current estimate

---

[12]The one-period ahead variance of expected real output, $\hat{q}_t$, is given by

$$
\sigma_{\hat{q}}^2 = \sum_m (x_m - \bar{x}_m)^2 \sigma_{\hat{\Omega}_m}^2 + 2 \sum_{m \neq n} (x_n - \bar{x}_n)(x_m - \bar{x}_m) \sigma_{\hat{\Omega}_n, \hat{\Omega}_m}
$$

where x_m denotes the explanatory variables in (1) and (2), that is T, Δy_t^*, q_{t-1}, z_{t-1} and ε_{t-i}. A bar, $\bar{x}_m$, indicates the mean of a variable. The vector $\hat{\Omega}_m$ contains the estimated parameters $\hat{\beta}$, $\hat{\pi}$, $\hat{\delta}$, $\hat{\psi}_1$ and $\hat{\phi}_i$. The term $\sigma_{\hat{\Omega}_m}^2$ denotes the sample variances and $\sigma_{\hat{\Omega}_n, \hat{\Omega}_m}$ the sample covariances of these parameters. Time indexes are supressed in the above equation, but since all parameters are time varying, a new parameter vector is estimated in each time period.

might be sustained. I assume the unemployment target for period t to be

$$U_t^T = U_{t-1} \left\{ \lambda_{left}(t) L_t + \lambda_{right}(t)(1 - L_t) \right\} \tag{10}$$

where $\lambda_{left}(t)$ and $\lambda_{right}(t)$ are defined as

$$\lambda_j(t) = \beta_j^u + \beta_{p0}^u \Delta p_t^e + \sum_{i=0}^{\infty} \beta_{pi}^u \Delta p_{t-i-1}, \quad j = left, right,$$

and now denotes the time-varying unemployment targets for the left-wing and right-wing parties, respectively. Thus, if the policy makers expect inflation to accelerate, the inherited unemployment is below the natural rate, which makes the policy makers to revise their unemployment target upwards. The expected loss function is expressed as a direct parallel to (8). For period t the expeced loss is defined as

$$
\begin{aligned}
E(\Lambda_t^U) &= E(U_t - U_t^T)^2 \\
&= \sigma_{\hat{U}_t}^2 + (\hat{U}_t - U_t^T)^2,
\end{aligned} \tag{11}
$$

where $\hat{U}_t$ is the expected unemployment rate in period t, based on rolling regressions of Equation (5) and where U_t^T is the unemployment target prevailing for period t. Figure 1 shows that the variance in Swedish unemployment has been quite low, why I assume all uncertainty terms to be zero.[13] Proceeding like in Section 3.3.1 and minimizing this loss function with respect to nominal output expansion then gives us the optimality condition

$$\Delta y_t^* = \frac{1}{\Theta(t)} \left[U_t^{T\prime} - \hat{U}_t{}' \right], \tag{12}$$

where $\Theta(t) = \left[\hat{\pi}(t)\hat{\eta}(t) - U_{t-1}\beta_{p0}(1 - \hat{\pi}(t)) \right]$, $\hat{U}_t{}' = \left[\hat{U}_t - \hat{\pi}(t)\hat{\eta}(t)\Delta y_t^* \right]$ and $U_t^{T\prime} = \left[U_t^T - U_{t-1}\beta_{p0}(1 - \hat{\pi}(t))\Delta y_t^* \right]$.

---

[13]This assumption simplifies the expression for optimal aggregate expansion (Δy_t^*) considerably.

4 Empirical results

4.1 Real output as the policy target variable

The results from nonlinear least squares estimation of Equation (9) are presented in table 4.1. A comparison between the estimated value of the two partisan parameters, β^q_{left} and β^q_{right} gives significant indications of partisan differences among policymakers in Sweden. If we do not account for the inflation effect, the interpretation of Regression (1) in Table 4.1 below is that over a three-year administration period left-wing governments set real output growth targets 0.6% above the estimated historical trend growth of real output. The corresponding value for right-wing governments is about 4.8% below estimated trend growth. Even if the annual diffence is quite small $\left(\beta^q_{left} - \beta^q_{right} = 0.018\right)$, low standard errors enable us to state that the diffence is statistically significant. If the estimation is undertaken with all uncertainty terms equal to zero, as in Regressions (3) and (4), the real output targets increase slightly. The interpretation is that uncertainty about how an aggregate demand expansion will actually be divided between inflation and real output growth makes the Swedish policymakers less prone to undertake an expansionary policy.

