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Essays on Shocks, Welfare, and Poverty Dynamics: Microeconometric Evidence from Ethiopia

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To Elsi, Ruth, and Rakeb

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Abstract

Five self-contained papers constitute this thesis.

Paper 1: Does fertilizer use respond to rainfall variability? Panel data evidence from urban Ethiopia

In this article, we use farmers' actual experiences with changes in rainfall levels and their responses to these changes to assess whether patterns of fertilizer use are responsive to changes in rainfall patterns. Using panel data from the Central Highlands of Ethiopia matched with corresponding village-level rainfall data, the results show that the intensity of current year's fertilizer use is positively associated with higher rainfall levels experienced in the previous year. Rainfall variability, on the other hand, impacts fertilizer use decisions negatively, implying that variability raises the risks and uncertainty associated with fertilizer use. Abundant rainfall in the previous year could depict relaxed liquidity constraints and increased affordability of fertilizer, which makes rainfall availability critical in severely credit-constrained environments. In light of similar existing literature, the major contribution of the study is that it uses panel data to explicitly examine farmers' responses to actual weather changes and variability.

JEL Classification: O12, O33, Q12, Q16, Q54
Keywords: Fertilizer use; Rainfall; Highlands of Ethiopia; Panel data

Paper 2: Household-level consumption in urban Ethiopia: The effects of a large food price shock

We use survey data to investigate how urban households in Ethiopia coped with the food price shock in 2008. Qualitative data indicate that the high food price inflation was by far the most adverse economic shock between 2004 and 2008, and that a significant proportion of households had to adjust food consumption in response. Regression results indicate that households with low asset levels, and casual workers, were particularly adversely affected by high food prices. We interpret the results as pointing to the importance of growth in the formal sector so as to generate more well-paid and stable jobs.

JEL Classification: O12, O18, D12.
Keywords: consumption, welfare, food price shock; Africa, urban Ethiopia.

Paper 3: The impact of food price inflation on consumer welfare in urban Ethiopia: A quadratic almost ideal demand system approach

This paper investigates the impact of food price inflation on consumer welfare in urban Ethiopia 2004-2009. A quadratic almost ideal demand system (QUAIDS) is estimated using data from 2000 to 2009. Statistical tests suggest the QUAIDS is preferred over the conventionally used AIDS model. Compensating variation calculated using estimated price elasticities shows that from 2004 to 2009, households in urban Ethiopia lost an equivalent of 15 percent of their food budget annually due to the unprecedented food price inflation. Poor households, who spend a higher proportion of their budget on food, were affected more adversely than non-poor households. Moreover, with a more or less uniform increase in the price of major food items, households in urban Ethiopia appear to have limited options for substitution. These findings can provide important information to policy makers and can help aid organizations design and implement better social assistance schemes in the future.

JEL Classification: D12, Q19, R2
Keywords: urban Ethiopia, food price, consumer demand, welfare

Paper 4: What do policy makers know about the factors influencing citizens' subjective well-being?

In light of the increased interest in using subjective well-being as an outcome variable beyond GDP, as for example argued by the Stiglitz Commission, there is an interest in analyzing policymakers' knowledge on what variables influence citizens' subjective well-being. We elicit what policymakers guess influence citizens' subjective well-being with a focus on environmental variables. Our study, conducted on policymakers in Addis Ababa, Ethiopia, shows large heterogeneity in their guesses. Overall, we find that the factors that correlate with citizens' subjective well-being in Addis Ababa are similar to those found in rich Western countries. Moreover, there is a low correlation between what policymakers guess affects citizens' subjective well-being and our empirical findings on the matter. As an alternative check for the similarities between citizens' and policymakers' preferences, we also undertook a ranking exercise of setting priority areas. Compared to the citizens, policymakers put more weight on longer-term projects. By and large, our study indicates that policymakers have a heterogeneous, and hence a non-negligible proportion of them have a fairly poor understanding of what correlates with citizens' subjective well-being.

JEL Classification: D61, Q58
Keywords: subjective well-being; policymakers; life satisfaction; environment; Ethiopia.

Paper 5: Poverty dynamics and intra-household heterogeneity in occupations: Evidence from urban Ethiopia

Using five rounds of panel data spanning 15 years, this paper investigates the dynamics and persistence of poverty in urban Ethiopia with a particular focus on the role of intra-household heterogeneity in occupations. Urban poverty measured by the head count index declined from 52 to 34 percent from 1994 to 2009. Regression results from dynamic probit models provide strong evidence of state dependence and show that education, labor market status of household heads, international remittances, and household demographic characteristics are important determinants of poverty. The paper also finds strong evidence of the role of labor market status of non-head household members. Regression results from discrete-time proportional hazard models of poverty spells also confirm the importance of labor market status of household members and remittances in determining poverty exit and re-entry rates of households. In addition to investigating the trends, dynamics and persistence of poverty in urban Ethiopia, the paper discusses important policy implications that can be useful for designing effective policies for poverty reduction and targeting.

JEL Classification: I32, R20, D80
Keywords: urban Ethiopia, poverty dynamics, dynamic probit, hazard rate, labor market status

Overview

Households in developing countries are vulnerable to different covariate and idiosyncratic shocks (serious adverse events) such as drought, inflation, conflict, unemployment, and health shocks. Investigating this vulnerability and the welfare impact of shocks has been a major theme of applied research in development economics over the past two decades. A region that is one of the world's most vulnerable to shocks is Sub-Saharan Africa (Dercon, 2008).

This thesis applies a variety of micro-econometric tools to address the issues of shocks, welfare, and poverty dynamics in Ethiopia in five self-contained but closely related papers. Although Ethiopia has exhibited rapid economic growth in recent years, it is still one of the least developed countries in terms of standard measures of development. In 2005, for instance, about 38 percent of the population was believed to live in absolute poverty (Central Intelligence Agency, 2011). This is mainly because the economy is highly dependent on the agricultural sector, which is predominantly rain-fed and vulnerable to climatic shocks. In 2009, this sector comprised about 43 percent of the GDP and 85 percent of total employment (Central Intelligence Agency, 2011). Thus, understanding the factors associated with vulnerability, and the implications and consequences of shocks in Ethiopia is highly relevant for policy makers, development organizations, and academicians at large. Given the similarities among African countries in terms of economic structure, the findings of this thesis may be relevant to other Sub-Saharan African countries as well.

Applied research on risk and shocks in developing countries in the past decades has not particularly focused on the implications of and the scope for interventions. Instead, the focus has to a great extent been on risk management and coping mechanisms (Dercon, 2008). In light of this, **Paper I** in the thesis, titled *Does fertilizer use respond to rainfall variability? Panel data evidence from Ethiopia* investigates the impact of rainfall variability on farmer's adoption behavior as regards a productivity enhancing agricultural input (fertilizer) in rural Ethiopia. Agriculture is inherently risky and in a predominantly rain-fed agricultural setting, the level of rainfall and its variability may affect decisions regarding the use of productivity-enhancing external inputs such as fertilizer and improved seeds. This is because the level of liquidity of a typical smallholder farm household is affected by rainfall availability and variability (Paxson, 1992). Moreover, the likelihood of crop failure, which is largely determined by rainfall abundance and variability, affects the risk-bearing ability of households. Since market imperfections (e.g., for insurance and credit) are common in rural

areas in developing countries (de Janvry et al., 1991), *ex ante*, farm households make production and input use choices that minimize their exposure to such risks (Dasgupta, 1993).

Using household data from the Central Highlands of Ethiopia matched with corresponding village-level rainfall data, this paper therefore investigates the impact of rainfall and rainfall variability on fertilizer adoption. Regression results from random effect tobit and probit models show that abundance in previous year's rainfall levels increase the current year's fertilizer use. This implies that in settings like rural Ethiopia, characterized by very low income levels and notoriously imperfect credit markets, abundant rainfall in the previous year increases harvests and households' disposable income, thereby relaxing liquidity constraints. The results also indicate that rainfall variability makes fertilizer use less likely and reduces the intensity of its application. In view of these findings, the paper highlights the importance of policies that in the short-run incorporate index-based insurance and credit provision to farm households. Given the unsustainability of providing insurance against crop failure in the long-run, the paper also highlights the importance of structural transformation that reduces dependency on agriculture and of exploring other livelihood strategies including, livestock production, and off-farm employment opportunities.

Since 2005, the world has been experiencing unprecedented surges in the price of globally traded major food items. For instance, from 2005 to 2007, the price of maize, milk powder, wheat, and rice increased by 80 percent, 90 percent, 70 percent, and 25 percent, respectively (Ivanic and Martin, 2009). Following the summer of 2008 prices declined for a while, but then the prices of all food items except dairy products soared again and reached the highest levels ever in December 2010 (FAO, 2011). One of the countries that experienced an unprecedented increase in food prices from 2005 to 2008 is Ethiopia. Ethiopia's economy grew rapidly during this period with an average real growth rate of 11 percent per year (IMF, 2011). During the same period, however, the country experienced the worst inflation rate in history – the overall annual rate of inflation rose from 15.1 percent in June 2007 to a peak of 55.3 percent in June 2008. The general inflation was mainly driven by food price inflation, which measured in simple growth rates rose from 18.2 percent in June 2007 to a peak of 91.7 percent in July 2008 (CSA, 2009). Both globally and in Ethiopia, food price inflation was driven by higher grain prices, and grains represent a significant portion of the food basket of households in developing countries.

The unprecedented food price shock in Ethiopia led the author to update the existing urban panel data – the Ethiopian Urban Socio-economic Survey (EUSS) – and investigate the possible welfare implications on household welfare in urban Ethiopia. The EUSS is a rich

panel dataset collected by the Department of Economics, Addis Ababa University, in collaboration with the Department of Economics, University of Gothenburg in five rounds 1994-2004. The author collected a sixth round of data in late 2008-early 2009 from a sub-sample of the households in four cities: Addis Ababa, Awassa, Dessie, and Mekelle. **Papers II** and **III** investigate the welfare impact of the 2007-08 food price inflation on households in urban Ethiopia using this data set. Households in urban Ethiopia are particularly vulnerable to food price shocks due to at least three reasons: First, the share of the household budget spent on food in urban Ethiopia is high, suggesting that welfare is sensitive to food price changes. Second, little food production takes place in urban areas, thus there will not be significant positive income effects from higher food prices. Third, households are not able to insure themselves against such types of covariate shocks through the formal insurance market.

Using panel data spanning 2000-2009, **Paper II** titled *Household level consumption in urban Ethiopia: The effects of a large food price shock* therefore investigates which socio-economic groups in urban Ethiopia were vulnerable to the food price shock in Ethiopia 2007-2008 using three distinct but closely related methodologies: a conventional before-after analysis, which models the change in log consumption 2004-2008 as a function of a set of household variables; a dynamic comparison of consumption growth rates and their determinants, contrasting the shock period (2004-2008) to a baseline period (2000-2004); and using self-reported effects of the food price shock on food consumption among households in the most recent survey.

Regression results show that asset-poor households and households headed by a casual worker were particularly adversely affected by the food price inflation. In contrast, the results suggest that education has played at most a small role for the ability of households to cope with food price inflation. Household demographics appear to play a limited role as well. The paper also investigates the welfare effects of idiosyncratic shocks such as a death or an illness of a family member, loss of assets, and unemployment. We find that a job loss has a large negative effect on consumption growth, implying an inability of households to insure themselves against this type of shock. Our findings emphasize the importance of expanding opportunities for stable and well-paid jobs to cope with a covariate shock like food price inflation. In addition, the findings can help governments design effective targeting strategies at times of shocks.

Quantifying the magnitude of welfare loss from a shock like food price inflation requires estimation of welfare change indicators such as Compensating Variation using estimated own- and cross-price elasticities. **Paper III** titled *The impact of food price inflation on consumer*

welfare in urban Ethiopia: A quadratic almost ideal demand system approach extends the analysis of the welfare impacts by estimating a complete demand system for food.

In order to estimate consumer welfare from estimated price and income elasticities, economists have long been using the tools of demand analysis. The almost ideal demand system (AIDS), developed by Deaton and Muellbauer (1980), has been the most popular demand system for more than two decades. However, Blanks et al. (1997) show that AIDS can be misleading if there is nonlinearity in the budget share equations, and thus developed the quadratic almost ideal demand system (QUAIDS). The QUAIDS has budget shares that are quadratic in log total expenditure, which intuitively implies that goods can be luxuries at low levels of total expenditure, for instance, and necessities at higher levels. Consequently, researchers have recently been using the QUAIDS to estimate demand systems using data from a wide range of countries.