The Regressions (1) and (2) are similar, but differ in how many previous inflation records governments account for when forming their time-varying policy targets for the coming period. Successive inclusion of inflation in period $t-2$ shows that expected inflation has a substantial negative influence on the formation of growth targets. Realized inflation two periods ago does not appear to have a significant impact on the formation of output targets in the current period. Using regression (1) we can write a linear combination of the inflation parameters $-0.885\Delta p^e_t + 0.159\Delta p_{t-1}$. Hence, Swedish governments partly accommodate the previous year's inflation, while the expected inflation for the current year is resisted. With the right-wing governments in office during the high inflation second half of the 70's, the evidence indicates that right-wing governments typically pursued output growth targets well below the historical trend.

Table 4.1 Estimates for aggregate demand expansion (Δy_t) models, policy target variable; log of real GNP, q_t, annual data 1958-2000.

Coefficient	$(1)^a$	$(2)^a$	$(3)^b$	$(4)^b$
		Regression models		
β_{left}^q	1.002	1.007	1.013	1.015
	(99.1)	(93.9)	(125.0)	(117.0)
β_{right}^q	0.984	0.992	0.994	0.998
	(86.2)	(76.0)	(108.6)	(96.8)
β_{p0}^q	-0.885	-0.872	-0.836	-0.836
	(-6.87)	(-6.92)	(-7.27)	(-7.25)
β_{p1}^q	0.159	0.263	0.179	0.241
	(1.51)	(1.93)	(1.99)	(2.02)
β_{p2}^q		-0.166		-0.094
		(-1.28)		(-0.85)
constant	0.026	0.022	0.035	0.034
	(1.78)	(1.53)	(2.55)	(2.41)
Adjusted $\bar{R}^2$	0.36	0.37	0.33	0.32
Durbin-Watson	1.55	1.62	1.41	1.46
Significance level for $\beta_{left} = \beta_{right}$	0.009	0.044	0.002	0.006

[a] Estimations based on equation (9) in the text.

[b] Estimations with the uncertainty terms set to zero.

t-statistics in parentheses.

Hence, as implied by the stylized facts in Section 2 and in accordance with the partisan theory, the evidence indicates that left-wing governments in Sweden pursue less disinflationary growth-oriented aggregate demand policies than right-wing governments. The regression results also imply that higher expected inflation leads politicians to lower their real output targets. The effect of expected inflation seems to be a greater determinant than the inherited inflation.

4.2 Unemployment as the policy target variable

The estimations, using unemployment as the policy target variable, give indications of partisan effects in Swedish macroeconomic policymaking, although the estimated difference is less significant than the results achieved with real output as the target variable. In both regressions the partisan parameters are smaller for left- than for right-oriented governments ($\beta_{left}^u < \beta_{right}^u$). The interpretation is that left-wing governments choose a lower unemployment target than right-wing governments. Once again the estimations imply that expected inflation has a significant influence on the optimal choice of aggregate demand expansion, as does the inherited inflation from

the previous period. As for the growth regressions, realized inflation two periods earlier does not seem to have any influence on the unemployment policy target.

Table 4.2 Estimates for aggregate demand expansion models (Δy_t), policy target variable; the unemployment rate U_t, annual data 1958-2000.

Coefficient	Regression models	
	(5)	(6)
β^u_{left}	1.250	1.270
	(6.81)	(6.85)
β^u_{right}	1.356	1.393
	(7.70)	(7.95)
β_{p0}	6.664	6.478
	(5.06)	(5.06)
β_{p1}	-4.133	-3.397
	(-3.89)	(-2.58)
β_{p2}		-1.022
		(-0.84)
constant	0.063	0.063
	(0.30)	(0.32)
$\bar{R}^2$	0.26	0.23
Durbin-Watson	1.50	1.46
Significance level for $\beta_{left} = \beta_{right}$	0.121	0.084

Note: *t*-statistics in parentheses.

5 Conclusions

The purpose of this paper is to trace partisan differences in Swedish macroeconomic policy using data for the time period 1958-2000. Statistically significant partisan differences are found when real output is used as the policy target variable. The results show that left-wing governments in Sweden generally pursue an economic policy aimed at pushing real output growth above the estimated historical trend. Both realized previous inflation and expected current inflation have dampening effect on the government's choice of aggregate demand expansion. When accounting for this inflation effect, right-wing governments typically aim for a demand expansion below the historical trend. We have not been able to establish significant partisan effects with unemployment as the policy target variable, although the results in Table 4.2 give indications of partisan differences.

The results in this paper extend previous research using Swedish data by explaining the within an election period observed pattern of partisan divergence during the

first half followed by convergence during the second half of an administration. As compared to the Hibbs' (1994) results for the U.S., the partisan difference between left- and rightwing administration seems smaller in Sweden than in the U.S. One explanation for this might be the restriction on pursuing independent partisan policies that follows from the fact that Sweden is a small, open economy.