We estimate the QUAIDS to derive expenditure and own- and cross-price elasticities of demand for major food items for both poor and non-poor households and compute welfare losses due to food price inflation. The demand systems are estimated using a non-linear seemingly unrelated regression method that applies an iterative generalized least square estimation technique. Statistical tests suggest that the QUAIDS is preferred over the conventionally used AIDS model. Estimates of compensating variation based on estimated price elasticities indicate that households in urban Ethiopia experienced a reduction in welfare equivalent to a 15 percent cut in the annual food budget due to the unprecedented food price inflation the country experienced 2004-2009. Poor households that spend a higher proportion of their budget on food were affected more adversely than non-poor households. The findings in this paper therefore imply that subsidy and other social support programs should target poor households.

The discussion on how to measure growth and development has in recent years shifted from solely using per capita income to an interest in measures that consider a broader spectrum of attributes that may affect people's well-being (e.g., Deaton, 2008; Fleurbaey, 2009). This shift has resulted in increased interest in studies using subjective well-being or life satisfaction as an indicator of well-being. Consequently, the last decade showed a tremendous increase in the number of studies that investigate the correlates of subjective well-being. **Paper IV** titled *What do policy makers know about the factors influencing citizen's subjective well-being?* therefore investigates the correlates of subjective well-being, and knowledge among policymakers about these correlates, using survey data collected from individuals and policymakers in urban Ethiopia.

Consistent with findings in other industrialized countries, life satisfaction regression results show that married individuals are more satisfied with life than unmarried ones, females are more satisfied than males, and healthy individuals are more satisfied than individuals in poor health. In addition, economic status as measured by consumption per capita has a significant and positive effect on life satisfaction, as do perceived change in living standard in the past five years and expectations for the future. Ability to raise a given amount of money for emergency needs affects life satisfaction significantly and positively. In addition, a clean outdoor environment, proxied by access to modern waste disposal facilities, is also an important factor in affecting citizens' subjective well-being. The results from our survey of policymakers, however, show that there is a low correlation between what policymakers believe affects people's subjective well-being and our findings from the life satisfaction regression. This implies that a sizable proportion of policymakers in urban Ethiopia have a rather poor understanding of what influences citizen's subjective well-being. Furthermore, a supplementary priority ranking exercise shows that there is a noticeable difference between policymakers' and citizens' preferences: on average, policymakers favor long-term projects more by focusing on issues like health, education, and housing, while citizens prioritize more short-term government interventions such as inflation control.

The **final paper,** titled *Poverty Dynamics and intra-household heterogeneity in occupations: Evidence from urban Ethiopia*, investigates the trends, dynamics, and persistence of poverty in urban Ethiopia with a particular focus on the role of intra-household heterogeneity in labor market status using panel data spanning 15 years. The paper is motivated by the fact that most previous studies of poverty and poverty dynamics in Sub-Saharan Africa have focused on rural areas.[1] While important, the results and insights generated by these studies do not necessarily carry over to the urban context. For instance, urban households may be more vulnerable to high food prices than rural households since there is little food production in urban areas (Alem and Söderbom, 2011). On the other hand, labor market opportunities are likely more diverse in urban than in rural areas, implying that urban households are less dependent on the developments in a single sector. Since the range of occupations available in urban areas is relatively wide (at least compared to in rural areas), it may be important to consider intra-household heterogeneity in labor market status when studying urban poverty. Using detailed intra-household occupational data, this paper therefore

[1] See for example Dercon & Krishnan (1998); Dercon, (2004); Dercon et al. (2005) ; Harrower & Hoddinott (2005); Barrett et al. (2006); Dercon (2006); Dercon (2008); Beegle et al. (2008); Litchfield & McGregor (2008).

takes a more comprehensive view of the household than most previous studies and investigates the dynamics and persistence of poverty in urban Ethiopia.

Regression results from dynamic probit and discrete-time proportional hazard models provide strong evidence on the impact of labor market status of household members in addition to that of heads on the likelihood of being a poor household and of exiting from and re-entering into poverty. Households with more members depending on unstable and low-skill jobs, such as casual workers and petty traders, have a higher likelihood of being poor and a lower likelihood of exiting poverty. This points to the importance of the government focusing on skill and job creation to reduce urban poverty. In addition, the paper points to the important role of international remittances, which have become a major source of income for households in urban Ethiopia, in pulling households out of poverty. Finally, the paper identifies important research questions in relation to skill and job creation, and international migration and remittances that can be addressed in the future.

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Paper I

AGRICULTURAL ECONOMICS

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Does fertilizer use respond to rainfall variability? Panel data evidence from Ethiopia

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Abstract

In this article, we use farmers' actual experiences with changes in rainfall levels and their responses to these changes to assess whether patterns of fertilizer use are responsive to changes in rainfall patterns. Using panel data from the Central Highlands of Ethiopia matched with corresponding village-level rainfall data, the results show that the intensity of current year's fertilizer use is positively associated with higher rainfall levels experienced in the previous year. Rainfall variability, on the other hand, impacts fertilizer use decisions negatively, implying that variability raises the risks and uncertainty associated with fertilizer use. Abundant rainfall in the previous year could depict relaxed liquidity constraints and increased affordability of fertilizer, which makes rainfall availability critical in severely credit-constrained environments. In light of similar existing literature, the major contribution of the study is that it uses panel data to explicitly examine farmers' responses to actual weather changes and variability.

JEL classification: O12, O33, Q12, Q16, Q54

Keywords: Fertilizer use; Rainfall; Highlands of Ethiopia; Panel data

1. Introduction

Agriculture is inherently risky. Agroclimatic situations condition the performance of agricultural activities and determine the types of crops grown and animals reared (Reilly, 1995; Risbey et al., 1999; Smit et al., 1996). Increased interannual climate variability accompanying mean climate changes has been argued to have a greater effect on crop yields than mean climate changes alone (Smit et al., 1996).

In addition to conditioning production outcomes directly, the level of rainfall and its variability may also affect decisions regarding the use of productivity-enhancing external inputs. This is because, in a predominantly rain-fed agricultural setting, the level of liquidity of a typical smallholder household is affected by rainfall availability and variability (Paxson, 1992). Moreover, the possibility of crop failures, which is largely determined by rainfall abundance and variability,[1] affects the risk-bearing ability of households.

In settings with perfect financial and insurance markets, households can borrow to finance external input use and also trade away the risk of crop failure in the insurance market. However, market imperfections are common in rural markets in developing countries (de Janvry et al., 1991) and rural capital and insurance markets are no exceptions. Living and operating in risky environments where capital markets are rationed affects how farm households decide on resource allocation and income-generating activities (Morduch, 1995). Missing formal insurance markets in developing countries implies that farmers face serious constraints in coping with production risks (Dercon, 2002). This in turn implies that, *ex ante*, households make production and input use choices that minimize their exposure to such risks (Dasgupta, 1993). Hence, *ex ante* mechanisms

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Data Appendix Available Online
A data appendix to replicate main results is available in the online version of this article. Please note: Wiley-Blackwell is not responsible for the content or functionality of any supporting information supplied by the authors. Any queries (other than missing material) should be directed to the corresponding author for the article.

[1] Inadequate, erratic, and/or untimely rainfall has arguably been the most important cause of frequent crop failures in Ethiopian agriculture. Hence, household income is highly dependent on the availability of adequate and timely rainfall.

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of risk management in contexts of imperfect markets for risk and credit (or, in other words, when households' consumption and production decisions are nonseparable) are important for explaining the behavior of poor farm households under uncertainty and market imperfections (Dercon, 2002).[2]

In line with this, factors that affect the financial capacity and risk-bearing ability of households become critical determinants of the decision to use productivity-enhancing inputs. A number of studies have documented the limiting role of resource and credit constraints on the use of modern agricultural inputs like fertilizer (see, e.g., Moser and Barrett, 2003). In their study of constraints regarding smallholder use of inorganic and organic fertilizers in South Africa, Odhiambo and Magandini (2008) find that inability to access credit significantly limits fertilizer use. Risk avoidance strategies have also been attributed to limited fertilizer use in developing countries (Lamb, 2003). However, in such settings, the effects of liquidity constraints and risk aversion of households are difficult to disentangle.[3]

In the generally moisture-constrained Ethiopian agriculture, higher average rainfall levels are expected to result in increased harvests and therefore eased household liquidity constraints. Eased liquidity constraints could then mean that households are more likely to adopt fertilizer.[4] At the same time, however, both rainfall availability and variability may impose *ex ante* barriers to fertilizer use, increasing the risk of crop loss and enhancing vulnerability, which in turn affects the liquidity positions and the overall well-being of households.

Based on this, our premise is that rainfall availability and variability affect the liquidity position and risk-bearing ability of households, which in turn affects their propensity to use external inputs such as fertilizer. This article contributes to the limited empirical literature that assesses empirically the role of rainfall on farmers' input demand and use. It does this by assessing the possible links between rainfall patterns and farmers' decisions to use fertilizer. The analysis is based on two rounds of representative household-level data from the Ethiopian Highlands. The analysis builds on Dercon and Christiaensen (2007), who focus on the role of rainfall in fertilizer use. We expand their analysis by including a measure of rainfall variability in addition to rainfall abundance, investigating their impact on fertilizer use. Our results confirm that fertilizer adoption decisions by farmers are positively associated with higher rainfall levels in the previous year, supporting the hypothesis that rainfall encourages fertilizer adoption by relaxing liquidity constraints. In addition, the results show that a higher coefficient of variation of rainfall reduces fertilizer use.

2. Abundance and variability of rainfall and fertilizer use in Ethiopia

While smallholder farming is the dominant livelihood activity for most Ethiopians, it is also the major source of vulnerability to poverty and food insecurity (Devereux et al., 2008). Such extreme poverty and vulnerability is mainly attributable to factors such as rainfall dependence, asset poverty, and market imperfections.

Rainfall forms a critical, but highly variable, input for agricultural production and thus rural income generation.[5] Ethiopia has experienced at least five major national, and several local, droughts since 1980. Cycles of drought create poverty traps for many households, constantly thwarting efforts to build up assets and increase income (Woldeamlak and Declan, 2007). Between 1999 and 2004, more than half of all households in the country experienced at least one major drought shock. These shocks are a major cause of transient poverty: had households been able to smooth consumption, then poverty in 2004 would have been at least 14% lower; a figure that translates into 11 million fewer individuals below the poverty line (World Bank, 2007).

Experience from other countries suggests that insurance delivers both social protection for farmers (a guaranteed safety net against harvest failure) and agricultural growth (confidence to take moderate risks such as investing in fertilizer or high-yielding varieties). However, farmers are rarely insured against such persistent risks of drought as conventional crop insurance is impractical in such circumstances (World Bank, 2005).[6]

In addition, micro-evidence on the state of household savings and access to credit indicates that, while there is significant credit activity among households in the country, it is largely informal and used for consumption purposes. There is also evidence of severe constraints to access, which include the anticipation of loan application rejection and the risk of defaulting (Geda et al., 2006). In addition, sources and composition of household income have been shown to be determined by credit constraints; poorer households tend to be screened out of high entry-cost activities (Dercon and Krishnan, 1996).

Ethiopian agriculture has been characterized by dismal performance, in part due to the agroclimatic and market constraints indicated above. In response to this need for increased

[2] Deaton (1989) also argues that liquidity constraints tend to affect consumption and production decisions simultaneously.

[3] Studies based on experimental and observed data tend to confound risk behavior with other underlying factors such as imperfect or costly product markets, different temporal input demand (Roumasset, 1976), and differences in farm households' constraints such as access to credit, marketing, and extension (Binswanger, 1980; Shively, 1997). In line with this, Eswaran and Kotwal (1990) show that risk preferences are influenced by the resource constraints and capital market imperfections faced by decision makers. Thus, differences in risk behaviors may not arise from differences in preferences, but may be due to differences in access to institutional arrangements that also include access to credit.

[4] Increased income may not necessarily (fully) translate into increased input use as consumption is generally constrained in such settings. We attempt to control for this effect in our empirical estimation by using socioeconomic indicators of consumption, for example, number of children and adults in the household.

[5] Agriculture is almost entirely rain-fed with only about 2% of the total arable land under irrigation (Rahmato, 1986).