There is an unfortunate dichotomy in partisan models of macroeconomic policies. Although critizised,[14] the theoretical foundations of the RPT does not invalidate the crucial assumption of rational expectations. Still, the empirical support for the core RPT model is weak, and is generally empirically outperformed by the traditional PT. In particular, the model in Hibbs (1994) and in this paper, including updating of partisan targets conditioned on economic outcomes, does well in expaining the observed partisan pattern in nominal spending and real output. The drawback of this model,[15] however, is that the microeconomic foundations, including the central question of what mechanism that allows even predicted nominal demand adjustments to affect the real economy, still needs a thorough theoretical as well as empirical explanation.

REFERENCES

Alesina, A. and N. Roubini (1992), "Political Cycles in OECD Countries," *Review of Economic Studies* 59: 663-688.

Alesina, A., N. Roubini and G. D. Cohen (1997), *Political Cycles and the Macroeconomy*, MIT Press, Cambridge, MA.

Alesina, A. and J. Sachs (1988), "Political Parties and the Business Cycle in the US," *Journal of Money, Credit and Banking* 20: 63-82.

Alt, J. and A. Chrystal (1983) *Political Economy* Berkeley University Press, Berkeley, CA.

Carlsen, F. (1998), "Rational Partisan Theory: Empirical Evidence for the United States," *Southern Economic Journal* 65: 64-82.

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[14] For example, as stressed by Rogoff (1988), the rationality of wage setters writing wage contracts that cross an election, even though that would significantly affect unemployment, can be questioned.

[15] This point is made also by Hibbs (1994) and Drazen (2000a)

Carlsen, F. and E. F. Pedersen (1999), "Rational Partisan Theory: Evidence for Seven OECD Economies," *Economics and Politics* 11: 13-32.

Chappell, H.W. and W. R. Keech (1986), "Party Differences in Macroeconomic Policies," *American Economic Review* 76: 71-74.

Chappell, H.W. and W. R. Keech (1988), "The Unemployment Consequence of Partisan Monetary Regimes," *Southern Economic Journal* 55: 107-122.

Cohen, G. (1993), *Pre- and Post-Electoral Macroeconomic Fluctuations Dissertation*, Department of Economics, Harvard University.

Drazen, A. (2000a), *Political Economy in Macroeconomics*, Princeton University Press, Princeton, NJ.

Drazen, A. (2000b), "The Political Business Cycle after 25 Years," *NBER Macroeconomics Annual 2000*, MIT Press, Cambridge, MA.

Fregert, K. (1994), *Wage contracts, policy regimes and business cycles: a contractual history of Sweden 1908-1990,* Lund Economic Studies 54, Lund, Sweden.

Hibbs, D. A. (1977), "Political Parties and Macroeconomic Policy," *American Political Science Review* 7: 1467-87.

Hibbs, D. A. (1987), *The American Political Economy: Macroeconomics and Electoral Politics in the United States.* Harvard University Press, Cambridge, MA.

Hibbs, D. A. (1992), "Partisan Theory after Fifteen Years," *European Journal of Political Economy* 8: 361-373.

Hibbs, D. A. (1994), "The Partisan Model of Macroeconomic Cycles: More Theory and Evidence from the United States," *Economics and Politics* 6: 1-23.

Hibbs, D. A., Carlsen, F. and Pedersen (1996), "Electoral Uncertainty and Partisan Output Cycles," *Working Paper*, Department of Economics, Norwegian University of Science and Technology, Trondheim, Norway.

Kiefer, D. (2000), "Activist Macroeconomic Policy, Election Effects and the Formation of Expectations: Evidence from OECD Countries," *Economics and Politics* 12: 137-154.

Lewis-Beck, M. (1988), *Economics and Elections*, University of Michigan Press, Ann Arbor.

Lucas, R. E. (1973), "Some International Evidence on Output-Inflation Tradeoffs," *American Economic Review* 63: 326-334.

Nordhaus, W. (1975), "The Political Business Cycle," *Review of Economic Studies* 42: 169-190.

Ohlsson, H. and A. Vredin (1996), "Political Cycles and Cyclical Policies," *Scandinavian Journal of Economics* 98: 203-218.

Paldam, M. (1979) "Is There an Electoral Cycle? A Comparative Study of National Accounts," *Scandinavian Journal of Economics* 81: 323-42.

Rogoff, K. (1988), "Comment on 'Macroeconomics and Politics'," *NBER Macroeconomics Annual*, MIT Press, Cambridge, MA.

Veiga, L. G. and Chappell, Jr, H.W. (2002), "Politics and Unemployment in industrialized democracies," *Public Choice* 110: 261-282.