[6] Weather-indexed insurance avoids some of the practical problems with insurance provision (especially moral hazard and asymmetric information) by using an index based on the relationship between lack of rainfall, crop failure, and humanitarian needs verified by historical records (World Bank, 2005).

production and productivity, a number of initiatives have been incorporated into economy-wide development programs. One pioneer was the Minimum Package Program Initiative, launched in the early 1970s and centered on a "Model Farmer" approach of replicating input use, improved seed and fertilizer distribution, and cooperative development. The overall achievements of the initiative were unsatisfactory, and a modified initiative called the Peasant Agricultural Development Program (PADEP) was launched in the mid 1980s. Unlike the across-the-board approach of its predecessor, PADEP focused on intensifying productivity in selected, high-potential highland areas in a bid to boost surplus production and cover the food needs in deficit areas. However, owing to its huge budgetary requirements and the impracticality of some of its goals, the project was eventually phased out (Demeke, 1995). The postsocialist strategy, Agriculture Led Industrial Development, has also taken intensifying agricultural production via external inputs as central to the country's leading development strategy (World Bank, 2007).

As a result of these programs and other factors, fertilizer importation, distribution, and pricing has been largely centralized, controlled by a government parastatal since 1984 (Demeke, 1995). In 1993, the Ethiopian government (GOE) began curtailing the operations of its official state marketing board under aid-conditionality agreements with donors. The private sector was allowed to participate in fertilizer importation and distribution following the issuance of the National Fertilizer Policy in 1993. However, since the late 1990s two regional holding companies and the fertilizer parastatal, AISE, have accounted for 100% of fertilizer imports and local distribution (Jayne et al., 2003). In fact, with the streaming of fertilizer distribution into a virtual government monopoly, earlier tendencies to access and distribute fertilizer using private channels have been drastically reduced.

Fertilizer consumption has increased dramatically in the last 10 years, and the government's campaign of distributing fertilizer and improved seed on credit has succeeded in intensifying crop production (World Bank, 2007).

3. The econometric framework and estimation strategy

In this section, we set up an econometric framework for analyzing the link between fertilizer use and rainfall patterns. We investigate whether the quantity of fertilizer applied on a given farm is attributable to changes in rainfall patterns by studying the relationships between farm-level fertilizer use and yearly average rainfall and variability, respectively.

The premise behind our hypothesis and the specification of the empirical model is that fertilizer is a liquidity-dependent risky input. Rural farming households in developing countries operate under uncertain production environments with imperfect credit and insurance markets, implying that liquidity constraints are a significant limiting factor in technology adoption and use decisions, for example, in fertilizer adoption and use decisions. Our key independent variables, that is, lagged average rainfall and the rainfall variation coefficient (capturing both average levels and variability) give an indication of the degree of liquidity constraints faced by a household in the current year since they determine the level of output in the lag year. Since fertilizer use is determined both by the level of liquidity constraints and the degree of uncertainty in the production environment, it responds directly to the lagged average rainfall levels and their variability. The advantage of using lagged rainfall here is that it is exogenous to current choices and as such provides a good proxy for income and consequently for the household's ability to afford fertilizer adoption.

As the next section describes, not all surveyed households used fertilizer. Accordingly, we employ a censored regression model to correct for this.[7]

Thus, given a latent variable K_{it}^*, which is observed only when fertilizer application takes place, the decision by household i to use fertilizer at time t is such that

$$\begin{aligned} K_{it}^* &= \beta_0 + \boldsymbol{\beta}_1 \mathbf{Z}_{it} + \beta_2 W_{i(t-1)} + \beta_3 W_{i(t-1)}^2 \\ &\quad + \beta_4 V_{it} + \beta_5 V_{it}^2 + \varepsilon_{it} \\ d_{it} &= 1 \quad \text{if } K_{it}^* > 0 \\ &= 0 \quad \text{otherwise,} \end{aligned} \tag{1}$$

where d_{it} is a dummy that denotes the decision by household i to use fertilizer on their farm at time t; $W_{i(t-1)}$ is the average yearly precipitation at time $(t-1)$; V_{it} is the rainfall variation coefficient, used here to capture variability of rainfall; and $\mathbf{Z}_{it}$ is a vector of other factors derived from economic theory and earlier work on fertilizer use. The parameters or vector of parameters to be estimated are β_0, $\boldsymbol{\beta}_1$, β_2, β_3, β_4, and β_5. It is assumed throughout the article that the error term, ε, is such that (Z, ε), (W, ε), and $(V, \varepsilon) \sim i.i.d$, and $N(0, \sigma^2)$. We include quadratic terms of lagged rainfall levels and the coefficient of variation to allow for nonlinear relationships between rainfall patterns and fertilizer use. For example, there could be threshold levels of rainfall abundance above which the marginal benefit associated with fertilizer application declines.

To use the random effects estimator, we decompose the error term into two components such that

$$\varepsilon_{it} = \varphi_i + \mu_{it}, \tag{2}$$

where we also assume that $\mu_{it} \sim i.i.d$ and $N(0, \sigma^2)$. φ_i is assumed to be from independent random draws from a normal distribution, where as before we assume $\varphi_i \sim N(0, \sigma^2)$. Hence, our estimation of the household's decision to use fertilizer applies the panel-data random effects estimator model with the

[7] We also attempted to specify an econometric framework that also modeled the decision to use fertilizer and the intensity of use separately. Yet, we finally chose to focus on Tobit models given that the same factors were found to impact both the decision to use and the intensity of use. In addition, we estimated a selection model, where farmers chose whether or not to use in the first stage and the intensity of use in the second stage. We found the inverse mills ratio, a variable that captures the dependency of the two decisions, to be statistically insignificant, suggesting that a selection model was not the appropriate model for the data.

dependent variable being observed across two time periods, and the weather variable is observed with lagged time.

Given that not all households used fertilizer, estimating the intensity of fertilizer application requires the use of econometric models that correct for this censoring of the dependent variable, since the use of ordinary least squares on the whole sample would yield inconsistent estimates (Wooldridge, 2002). A censored regression model is therefore used. Specifically, we estimate a random effects Tobit model on the intensity of fertilizer use. A censored regression model is such that

$$\begin{aligned} K_{it}^{*} &= \beta_0 + \boldsymbol{\beta}_1 \mathbf{Z}_{it} + \beta_2 W_{i(t-1)} + \beta_3 W_{i(t-1)}^2 + \beta_4 V_{it} \\ &\quad + \beta_5 V_{it}^2 + \varepsilon_{it} \\ K_{it} &= K_{it}^{*} \quad \text{if } K_{it}^{*} > 0 \\ &= 0 \quad \text{otherwise} \\ \Rightarrow K_{it} &= \max(0, \beta_0 + \boldsymbol{\beta}_1 \mathbf{Z}_{it} + \beta_2 W_{i(t-1)} + \beta_3 W_{i(t-1)}^2 \\ &\quad + \beta_4 V_{it} + \beta_5 V_{it}^2 + \varepsilon_{it}), \end{aligned} \tag{3}$$

where K_{it} is the observed intensity of fertilizer application, that is, the amount of fertilizer used per hectare, in kilograms. Assuming that the error term is independently, identically, and normally distributed with zero mean and constant variance leads to a Tobit model, originally developed by Tobin (1958).

The vector of independent variables, $\mathbf{Z}_{it}$, in Eqs. (2) and (3) include farmer characteristics as well as farm-specific attributes that may influence decisions to adopt and use fertilizer by influencing technology performance or adoption costs. Existing literature on adoption and use of agricultural technology has long emphasized the importance of farmer characteristics (e.g., education, age, gender, and farming experience); household physical endowments (e.g., farm size, livestock, and labor); farm biophysical characteristics; and access to agricultural extension, credit, and markets (e.g., Holden et al., 2001; Pender and Gebremedhin, 2007) as determinants of technology adoption and use.

In areas where markets are not functioning well and there is asymmetric information, household endowments and characteristics can affect input use, land investment, and production decisions (de Janvry et al., 1991). For instance, households with more oxen may be able to plow the land at the right time, use more oxen power, and obtain higher yields and income than households with fewer oxen. Also, in areas where labor markets are not well developed, family labor becomes an important determinant of technology choice since alternative technologies have different labor use intensity. The impact of labor on fertilizer use is ambiguous. The use of fertilizer is less labor intensive compared to other soil-fertility-enhancing alternative practices, and thus labor and fertilizer use can be inversely related (Freeman and Omiti, 2003). However, if fertilizer use increases production, harvesting and threshing operations demand more labor and hence households with more members may be better positioned to use fertilizer. At the same time, more household members or labor may reduce marketed surplus and increase household expenditures, which in turn reduces the household's input-purchasing ability. In semi-arid Kenya, Freeman and Omiti (2003) find a negative and significant association between family size (used as a proxy for household labor) and fertilizer adoption and intensity. They also find that farmers with access to land or other physical assets are more likely to adopt innovations because they may be willing and able to bear more risk than their counterparts and may have preferential access to inputs and credit. Previous research has consistently shown physical assets (farm size and livestock ownership) to be positively and significantly related to chemical fertilizer adoption (e.g., Adesina, 1996; Pender and Gebremedhin, 2007; Waithaka et al., 2007).

In an environment of imperfect information, the role of human capital (e.g., education) is important in technology adoption decisions. Households with more education may have greater access to nonfarm income and thus be more able to purchase inputs. They may also be more aware of the benefits of modern technologies and more efficient in their farming practices. There is significant evidence that education positively influences fertilizer use (Freeman and Omiti, 2003; Waithaka et al., 2007). At the same time, some studies have not found any relation in this respect, arguing that adequate availability of information on fertilizer use could make the role of formal education marginal (Adesina, 1996; Fufa and Hassan, 2006).

Gender and age variables are other forms of human capital usually considered in the technology adoption literature. Although women have important key roles in the agricultural sector of the developing world, they often lack access to productive inputs, credit, education, extension, and technical information (Doss, 1999). In Ethiopia, in addition to the cultural taboo against using oxen for plowing, women are often excluded from agricultural extension programs (Pender and Gebremedhin, 2007). This situation may affect women farmers' technology uptake compared to that of male farmers. Age captures both experience and loss of energy. Older farmers are likely to have accumulated technical information on fertilizer use from various sources and thus are likely to be proficient in using the input. These farmers might also be in a better position to evaluate the risks and relative returns from using fertilizer. On the other hand, farmers lose energy with age and thus may, relative to younger farmers, have less interest in adopting labor-intensive technologies.

Access to agricultural extension services can be crucial to adoption and use of technology as they avail agricultural information. Access to extension services can also substitute for lower levels of education if they assist farmers in dealing with some of the complexities of using chemical fertilizer. However, the role of extension in technology up-scaling is important only if the technology is new. In Ethiopia, over the last decades, the agricultural extension program has strongly promoted fertilizer use and has made credit available to help finance the use of farm inputs, including fertilizer. Yet, previous research has shown that extension contact (or services) has not significantly affected adoption of chemical fertilizer (e.g., Freeman and Omiti, 2003; Fufa and Hassan, 2006; Pender and Gebremedhin, 2007).

This suggests that access to extension per se does not stimulate fertilizer use, probably because information on fertilizer use is already extensively available.

While there is extensive literature on chemical fertilizer adoption, the literature on the impact of the abundance and variability of rainfall on fertilizer use is very limited. Rainfall is a crucial production factor in areas such as our study site where rain-fed agriculture is dominant. Rainfall patterns influence the adoption and economic performance of technology (Kassie et al., 2008; Paxson, 1992). The agronomic response from fertilizer is expected to be higher in wetter than in drier areas. A significant impact of rainfall patterns on fertilizer use is, thus, expected in our analysis.

4. The data

To estimate the models, we use household or farm-level panel data collected from around 1,500 rural households in two waves in 2002 and 2005 by the Environmental Economic Policy Forum for Ethiopia and Department of Economics, Addis Ababa University. The survey covered 12 villages within two *Zones* (districts) of the Amhara National Regional State. A stratified sampling technique was used to select around 120 households from each village. One of the districts, East Gojjam, is situated on a relatively high production-potential plateau that receives abundant rainfall, while the other, South Wollo, is characterized by rugged topography and erratic and insufficient rainfall. The cropping patterns in the two districts are quite similar: the types of crops grown are mainly small and large cereals and pulses. Teff, wheat, barley, peas, beans, and maize are some of the most important ones, and vegetables, spices, and perennials also cover a small portion of the plots. Given little intra- and inter-village migration, not much attrition is experienced in forming the panel. In the few cases where respondents are missing in the succeeding waves of the survey, the households were dropped from the sample. We match this data set with longitudinal annual rainfall data collected from local meteorological stations by the Ethiopian Meteorology Authority.

Monthly rainfall data were collected from the stations close to the 12 studied villages from 2002 to 2005.[8] The annual rainfall comprises rain that falls from January to December, observed on a monthly basis. Constructing the rainfall variability and abundance variable this way, for one, coincides with the meteorological authority's yearly recording. In addition, it matches the production cycle with rainfall fairly well with the preplanting (January–March), planting (April–June), growing (June–September), and maturing/harvesting months (October–December). It should be noted that significant local variations in rainfall lead to distinct microclimates for each village. On the other hand, while there is significant variation in the distribution of rainfall across zones, the villages within the zones are located reasonably close to each other, making our assignment of the values fairly reasonable.

The monthly figures are then used to compute and convert the three main variables used in this analysis, that is, current mean annual rainfall, lagged mean annual rainfall, and the annual coefficient of variation measures into annual figures. The current yearly average rainfall is calculated as the mean of the monthly rainfall observations in the particular survey year (2002 or 2005). Similarly, the lag annual average rainfall is computed as the mean of the monthly rainfall corresponding to the lag of the survey year (2002 or 2005). The coefficient of variation of rainfall, calculated for the current year, is computed as the ratio of the mean to the variance of the monthly rainfall data.

Table 1 presents summary statistics of all the variables used in the ensuing analysis. The data set contains rich information on farm characteristics, cropping patterns, the traditional and modern inputs used in each period, as well as socioeconomic characteristics. Our key variables of interest are lagged rainfall and coefficient of variation of rainfall. Lagged rainfall is expected to increase productivity in the previous year, thereby easing liquidity constraints faced by households in fertilizer use decisions in the current year. A high coefficient of variation, on the other hand, imposes a production risk, which subsequently makes fertilizer use risky. Though difficult to verify given data limitations, lagged rainfall could be correlated with the levels of rainfall households anticipate in the current year, which could intuitively influence their fertilizer adoption and use decisions, with higher anticipated rainfall levels encouraging use of fertilizer since use of fertilizers in dry years will burn seeds and thus increase the risk of low harvests. The average lagged rainfall over the period of analysis was around 1,205 mm, and the rainfall variation coefficient was 1.3.

Although we attempted to include relevant variables in our analysis, we do not claim our list to be exhaustive. Important factors like prices and cost of fertilizers are not included since we do not have complete information on these factors. Moreover, variables like actual credit (as opposed to access) and off-farm income, which are partially observable, are not included lest they would bias the analysis. While the cost of fertilizer is very high (even when fertilizer is obtained through credit, it eventually has to be paid for), our premise is that liquidity and wealth positions of households would capture the effect of cost on fertilizer use. In order to control for the effect of extension services, a potentially important factor in the decision to use fertilizer, we include farmers' participation in training programs organized by the extension services.

Other factors that we do not directly control for are farmers' aversions to using high-yielding external inputs for seemingly irrational reasons. Anecdotal evidence shows that farmers tend to believe that fertilizer could "burn" the soil, that the soil "gets used to" fertilizer, and that fertilizer reduces the shelf life of seeds and cooked food. Some of these beliefs are justifiable. For instance, the fact that fertilizer is a moisture-intensive input and also that yields tend to be significantly smaller with

[8] We only had rainfall data for 2000–2005 and thus were not able to use historical weather information, which could have facilitated computation of variability as deviation from the long-term mean.

Table 1
Definition of variables and descriptive statistics

Variable	Description	South Wollo	East Gojjam	Pooled
Fertilizer use				
Household-level adoption	Whether any fertilizer was applied on the plot (1 = yes, 0 = no)	0.10	0.64	0.28
Household-level intensity	Fertilizer application per hectare, in kilograms	11.35	189.51	69.51
Rainfall variables				
Lagged rainfall	Lagged rainfall levels/1,000, in mm	1.168	1.258	1.20
Coefficient of variation	Rainfall variation coefficient	1.30	1.248	1.29
Socioeconomic characteristics				
Gender	Gender of household head (1 = male, 0 = female)	0.83	0.89	0.85
Age	Age of household head	51.13	45.83	49.40
Education	Level of education of household head (1 = illiterate, 2 = read, 3 = read and write)	1.91	1.88	1.90
Formal farmer training	Household head received some formal farmer training (1 = yes, 0 = no)	0.19	0.23	0.20
Household size	Number of members of the household	7.03	6.62	6.90
Male adults	Number of male adults	3.06	2.81	2.98
Female adults	Number of female adults	2.90	2.70	2.83
Children	Number of children	1.07	1.11	1.09
Population pressure	Household size/farm size	2, 885.9	603.89	2,141
Oxen	Number of oxen owned and used by the household	1.15	1.17	1.16
Farm characteristics				
Average plot distance	Average distance from homestead to plots, in minutes	13.16	14.48	13.60
Farm size	Size of the farm, in hectares	0.59	0.85	0.67
Fertile	Proportion of fertile plots in the farm	0.50	0.31	0.44
Moderately fertile	Proportion of moderately fertile plots in the farm	0.39	0.35	0.38
Flat slope	Proportion of flat slope plots in the farm	0.71	0.53	0.65
Moderate slope	Proportion of moderate slope plots in the farm	0.24	0.36	0.28

Source: Authors' own calculations.

fertilizer than without when rain fails indeed support the claim that fertilizer "burns" the soil.

The intensity of farm-level fertilizer use is 70 kg/ha. The mean farm size is approximately 0.67 hectares. It should be noted that it is preferable to measure fertilizer application at the plot rather than the farm level since households apply fertilizer at the plot level (on selected crops), meaning that using farm-level data might underestimate the intensity of fertilizer use. However, since our analysis is at the panel level, matching plots across years is impossible as plots are not fixed in size and in types of crops grown (households could resize the plots and grow different crops in the following year).

The summary statistics in Table 1 are presented by zones to highlight zonal variations in socioeconomic and physical farm characteristics between the two zones (East Gojjam and South Wollo). Around 33% of the surveyed households reside in East Gojjam and 67% in South Wollo.

According to the Food and Agriculture Organization of the United Nations (FAO) (1995), fertilizer was first introduced in Ethiopia in 1967 following four years of trials carried out by the Imperial Government with the assistance of FAO. Fertilizer adoption by the peasant sector, which was 14,000 metric tons in 1974/1975, reached about 50,000 metric tons in 1979/1980 and 200,000 metric tons in 1993/1994. About 80% of the fertilizer used is for cereals and 45 to 50% of it is applied on the major staple teff and the remainder on wheat, barley, maize, and sorghum. Only about one-third of the highland farmers apply fertilizer and their rate of application is much lower than 50 kg/ha on average (FAO, 1995). According to Demeke (1995), it is recommended to use 200 kg (100 kg Urea and 100 kg Di-Ammonium phosphate, DAP) per ha for all cereal crops in most areas of Ethiopia. The current intensity of fertilizer use is therefore quite lower than recommended. Table 2 gives a year-by-year breakdown of fertilizer use and intensity of use in our sample.

Table 2
Fertilizer use in the Highlands of Ethiopia, 2004 and 2007

Year	Farmers using fertilizer (%)	Application rate per ha (kg)
2004	30.40	59.52
2007	25.78	79.13

Source: Authors' own calculations.

Table 2 indicates that approximately 30% of the plots in the sample were fertilized in 2004. This figure declined to about 26% in 2007. Consistent with all previous studies, Table 2 also shows that the intensity of fertilizer use is still very low in the Highlands of Ethiopia. In 2004, an average of about 60 kg of fertilizer was applied per hectare at the farm-level, and this figure increased to 79 kg/ha in 2007. While the number of farmers using fertilizer is declining, the intensity among farmers choosing to use fertilizer is on the rise. However, the intensity is still

lower than the recommended 200 kg/ha. Dercon and Christiaensen (2007) also suggest that both adoption rates and intensity of fertilizer use are relatively low, with only 22% of all households in their sample using fertilizer in each period and only about 30 kg/ha being used, which is far below the recommended 200 kg/ha. Thus, the main objective of this study is to examine factors explaining the low fertilizer use or adoption rates and subsequent intensity of use, with a focus on how rainfall patterns impact adoption and use decisions.

With the exception of Dercon and Christiaensen (2007), studies examining factors determining fertilizer adoption decisions among farmers in rural Ethiopia have tended to ignore risk factors associated with rainfall variability, probably due to data unavailability. Accordingly, the main contribution of this article lies in employing panel data collected from about 1,500 rural households in the Highlands of Ethiopia to investigate whether households, faced with imperfect insurance and credit markets, use risk avoidance as a strategy to cope with threats to harvests (which is directly related to income) related to climate change and variability. The main improvement compared to Dercon and Christiaensen (2007) is the explicit inclusion of the rainfall variability measure as a determinant of fertilizer use.

5. Empirical results and discussion

Table 3 below presents the random effects Tobit results for the intensity of fertilizer application, in log form. Assuming that the decisions to use fertilizer as well as the amount used are entirely driven by the same factors could be restrictive. As indicated earlier, estimating both Probit and Tobit models confirms that the same set of factors impact both the decisions to use fertilizer and the intensity of its application, implying that this assumption might not be too restrictive (see Table A1 in the appendix for the random effects Probit results); hence our decision to base the discussion on the Tobit results. Two Tobit models are estimated: the first model (model *a*) is as specified in Eq. (3) above while the second model (model *b*) explores the possibility that the effects of rainfall levels as well as their variability might vary across households depending on household characteristics such as asset indicators. We do this by interacting rainfall variables with our wealth indicator, that is, the number of oxen owned by the household. In both models, we report the marginal effects computed conditional on having used fertilizer.

Indicators of access to fertilizer are arguably important when discussing use of fertilizers in Ethiopia. In the absence of such variables as is the case in this study, one could use village-level fixed effects to control for access. However, attempts to use village-level fixed effects estimators proved problematic as village variables are correlated with the rainfall variables.

The coefficient *rho* basically represents the proportion of the observed total variance of the error term due to random effects. Thus, the test for the null hypothesis that $rho = 0$ is rejected, justifying the use of a random effects estimator. This demonstrates the importance of intrahousehold correlation due to unobserved cluster effects in fertilizer use decisions.

5.1. Rainfall variability and fertilizer use

The primary objective of this article was to analyze the link between rainfall patterns and farmers' fertilizer use decisions, with a particular focus on rainfall abundance and variability. The results are in line with our hypothesis that higher previous season rainfall levels will lead to increased fertilizer use while rainfall variability leads to reduced use. This is because abundant rainfall in the previous year translates into good harvests, which could in turn relax liquidity constraints and consequently lead to increased probability and intensity of fertilizer application. Rainfall variability, on the other hand, implies increased risk arising from fertilizer application; applying fertilizers under dry conditions could simply burn seeds and increase the probability of crop failure.

Our results also show that both the decision to use fertilizer and the intensity of use in a given year are positively affected by the previous year's rainfall levels, in line with the *a priori* hypothesis. Furthermore, we find a concave relationship between previous year's rainfall levels and fertilizer use. This suggests a threshold level of rainfall after which the marginal impact of rainfall on fertilizer use starts to decline. Also in line with the *a priori* hypothesis, we find that rainfall variability negatively impacts both the decision to use fertilizer and intensity of its application. We find a convex relationship between rainfall variability and fertilizer adoption, suggesting a threshold level of rainfall variability after which the marginal impact of rainfall variability on fertilizer use starts to increase.

This result also supports previous similar studies assessing the relationship between rainfall patterns and household welfare. Paxson (1992) shows that rainfall variability negatively affects households' propensity to save. Moreover, poverty being an indicator of vulnerability due to its direct association with income or access to resources, significantly constrains households in coping with impacts of extreme weather changes (Adger, 1999). In line with this, our results suggest that rainfall variability and change, via their direct impact on crop income, might worsen poverty levels by lowering incomes of better-off farmers while those who are already poor remain trapped in poverty as adverse weather patterns negatively impact their income prospects.

Our analysis does not incorporate the impact of anticipation regarding future rainfall patterns, as informed by current year rainfall patterns. This is mainly because our rainfall series is not rich (long) enough to capture historical patterns fully. However, a number of studies show that in anticipation of lower rainfall levels, households reduce or abandon fertilizer use (Fufa and Hassan, 2006). This is also supported by findings by Smit et al. (1996) and Hucq et al. (2000), who find evidence that farmers alter the intensity of input use to reduce the risks associated with climate change.

Table 3
Random effects tobit on household-level fertilizer adoption

	a			*b*		
Variable	Coeff.	Std. error	Marginal effects	Coeff.	Std. error	Marginal effects
Rainfall variables						
Lagged rainfall	25.103**	10.594	0.608	24.453**	10.505	0.528
Lagged rainfall squared	−10.668**	4.365	−0.258	−11.103**	4.337	−0.240
Coefficient of variation	−18.749**	9.332	−0.454	−20.287**	9.344	−0.438
Coefficient of variation squared	8.869**	3.725	0.215	9.388**	3.711	0.203
Interaction of rainfall with Oxen						
Lagged rainfall ∗ Oxen				1.517**	0.611	0.033
Coefficient of variation ∗ Oxen				0.214	0.69	0.005
Socioeconomic characteristics						
Gender	1.017**	0.419	0.024	1.056**	0.419	0.022
Age	−0.013	0.009	−0.0003	−0.012	0.009	−0.0003
Literacy	0.090	0.145	0.002	0.096	0.145	0.002
Formal farmer training	0.134	0.304	0.003	0.157	0.304	0.003
Male adults	0.176**	0.087	0.004	0.191**	0.087	0.004
Female adults	−0.074	0.094	−0.002	−0.070	0.094	−0.002
Children	0.213**	0.091	0.005	0.211**	0.091	0.004
Population pressure	−0.010**	0.005	−0.0002	−0.011**	0.005	−0.0002
Oxen	0.567***	0.138	0.014	−1.572	1.11	−0.034
Farm characteristics						
Average distance to plots	−0.012	0.009	−0.0003	−0.013	0.009	−0.0002
Fertile	−0.169	0.5	−0.004	−0.164	0.499	−0.004
Moderately fertile	0.097	0.486	0.002	0.076	0.485	0.002
Flat slope	−0.882	0.643	−0.021	−1.020	0.646	−0.022
Moderate slope	−0.742	0.666	−0.018	−0.904	0.669	−0.020
East Gojjam	5.822***	0.366	0.154	5.750***	0.365	0.134
Constant	−9.949**	4.83		−7.273	5.01	
Rho	0.182***	0.058		0.187***	0.058	
Wald χ^2		519.80			522.17	
Log-likelihood		−2161.53			−2158.26	
Observations		2,086			2,086	
Number of households		1,140			1,140	

Note: **significant at 5%; ***significant at 1%.

5.2. Other correlates of fertilizer adoption

We find gender differences in fertilizer use, with male-headed households being more likely to use fertilizer and applying significantly higher levels. This lends support to the contention that women are generally discriminated against in terms of access to productive inputs (Dey, 1981; Doss, 1999). Given the demonstrated contribution of chemical fertilizer to raising agricultural yields and land productivity in sub-Saharan Africa (Mwangi, 1997) and particularly in Ethiopia where the population growth rate and land degradation place a challenge on agriculture (Fufa and Hassan, 2006), such discrimination can result in gender differentials in farm productivity (Udry et al., 1995) and subsequently poverty. This is further supported by the fact that male labor, proxied by the number of male adults in the household, is associated with higher intensity of fertilizer application.

The use of fertilizer increases with the number of children in the household (a proxy for the dependency ratio). The more mouths a household has to feed, the more money (from higher production of last year's rain) used for consumption, which could suggest that as the dependency ratio rises, the household, *ceteris paribus*, strives to increase the productivity of their land via increased fertilizer use. On the other hand, the variable *Population pressure* indicates that the larger the household relative to the farm size, the less fertilizer is used.

Interestingly, the impact of wealth indicators, proxied by the number of oxen owned by the household, depends on the abundance and variability of rainfall. The first model suggests a positive impact of oxen ownership on both the decision to use fertilizer and the intensity of use, suggesting that wealthier households have an advantage in terms of fertilizer use. However, when the wealth indicator is interacted with rainfall variables (both rainfall abundance and variability) in the second model, *Oxen* becomes insignificant while its interaction with rainfall levels is significant, suggesting that wealth is crucial in conditioning how households respond to rainfall abundance. More oxen are associated with increased adoption in the face of high rainfall levels.

The significance of the zone dummy points to the importance of location-specific determinants of the decision to use fertilizer and intensity of application, with households in East

Gojjam demonstrating both a higher probability and intensity of fertilizer use on their plots compared to households in South Wollo.

6. Conclusions and policy implications

This article investigates how farmers' fertilizer use is influenced by the abundance and variability of rainfall using household-level panel data from the Central Highlands of Ethiopia matched with corresponding village-level rainfall data. The analysis is an addition to the limited empirical literature that assesses empirically the role of liquidity constraints and weather variability in decisions regarding productive farm inputs such as fertilizer. Our main hypothesis is that higher rainfall levels lead to increased fertilizer use while rainfall variability is associated with reduced use. This is based on the argument that higher rainfall is likely to result in increased harvest levels, which in turn are expected to ease the liquidity constraints faced by households. Rainfall variability, on the other hand, increases the risk or uncertainty associated with fertilizer use. The major strength of the analysis is that, unlike similar studies, it examines the determinants of fertilizer use based on actual rainfall abundance and variability data.

The results show that the previous year's rainfall levels increase the current year's fertilizer use. This implies that in settings like rural Ethiopia, characterized by very low income levels and notoriously imperfect credit markets, abundant rainfall in the previous year increases harvests and households' disposable income, thereby relaxing liquidity constraints. The results also indicate that rainfall variability makes fertilizer use less probable and reduces the intensity of fertilizer application.

The findings also highlight the importance of all-rounded policy actions given the interaction of institutional (credit and insurance) and natural environmental (rainfall) factors in fertilizer use decisions. Specifically, the results suggest that there is room for development of weather-based derivatives in low-income agriculture and that the next step would be to establish the value and development of a proper mechanism design of such insurance. One plausible policy is to provide credit and insurance to ease the constraints households face when they try to use productivity-enhancing farm inputs. However, ensuring that households have access to credit (working on improving the demand side of credit) is equally important in terms of ensuring that liquidity constraints are relaxed.

Another possibility is to develop index-based crop insurance schemes whereby indemnity payments are made when an agreed upon condition occurs, in this case when recorded rainfall at a particular station falls below a certain threshold. The advantage with such insurance schemes is that they are based on conditions that are independent of both farmers and insurers' influence, thereby minimizing moral hazard and adverse selection problems. Such mechanisms might ease households' vulnerability to crop failure, which might otherwise constrain the ability to invest in farm inputs. Furthermore, such mechanisms need to be accompanied by policies that seek to eliminate possible discrimination against female household heads in terms of access to productive inputs such as fertilizers.

The analysis is important in informing future studies that attempt to assess the link between weather-related uncertainty and agricultural investment in credit-constrained settings. The fact that we find evidence that households depend on good weather and reduced weather variability to make use of necessary productivity-enhancing inputs underscores the enormous importance attached to weather in terms of determining not only current productivity but also future investments.

Enhancing fertilizer use among Ethiopian farmers would require policy measures that provide insurance against losses associated with such weather variability. In addition, given the near-total dependence of the Ethiopian economy on risk-prone small-holder agriculture, short-term insurance measures might not be affordable coverage-wise; structural measures to reduce the dependency on agriculture, particularly crop production, such as livestock production and off-farm employment options are worth exploring.

Appendix

Table A1
Random effects probit on household-level fertilizer adoption

	Probit (1)		Probit (2)	
Variable	Coeff.	Std. error	Coeff.	Std. error
Rainfall variables				
Lagged rainfall	8.406**	3.41	7.872**	3.399
Lagged rainfall squared	−3.534**	1.412	−3.562**	1.408
Coefficient of variation	−5.677*	3.14	−5.899*	3.153
Coefficient of variation squared	2.678**	1.254	2.725**	1.255
Interaction of rainfall with Oxen				
Lagged rainfall ∗ Oxen			0.549***	0.207
Coefficient of variation ∗ Oxen			0.082	0.242
Socioeconomic characteristics				
Gender	0.312**	0.135	0.330**	0.136
Age	−0.004	0.003	−0.004	0.003
Education	0.029	0.048	0.030	0.049
Formal farmer training	0.054	0.101	0.066	0.102
Male adults	0.072**	0.028	0.080***	0.029
Female adults	−0.009	0.031	−0.006	0.031
Children	0.068**	0.031	0.067**	0.031
Population pressure	−0.006***	0.002	−0.006***	0.002
Oxen	0.206***	0.047	−0.576	0.356

Continued

Table A1
Continued

Variable	Probit (1) Coeff.	Probit (1) Std. error	Probit (2) Coeff.	Probit (2) Std. error
Farm characteristics				
Average distance to plots	−0.004	0.003	−0.004	0.003
Fertile	−0.081	0.165	−0.074	0.166
Moderately fertile	0.014	0.161	0.009	0.162
Flat slope	−0.332	0.213	−0.387*	0.215
Moderate slope	−0.233	0.222	−0.292	0.224
East Gojjam	1.713***	0.139	1.705***	0.14
Constant	−3.574**	1.601	−2.652	1.656
Rho	0.229***	0.072	0.234***	.072
Wald χ^2	274.13		271.57	
Log-likelihood	−851.9188		−847.8155	
Observations	2,086		2,086	
Number of households	1,140		1,140	

Note: *significant at 10%; **significant at 5%; ***significant at 1%.

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Paper II

Household-Level Consumption in Urban Ethiopia: The Effects of a Large Food Price Shock

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Abstract

We use survey data to investigate how urban households in Ethiopia coped with the food price shock in 2008. Qualitative data indicate that the high food price inflation was by far the most adverse economic shock between 2004 and 2008, and that a significant proportion of households had to adjust food consumption in response. Regression results indicate that households with low asset levels, and casual workers, were particularly adversely affected by high food prices. We interpret the results as pointing to the importance of growth in the formal sector so as to generate more well-paid and stable jobs.

JEL classification: O12, O18, D12.

Keywords: consumption, welfare, food price shock; Africa, urban Ethiopia.

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1. INTRODUCTION

In February 2011, the Food and Agricultural Organization of the United Nations (FAO) Food Price Index (FFPI) rose for the eighth consecutive month, to the highest level since January 1990, the date at which the index was first computed. Soaring food prices have become a major concern amongst policy makers. For example, the group of 20 developed and leading emerging economies (G20) have put the food price spike and food security at the top of their 2011 agenda. Food prices soared previously in 2008. In this paper we investigate the effects of the 2008 food price shock on what would seem likely a very exposed population, namely urban households in Ethiopia. In July 2008 food prices in Ethiopia had increased to an unprecedented level, on average 92 percent higher than twelve months earlier. Food prices then began to fall, and during the first six months of 2009 they stabilized at a level about 15 percent lower than at the peak in 2008, on average (Central Statistics Agency, 2008, 2009). These dramatic developments are illustrated in Figure 1.

(Figure 1 here)

There are several reasons the effects on food consumption, and welfare more generally, may have been quite serious, at least for certain types of households in urban Ethiopia.[1] First, the share of household expenditure spent on food in urban Ethiopia is high, suggesting that welfare is sensitive to food price changes. Second, little food production takes place in urban areas, thus higher food prices do not raise urban incomes. Urban households are not in a good position to produce for own consumption, another notable difference compared to rural households. Third, there is no formal insurance mechanism for this type of shock.

These and other related factors suggest the welfare effects of higher food prices would vary considerably across urban households. One reason is that there is likely substantial heterogeneity across households in the ability to cope with shocks. Standard intertemporal models of consumption predict a small effect of a transitory price shock on utility if, as seems likely, households desire a stable consumption path and are able to smooth consumption over time, e.g. by borrowing or by tapping into financial assets accumulated in the past. Since not all households in urban Ethiopia are in a position to smooth consumption intertemporally, some may be more vulnerable than others. In particular, it seems likely that poor households may be unable to self-insure since they possess low levels of financial assets. Another reason why the welfare effects may vary across households is heterogeneity in consumption patterns. For example, in our sample it is clear that poor households spend a larger share of their food budget on cereals, compared to households that are better off. As will be shown below, cereals one of the items within the food basket for which inflation was particularly high. Hence, it seems likely that poor households fared particularly badly during the period of high food prices. Furthermore, it seems quite likely that the effect of the food price shock may vary depending on labor market status. For example, casual urban workers may be quite exposed to a food price shock if this impacts strongly on local demand. As will be discussed below, there are other reasons too to suppose that labor market status matters in this context. We therefore pay close attention to the occupational status of the household head and the members of the household in the empirical analysis.

The main goal of the paper is to establish what types of households were most adversely affected by the 2008 food price shock. To this end we use panel data on urban households in Ethiopia for 2008, 2004 and 2000. Our empirical approach consists of three different, but related, methods. First, we carry out a conventional before-after analysis, modeling the change

in log consumption between 2004 and 2008 as a function of a set of household variables. This will tell us if and how changes in consumption varied across certain types of households over this period. A similar approach has been used by Glewwe and Hall (1998) in their analysis of the effects of the macroeconomic decline in Peru in the late 1980s on household welfare. Second, we undertake a dynamic comparison of consumption growth rates and their determinants, contrasting the shock period (2004-2008) to a baseline period (2000-2004). One attractive feature of using data from 2000-2004 to form a baseline is that price inflation over this period was low. Third, we investigate how self-reported effects of the food price shock on food consumption vary across households, using data from the most recent survey.

Overall, we find that the dynamic comparison and the analysis of self-reported effects yield results that are qualitatively similar, with slightly better statistical significance for those based on the self-reported data. We find that households with low levels of assets, and households headed by a casual worker, were particularly adversely affected by the food price inflation. In contrast, the results suggest that education has played at most a small role for the ability of households to cope with food price inflation. Similarly, household demographics appear to play a limited role in this context. We also consider the effects of idiosyncratic shocks such as the death or illness of a family member, the loss of assets, or unemployment. We find that a job loss has a large negative effect on consumption growth, suggesting that households are unable to insure themselves against this type of shock.

Some implications for policy follow from our results. For example, our finding that workers whose skills are in low or volatile demand are very exposed points to the importance of facilitating for the creation of more relatively well-paid and stable jobs in urban Ethiopia. Policies facilitating for growth of stable jobs may thus improve the ability of the urban

population to cope with shocks. Our research also has implications for how to design effective policies in periods of high food prices. During the food price crisis in 2008, the Ethiopian government undertook to help urban households by providing low cost wheat. Since no explicit targeting of households was adopted, the allocation of the resources devoted to the support program may have been inefficient. For example, poor households had no better access to cheap wheat than relatively well-off households and therefore received less support than might have been possible with a well targeted program. With knowledge about which groups are least able to cope with shocks, better and more effective policies can be formulated.

The remainder of the paper is organized as follows. Section 2 provides background information on the performance of the Ethiopian economy, food prices and general inflation. Section 3 reviews previous research and discusses theoretical predictions on the relationship between price shocks and consumption. Section 4 describes our empirical approach. Section 5 describes the data source and contains descriptive statistics. Section 6 contains the results from our econometric analysis. Section 7 provides conclusions.

2. ECONOMIC PERFORMANCE, INFLATION AND FOOD PRICES IN ETHIOPIA

Ethiopia is one of the poorest countries in the world. The economy is predominantly agrarian; in the year 2009, for instance, about 43 percent of the GDP, 60 percent of exports, and 85 percent of total employment was generated from this sector (Central Intelligence Agency, 2009). Poverty is a serious development problem for the country and in the year 2005 about 38 percent of the population lived below the official poverty line. Bigsten and Shimeles (2008) document evidence indicating that shocks play an important role in moving people in and out of poverty. Beginning 2002, the Ethiopian government has adopted a development

strategy called "Sustainable Development and Poverty Reduction Program (SDPRP)" centered on the principal goal of reducing poverty in the country. Official statistics indicate that Ethiopia's economy has grown rapidly during the last five years. Table A.1 in the Appendix shows some macroeconomic indicators. According to Table A.1, real GDP on average grew by about 11 percent during the years 2004 to 2008. During the same period, however, the country exhibited the highest rate of inflation in its history and the highest in the world next to Zimbabwe in 2008 (Central Intelligence Agency, 2009). Overall inflation rose from 15 percent in June 2007 to 55 percent in June 2008 (Loening et al. 2009).[2]

The driving factors behind the high general inflation rate in Ethiopia have been extensively discussed. The World Bank (2007) and the IMF (2008) argue that excess aggregate demand generated by expansionary monetary policy were key driving factors of overall inflation, calling for forceful policy tightening. EDRI (2007) and FAO (2008a) however highlight a multitude of domestic and external factors that could account for the inflation, among them (i) increase in international commodity prices including oil; (ii) structural change and continued good economic performance; (iii) increasing supply of money and injection of cash into the rural economy; (v) changes in farmers' behavior to supply products more uniformly over the year (improvements in access to micro-credit, storage facilities, marketing information, etc; and (vi) increased local purchases by governmental food security institutions, agricultural cooperatives, and relief agencies. More recently, Loening et al (2009) have argued that in the short to medium run, agricultural supply shocks and inflation inertia strongly affect domestic inflation in Ethiopia, causing large deviations from long-run price trends.

Global food prices have been increasing rapidly since 2005. International food prices in April 2008 were 60 percent higher than 12 months earlier. There is some evidence indicating that

world food prices have been driven by higher grain prices. For instance the international price of wheat more than tripled between 2002 and March 2008. The price has since then come down, but as of August 2008 it remained 70 percent higher than the average price in 2006. Similar trends have been exhibited for other cereals and food items (Ahmed, 2008; Ivanic and Martin, 2008). Several factors have been mentioned as causes of the surge in global food prices in 2008, for example: rising population; rapid economic growth in emerging economies which resulted in increased food demand; high energy and fertilizer prices; increased use of food crops for bio-fuels; depreciation of the US dollar; and declining global stocks of food grains due to changes to buffer stock policies in the US and European Union (Ahmed, 2008). FAO (2008b) argue that the use of agricultural products, in particular maize, wheat and vegetable oil, as feedstock for biofuel production has been the most important factor behind the rise of global food prices during 2005-2008. More recently, Gilbert (2009) has argued that the world food price hikes in 2006-2008 are mainly explained by depreciation of dollar and future market investments.

3. SHOCKS AND CONSUMPTION

The impact of shocks on individual welfare in poor countries is a research topic that has attracted a lot of interest from academics and policy makers.[3] Most studies have focused on income shocks. The theoretical model underlying such studies typically has the individual choosing consumption so as to maximize the present discounted value of current and (expected) future utility, subject to a set of relevant constraints. (see e.g. Fafchamps, 2003, for a thorough discussion of how this type of framework has been used in development economics). The utility function is typically specified as strictly concave in consumption, which implies that the individual dislikes consumption volatility. Consequently, the individual will seek to offset the effects of income shocks on consumption, for example by adjusting the

level of assets. Under this type of behavior, often referred to as consumption smoothing in the literature, the impact of temporary income shocks on consumption will be small, a prediction that many empirical studies set out to test (e.g. Paxson, 1992; Udry, 1995).[4] While insurance and credit markets are usually poorly developed in poor countries, households can still protect themselves against temporary income shocks by building up a sufficient buffer stock that they can tap into in difficult times. Empirical evidence that assets are accumulated in this manner has been reported by e.g. Behrman et al. (1997), Lim and Townsend (1998), and Rosenzweig and Wolpin (1993).[5] Nevertheless, the empirical literature for developing countries, which primarily is concerned with rural households, typically provides evidence that income shocks tend to affect welfare suggesting limited ability of in particular poor households to cope with such shocks (e.g. Townsend, 1994; Dercon, 2004; Skoufias and Quisumbing, 2005).

The dynamic implications of price shocks have received less attention in the microeconomic development literature. A temporary price shock will have a temporary income effect but also a substitution effect. For example, if the price this period is high relative to what is expected in the next period, it may be optimal for the individual to consume relatively less this period than in the next period. Hence, while a temporary income shock may have a small effect on consumption, the effect of a temporary price shock may be large. To illustrate this, suppose the utility function U exhibits constant relative risk aversion,

$$U(C_t) = \begin{Bmatrix} C_t^{1-\sigma} / (1-\sigma) \text{ for } \sigma > 0, \sigma \neq 1 \\ \ln C_t \text{ for } \sigma = 1 \end{Bmatrix},$$

where C_t denotes consumption in period t and σ is a parameter. Denote the discount rate in the intertemporal utility maximization problem by r and assume this is constant. Consider first the case where individuals can borrow and save at the constant rate r, i.e. a perfect capital markets scenario. Optimal consumption in period t is then such that

$$\frac{C_t^{-\sigma}}{P_t} = E_t\left(\frac{C_{t+1}^{-\sigma}}{P_{t+1}}\right)$$

where P_t denotes the price of consumption. Abstracting from uncertainty (in order to highlight the intertemporal substitution mechanism) this can be written as

(1) $$\frac{C_t}{C_{t+1}} = \left(\frac{P_{t+1}}{P_t}\right)^{1/\sigma}$$

This shows that if the price in period *t* is high relative to that in period *t*+1, consumption in period *t* will be lower than in period *t*+1. Just how much lower is determined by the parameter σ: the higher the value of σ, the lower is the effect of a given relative price difference on the relative difference in consumption across the two periods. For the model with σ=1, so that utility is logarithmic in consumption, there is a negative 1:1 relationship between the relative price and relative consumption; for higher values of σ, the effect on consumption is smaller. Given that our focus is on food consumption, it is reasonable to suppose that σ is rather high, reflecting limited willingness to substitute food consumption across time periods.

Now suppose individuals cannot borrow. Consider an individual with no accumulated assets who is exposed to a temporary price increase in period *t*. For simplicity, suppose the price is expected (with probability 1) to revert to its normal level in the next period. Since σ is high, desired consumption in period *t* is close to the normal level (see eq. 1). However because the individual has no assets and cannot borrow, consumption expenditure in period *t* cannot exceed the level of income generated in period *t*. This implies that, holding income constant, the relative decrease in consumption must be equal to the relative increase in the price so as to keep expenditure constant. In other words, even though σ is high, consumption may be quite sensitive to a price increase for individuals who lack the means to smooth consumption over time. Heterogeneity in the effect of a food price shock may thus reflect heterogeneity across individuals in the ability to cope with the shock.

Next consider a framework in which utility is explicitly defined as dependent on a vector of different food items (as well as other goods). If preferences are homothetic and all individuals face the same prices, the consumption ratio for any two goods is constant across rich and poor individuals at a given point in time. This is typically not what one would observe in real data however. Poor individuals (households) typically spend a relatively large share of their food budget on inexpensive products, while more well-off individuals tend to spend a larger share of their budget on 'luxury' products. As we shall see below, households in our sample with low levels of assets spend a larger share of their total food expenditure on items like cereals, pulses, spices, and coffee and tea, and a smaller share on meat, dairy products and oils and fats, than do wealthier households. This suggests preferences are in fact non-homothetic. This, in turn, suggests that the impact of a food price shock may differ across households of differing economic status. For example, poor households may be severely affected if prices increase most for the products intensively consumed by the poor. In this example, assets may thus correlate with the size of the food price shock even if assets play no role for consumption smoothing. If assets matter for the ability to smooth consumption as well, this would compound the heterogeneity in the effect of the food price across rich and poor households.

Finally, the effect of the food price shock may vary depending on labor market status. Workers whose nominal salaries are fixed in the short term – e.g. public sector employees - will obviously see a strong reduction in the real wage as a result of high food prices and may therefore be more severely affected than individuals whose nominal incomes rise with inflation. Individuals whose incomes are dependent on demand in the local urban market may also be quite exposed, since local demand in urban areas likely falls rather strongly as a result of the food price shock (more so than in rural areas, for example, where high food prices may

have a positive income effect, or in international markets where food prices rose less dramatically). This effect would be amplified for workers whose foothold in the labor market is weak. This suggests casual urban workers may be particularly exposed to a food price shock.

Summarizing, we have discussed several potential reasons why a large food price shock may impact differently across different types of households. We have identified two possible reasons why the effect may be stronger for individuals or households with low levels of assets (limited ability to smooth consumption and strong preferences towards food items for which prices were rapidly increasing), and we have noted that labor market status may be a source of heterogeneity in the effect too. Next, we outline our empirical framework used to study these and other related effects.

4. EMPIRICAL APPROACH

Our main aim in this paper is to document the effects of the 2008 food price shock across households in urban Ethiopia, and to shed light on whether certain types of households are relatively 'vulnerable' to food price shocks.[6] We focus on three household level outcomes: household consumption of food, measured as food expenditure per adult equivalent (henceforth, food consumption); the overall effect of the food price shock as perceived by the household head; and a self-reported measure of the effect of the shock on the quantity of food consumed.[7] We define Ω_{ij} as the effect of the food price shock on expected outcome *j* for household *i*. We let period *T* denote the shock period, and model the effect of the shock using a simple linear specification

$$\Omega_{ij} = \gamma_{j0} + \mathbf{X}_{i,T-1}\boldsymbol{\gamma}_J^1 + \Delta\mathbf{X}_{iT}\boldsymbol{\gamma}_J^2, \quad (2)$$

where γ_{j0} is an intercept, $\mathbf{X}_{i,T-1}$ is a vector of observable household characteristics, $\Delta\mathbf{X}_{it}$ is a vector of explanatory variables expressed in first differences, and $\boldsymbol{\gamma}_J^1$, $\boldsymbol{\gamma}_J^2$ are parameter vectors. Hence, if the ability to cope with the food price shock depends on household characteristics or changes in those characteristics, some elements of the vectors $\boldsymbol{\gamma}_J^1$, $\boldsymbol{\gamma}_J^2$ will differ from zero. In the empirical analysis we include the following variables in the vector ***X***: household assets; the age, education, occupation and sex of the household head; the number of adult household members, distinguishing between different occupations; the number of children (younger than 15) and elderly (older than 65) in the household; and location of the household. By controlling for the headcount for each occupation of the adult household members and the number of children and elderly, we control for household size while allowing for the possibility that the effect of household size may depend on the demographic composition and the occupations of the household members. The age, education and sex of the household head, and the location of the household, are not included in the vector of differenced explanatory variables.

(a) Identification strategy

In this sub-section we discuss the assumptions under which the parameters of interest ($\boldsymbol{\gamma}_J^1, \boldsymbol{\gamma}_J^2$) can be identified. We specify our general model of food consumption as

$$\ln C_{it} = \mathbf{X}_{it}\boldsymbol{\alpha} + \sum_{k=1}^{K}\theta_k \sum_{s=0}^{t-1} X_{is}^{k} + \Omega_{i1}S_t + \beta_t + \delta_i + \varepsilon_{it} \tag{3}$$

where C_{it} denotes food consumption, $\mathbf{X}_{it} = (X_{it}^1,..., X_{it}^K)$ is vector of determinants of food consumption, β_t is a time effect, δ_i is a fixed effect capturing unobserved time invariant heterogeneity across households in consumption, ε_{it} is a residual assumed uncorrelated with

all other terms on the right-hand sided of (3), while $\boldsymbol{\alpha}$ and $\boldsymbol{\theta} = (\theta_1, ..., \theta_K)$ are parameter vectors.[8] Taking first difference of (3) removes the household fixed effects:

$$\Delta \ln C_{it} = \Delta \mathbf{X}_{it}\boldsymbol{\alpha} + \mathbf{X}_{i,t-1}\boldsymbol{\theta} + \{\gamma_{10} + \mathbf{X}_{i,t-1}\boldsymbol{\gamma}_1^1 + \Delta \mathbf{X}_{it}\boldsymbol{\gamma}_1^2\}S_t + \beta_t + \Delta\varepsilon_{it} \quad (4)$$

It is now straightforward to see that the vector $\boldsymbol{\theta}$ is interpretable as consumption growth effects. For example, if $\theta_1 > 0$, then a high value of X_{it}^1 leads to high growth over the subsequent period. It follows that the *level* of consumption in period *t* depends on the *accumulation* of the variable X^1 at that point, which is reflected in (3). It also follows that if X^1 is time invariant, the cumulative term becomes an interaction term between X^1 and time. It should be noted that, in a model in which the parameters vary freely over time, coefficients on time invariant explanatory variables in a first-differenced equation are interpretable as changes in the coefficients in the levels specification between periods (see e.g. Glewwe and Hall, 1998).

Given the specification in (4), we need at least three rounds of data in order to identify our parameters of interest ($\gamma_{10}, \boldsymbol{\gamma}_J^1, \boldsymbol{\gamma}_J^2$). With just two waves of data, (4) would reduce to a before-after model, similar to that adopted by Glewwe and Hall (1998). Parameter estimates obtained from such a model would be informative about patterns of consumption changes between the two time periods. But they would not be interpretable as causal effects unless $\beta_1 = 0$, $\boldsymbol{\theta} = 0$, $\boldsymbol{\alpha} = 0$, i.e. expected consumption growth would have to be zero and independent of household characteristics in non-shock periods. This would be quite a restrictive assumption. With three waves of data available, two data points per household are available after taking first differences. In such a case (4) can be estimated using OLS and $\gamma_{10}, \boldsymbol{\gamma}_J^1, \boldsymbol{\gamma}_J^2$ (and hence Ω_{i1}) can be identified from the coefficients on the time dummy and the interaction terms $\mathbf{X}_{i,t-1}S_t$ and $\Delta \mathbf{X}_{it}S_t$.

As is emphasized in much of the recent treatment effects literature, identification of the causal effect of some treatment requires a counterfactual – the outcome in an alternative scenario in which individuals are not treated - to which actual outcomes can be compared. The most common way of constructing counterfactuals for treated individuals is to use data on similar individuals not exposed to the treatment. As already discussed, in our application the food price shock is common to all households at one point in time, hence no control group exists in the cross-section. The identification strategy described above amounts to letting households observed prior to the shock period, in our case 2000-2004, constitute the control group. The average inflation rate over the 2000-2004 period was lower than 4 percent on average, which stands in sharp contrast to the situation during 2004-2008. It could be, of course, that this still does not produce a valid counterfactual. Our identification strategy would not work, for example, if as is the case in the model proposed by Glewwe and Hall (1998) parameters vary freely across time periods. The analysis of our qualitative outcome variables ought to shed some light on whether this is a serious problem. We turn to the qualitative outcome variables next.

In the survey we asked the respondents how the food price shock affected the household's food consumption in general (distinguishing *very negatively*, *negatively* or *not at all* as possible answers) and whether the household cut back on the quantity of food consumed as a result of the food price shock (yes or no). Households were thus asked to assess the (qualitative) difference in consumption under treatment (the food price shock) compared to the counterfactual. We model these outcomes directly using ordered probit for the perceived general effect, and binary probit for the variable indicating whether the quantity of food consumed was affected. We note that these probit specifications can be derived from latent

variable equations of the form $\widetilde{\Omega}_{ij} = \Omega_{ij} + \xi_{ij}$, j = 2,3, where ξ_{ij} is an error term with mean zero and variance equal to one, assumed normally distributed and uncorrelated with Ω_{ij}. Because the underlying survey questions refer specifically to effects of the food price shock, the impact of confounding factors (e.g. high energy prices or economic growth) should be small in this modeling framework. This is potentially an important advantage compared to the analysis based on consumption data, where confoundedness may be an issue. However there may be problems too. Ravallion and Lokshin (2001) stress that, in general, measurement errors and differences in latent psychological factors across respondents may yield misleading results in the analysis of subjective-qualitative survey questions. Indeed, if different households have different reference points, answers to subjective questions may not be comparable across households. Moreover, because only a small number of outcomes are distinguished, our qualitative variables may not be very informative. Our belief is that there is value-added to comparing the results produced by the different methods. For example, if the results in the analysis of the qualitative variables are completely different from those from the consumption regressions this would suggest that something has gone awry, whereas if the results are similar this would provide some reassurance.

Throughout the empirical analysis we try to correct for various forms of omitted variables bias. The analysis of the food consumption expenditure data allows for unobserved household fixed effects, which, if ignored, might lead to omitted variables bias. We use data from survey questions that refer specifically to effects of the food price shock, which ought to lessen the impact of confounding factors (e.g. high energy price prices or economic growth). However we do assume that the explanatory variables are econometrically exogenous, i.e. uncorrelated with the residual part of the outcomes under study. This may be restrictive. For example, omitted factors, such as general ability or 'social capital', may impact on the effects of the

food price shock. If such unobserved factors are correlated with the observed explanatory variables, our parameter estimates are not interpretable as causal effects but rather as partial correlations. The empirical analysis below should be viewed in this light.

5. DATA AND DESCRIPTIVE STATISTICS

Our empirical analysis is based on survey panel data for 2008, 2004 and 2000. The most recent survey, fielded by us in late 2008 and early 2009, covered 709 households located in Addis Ababa, Awassa, Dessie and Mekelle. One of the key objectives was to generate data suitable for analysis of the effects of the food price shock. We therefore included in the survey instrument several questions referring to the perceived effects of the food price shock. We also ensured the data could be linked with data for 2004 and 2000, enabling us to analyze consumption growth. The two earlier waves of data derive from the Ethiopian Urban Socio-economic Survey (EUSS), organized by the Department of Economics at Addis Ababa University in collaboration with the University of Gothenburg in Sweden.[9] Out of the 709 households surveyed in 2008/09, 128 are new households drawn randomly from the urban population for the first time in 2008/09. We surveyed these new households in order to investigate if the panel households – some of which were initially selected in 1994, see note 9 - have become atypical and not very well representative of the Ethiopian urban population. To form our estimation sample, we dropped 24 of the 581 panel households because information on these households was missing in the 2004 round. Our final sample based on the 2008/09 survey contains 557 households; 341 from Addis, 71 from Awassa, 70 from Dessie and 75 from Mekelle. Our dataset contains information on household living-conditions including income, expenditures, demographics, health, educational status, occupation, production-activities, asset ownership and other variables. In addition, new modules on shocks and coping mechanisms were included in the 2008/09 survey instrument.

We first consider descriptive statistics for variables measuring shocks and coping mechanisms. Table 1 provides information on the incidence of shocks in urban Ethiopia during 2004-2008 based on self-reported data obtained in the most recent survey. By far the most common shocks refer to the rapid increase in food prices (94 percent) and rising energy prices (74 percent).[10] The most commonly cited idiosyncratic shock is death of a household member (non-spouse) (9 percent), followed by serious illness of wife (6 percent). When asked to indicate the most influential shock (idiosyncratic or covariate) during 2004-2008, 89 percent of the households considered the food price shock as the main shock, which completely dwarves the other types of shocks. A follow-up question on households' expectation of the re-occurrence of the most influential shock was also asked and 74 percent of the households responded that they thought the risk of such a shock happening again had increased.

(Table 1 here)

There has been a lot of evidence documented in the literature on shocks and coping mechanisms that households faced by uninsured risk and shocks adopt their own coping mechanisms to protect themselves against a serious decline in welfare. In view of this, the households interviewed in the 2008/09 survey were asked about the coping strategies they adopted in response to the food price shock. Table 2 presents these data. The four leading coping mechanisms are as follows: 36 percent of the households reported that they cut back on the quantities served per meal; 20 percent received assistance from relatives and friends both from domestic and foreign sources; 16 percent coped by shifting resources from other consumption items to food; and 9 percent of the households earned extra income from

activities such as increased labor force participation or renting out residential houses. Intriguingly, only 6 percent of the households seemed to use own assets or loans to cope with the shock. This suggests that consumption smoothing through borrowing is not common in urban Ethiopia.

(Table 2 here)

The data thus suggest the food price shock has been a major adverse economic event in urban Ethiopia, affecting the consumption and, presumably, the welfare of a significant number of households. In the next section we discuss our econometric results on the heterogeneous effects of the food price shock. Table 3 shows summary statistics for the key variables in the regression analysis, across the three years considered. Since households that were sampled for the first time in 2008/09 cannot be included in consumption growth equations, these are excluded from our estimation sample. All financial variables are expressed in real terms using 1994 as the base year. For food consumption per adult equivalent, we observe a modest increase in the sample average over time. In 2008 the sample average of log overall consumption is 4.78 which corresponds to 119 birr per month expressed in constant 1994 values. The share of food expenditure in total expenditure is 0.78, suggesting a high sensitivity of welfare to food price changes. Related to this, 60 percent of the households interviewed in 2008/09 say that food consumption has been very negatively affected by the food price shock; a further 29 percent say that the effect has been negative, leaving 11 percent stating that there had been no effect. Thirty-two percent of the households in the estimation sample state that they have cut back on the quantity of food served in response to the food price shock.[11] About half of the household heads are female, and the average age of the head is 55 in the last wave of the data. In 2008 the sample average of household size, excluding the household head, is

5.39. This is lower than in 2000, reflecting a natural process by which children exit from the household as they become older. Consistent with this, the average number of children in the household falls from 1.90 in the 2000 sample to 1.03 in the 2008 sample. Education is low on average, and around 40 percent of the household heads have no education. Slightly less than half of the households own their own house, and the average log real value of household assets ranges between 6.86 in 2000 (which corresponds to 953 Birr) and 7.29 in 2008 (1,466 Birr).[12] The most common type of occupation for household heads that are in the labor force is to be self-employed, followed by public sector employee (including civil servants). However, between 41 and 45 percent of the heads are out of the labor force, a category that includes housewives, retired individuals and other individuals not actively seeking work.

(Table 3 here)

6. ECONOMETRIC ANALYSIS

(a) Consumption levels

We begin by reporting results from regressions in which log consumption per adult equivalent in 2008 is the dependent variable, distinguishing food consumption and overall (all types of) consumption. By definition, since the dependent variable is in levels and not differences, these results are not informative about vulnerability to food price shocks. The results are of interest for two reasons. First, estimating consumption levels regressions constitutes a useful 'quality control' on the consumption data. For example, were we to find no positive association between education and consumption, one might be concerned that our consumption data are not very accurate. Moreover, we consider results with and without the new households included, so as to check if the panel households have systematically different consumption

levels compared to a random sample drawn from the 2008 population. Second, documenting the correlates of consumption is of interest in and of itself. The analysis sheds some light on, for example, the differences in consumption across households of differing size, a question that has interested economists for a long time (see e.g. Deaton and Paxson, 1998) and the correlation between consumption and education. In all regressions reported below, standard errors are robust to heteroskedasticity.

The results, shown in Table 4, can be summarized as follows: consumption is somewhat lower in households in which the head is female; there is no evidence that consumption varies with the age of the household head; consumption falls with household size, an effect that is particularly strong if there is a large number of casual workers in the household; consumption rises with education and household assets; consumption is lower amongst households in which the head is a casual worker than in households in which the head has a different occupation (including being out of the labor force, which is the reference category in these regressions); and there are no systematic differences across locations, conditional on other explanatory factors. The signs of these partial correlations appear reasonable. Furthermore, the explanatory variables explain around 50 percent of the variation in consumption, which is a fairly good fit. We conclude that the consumption data appear to be of sufficiently high quality for it to be possible to learn about vulnerability from consumption growth regressions. Finally, we observe that the coefficient on the dummy variable for new households is small and completely insignificant, suggesting that there are no systematic differences in consumption across new households and panel households.[13]

(Table 4 here)

(b) Changes in food consumption

We now analyze how consumption growth rates differ across households depending on observable characteristics. We begin by modeling food consumption growth rates during 2004-2008 as a function of household characteristics. A similar before-after approach has been used by Glewwe and Hall (1998). Results are shown in Table 5, column 1. We find evidence that consumption growth over this period varies with changes in household composition and household size. All coefficients on the change in the number of household members in various occupations are negative, indicating a negative effect of household size on consumption. This effect is strong and statistically significant for casual workers, individuals who are unemployed or out of the labor force, and children. We find a positive and highly significant effect of a change in household assets on consumption growth, but no evidence of systematic growth differences depending on initial assets. The coefficients on primary, secondary and tertiary education are negative, suggesting, somewhat surprisingly, that households headed by individuals with some education have experienced lower consumption growth rates than households in which the head has no education. Consumption growth varies across occupations of the household heads. In all the regressions shown in this section, the reference category (omitted dummy) consists of household heads out of the labor force. Casual workers stand out as being the job category for which consumption developed least favorably during 2004-2008, recording an average growth rate of consumption about 41 percent lower than the reference category. Further analysis into the characteristics of household heads that are out of the labor force suggests that this group has alternative sources of income. For example, remittances from abroad were recorded for 17 percent of the households headed by an individual out of the labor force but only for 10 percent of the households headed by an individual in the labor force. Moreover, there are on average 0.44 more working members in households headed by individuals outside the labor force than in

households headed by labor force participants (we can reject the null hypothesis that these two sub-samples of households have the same average number of working household members at the 1 percent level).

(Table 5 here)

As discussed in Section 4 we cannot infer from these results how the effect of the food price shock varies with households characteristics, since we do not know how consumption would have developed in the absence of the shock (the counterfactual). The macro nature of the shock implies it is not possible to find a counterfactual in the cross-section, which is why we exploit the panel dimension in the data. The period 2000-2004 was characterized by low average inflation, presenting us with a potentially useful comparison period. We show results for the 2000-2004 period in Table 5, column 2. We are primarily interested in how these results differ from those for 2004-2008. To assess whether these differences are significantly different across the two periods, we pool the data, interact a dummy variable for the shock period with all explanatory variables, and regress the change in log consumption on all explanatory variables and the interaction terms (see eq. [4] above for the exact specification). The estimated coefficients on the interaction terms, and the associated standard errors (which are robust to heteroskedasticity and serial correlation) are shown in Table 5, column 3. Note that, by construction, these coefficients are equal to the difference in the coefficients between 2004-08 and 2000-04. We find that the coefficient on log household assets is higher in the shock period than in the baseline period, and that the difference is significant at the 5 percent level. In the baseline period, the coefficient on assets is negative and significant, possibly reflecting a convergence process by which households that have low assets initially tend to record higher subsequent growth rates. In contrast, in the shock period, the asset coefficient is

close to zero. The results for the baseline period thus suggest that the 'normal' relationship between initial assets and subsequent growth is negative. Taking this to be the counterfactual relationship, we hence obtain evidence that households with little assets were particularly adversely affected by the food price shock. Households with high initial levels of assets were better able to sustain food consumption during the shock period.

We also find that some of the coefficients on the occupation dummies are significantly different across the two periods, suggesting that labor market status matters for the effect of the food price shock. Recall that the omitted occupation dummy is 'out of the labour force'. Hence, in the baseline period, participating in the labor market tends to lead to higher rates of consumption growth than if you are out of the labor force. In the shock period, however, this pattern is reversed. To the extent that the baseline period is a valid counterfactual, this is interpretable as saying that the food price shock had adverse effects on those in the labour market. The results in column 3 suggest public sector employees (including civil servants) and casual workers were the types of occupations most adversely affected by the food price shock. Different mechanisms clearly operate here. The salaries of civil servants and public sector employees would not have been adjusted instantaneously in response to the food price shock, hence this group of individuals would have seen their real earnings fall as a result of the high inflation. Casual workers, on the other hand, tend to have very uncertain and volatile earnings. The large growth shortfall recorded by this group thus suggests that high income variability in itself is associated with limited ability to smooth consumption, perhaps because of limited access to basic financial services such as overdrafts or savings accounts.

Some of the effects that were found to be statistically significant in the before-after analysis (column (1)) are not significant in the analysis based on the dynamic comparison. There is no

evidence that the impact of the food price shock depends on household demographics. The coefficients on the age of the household head are not significantly different across the two periods. This is also true for education, which, provided the baseline period is a valid counterfactual, can be interpreted as saying that education has not provided effective insurance against the food price shock. The coefficient on female household head is negative and significant at the 5 percent level. Finally, it should be noted that there are relatively few household heads in our sample that are casual workers (5 percent of the individuals in the 2008 sample; see Table 3). Thus it is possible a small number of outliers drive the results. To investigate this, we exclude from the sub-sample of casual household heads the observations with the highest and lowest consumption growth rates, and re-estimate the regression. We obtain a difference-in-difference point estimate on casual worker equal to -0.73 and a standard error equal to 0.36. Thus, the main results appear quite robust.

As discussed in Section 5, we have data on the perceived impact of the food price shock on food consumption: very negatively, negatively or not at all. Assigning higher values to less negative outcomes we model this variable using ordered probit. Column (1) in Table 6 shows the results. Most of the findings are similar to those obtained from the dynamic comparison contrasting the shock period to the baseline period. The coefficient on log household assets is positive and highly significant, supporting the notion that household with relatively high levels of assets were less affected by the food price shock. Similar to the results for consumption growth we find a negative and significant (at the 10 percent level) effect of being a casual worker, suggesting that volatile incomes accentuate vulnerability. We find some evidence that the effect of the food price shock was perceived as more severe amongst households with many children. We also find that age has a convex effect on the perceived

severity of the effects of the food price shock, suggesting that young household heads were less adversely affected than moderately old heads.

(Table 6 here)

The final model that we consider in this part of the empirical analysis is a probit regression in which the dependent variable is equal to one if the household did not cut back on the quantity of food served despite the food price shock, and zero otherwise. Results are shown in Table 6, column 2. Again, we find strong evidence that household assets mitigate the effect of the food price shock, and that casual employment of the household head is associated with stronger sensitivity of food consumption to higher food prices. Taken together with the previous results, we thus have strong evidence that households with little assets and uncertain labor market outcomes are particularly vulnerable. The coefficients on age and age squared are negative and positive, respectively, suggesting that young households cope better with the food price shock than moderately old ones.

Why might the effect of the food price shock on consumption vary with household assets? As discussed above, the standard explanation advanced in much of the literature on shocks is that assets enable households to self-insure against shocks. However, recall from the survey data reported in Table 2 that very few households in our sample appear to behave in a way consistent with self-insurance and consumption smoothing. Only about 6 percent of the households claim to have responded to the food price shock by tapping into own assets or taking out a loan. This suggests that there is an alternative underlying reason for the relationship between assets and the impact of the shock observed in the data. Table 7 shows how food consumption patterns compare across households with high and low levels of assets

(as measured in 2004), with the cut-off point defined as the sample median of the value of assets. It is clear that households with relatively low levels of assets spend a relatively larger share of their total food expenditure on items like cereals, pulses, spices, and coffee and tea, and a relatively smaller share on meat, dairy products and oils and fats. The presence of such differences, which are all statistically significant, suggests that utility over food consumption is non-homothetic. The last column of Table 7 shows price changes in specific food items between December 2006 and December 2008. Strikingly, there is a fairly clear pattern that the price increases have been particularly high for those food items more intensively consumed by the less well off. The price level for cereals, for example, increased by 114 percent while that for spices rose by 176 percent. In contrast, for meat, which is more intensively consumed by richer households, the price level increased by only 47 percent. Figure 2 plots the differences across the two sub-samples in food shares against the food price index. There is a clear negative association between these two variables. That is, in 2004, before food prices began to increase rapidly, the poorest households were allocating larger shares of their food expenditure towards food items for which subsequently prices increased atypically fast. This suggests that the effects documented for assets in the econometric analysis are attributable to underlying differences in the combination of food items consumed, depending on economic status.

(Table 7 here)

(Figure 2 here)

(c) Changes in overall consumption

We now consider a broader definition of the outcome variable, modeling overall consumption growth rather than just food consumption growth. Results are shown in Table 8. Focusing on

the estimates in column (3), it is clear that the results are quite similar to those for food consumption in Table 5. Arguably, this is not very surprising given that the average food share in the data is as high as 0.78. However, most of the coefficients in the present regression are less significant than those in the food consumption models, possibly because the effects of higher food prices matter more for food consumption than for the consumption of other products. In fact, only household assets and female head of the household have statistically significant difference-in-difference effects on overall consumption.

(Table 8 here)

(d) Observable shocks

The evidence reported above thus suggests assets and labor market status play important roles for how severely the food price shock affects households. To probe these results further, we now investigate whether the levels and growth rates of consumption vary with related observable shocks that are idiosyncratic to the household. Data on idiosyncratic shocks were collected for the first time in the 2008/09 survey, thus no panel data exist for these variables. Based on the 2008/09 survey data, we construct five idiosyncratic shock variables: death of a family member; illness of a family member; job loss of a family member; asset loss; and other idiosyncratic shocks, and test whether these impact significantly on consumption. The objective is to measure shocks more directly than has been possible in the analysis above. We control for the full set of variables in $\mathbf{X}_{i,t-1}$ as well as changes in household size, number of children and the number of elderly in the household. We exclude variables from the $\Delta\mathbf{X}_{it}$ vector that refer to changes in labor market status and changes in assets, since we now measure shocks to employment and assets directly.

Results are shown in Table 9. The control variables are all included in these regressions, but we omit the associated results from the table in order to conserve space. Whether we look at food consumption or overall consumption, or levels or growth rates, the result is the same: only job loss of a household member has a statistically significant negative effect. Quantitatively the job loss effect is large, reducing food consumption growth by 28 percent and overall consumption growth by 31 percent. These results indicate, not very surprisingly, that urban households in Ethiopia cannot insure themselves fully against a job loss shock, and that when one occurs, the effects are substantial. One way of interpreting the insignificance of the other types of shocks is that these are easier to cope with than losing one's job.

(Table 9 here)

We have also investigated whether a similar effect of a job loss can be found for 2004. While data on idiosyncratic shocks are not available for this period, we used employment data and created a dummy variable equal to one for households whose members had experienced a job loss and zero otherwise. We found the coefficient on this dummy variable to be negative but smaller in absolute size than what is obtained for 2008/09 and not statistically significant (results are available on request). This suggests becoming unemployed is a particularly serious shock if combined with a food price shock.[14]

7. CONCLUSIONS

In this study we use panel data on urban Ethiopian households to examine the effects of the dramatic food price shock in 2008. We study how changes in food consumption and overall consumption relate to household-level variables. We also analyze self-reported data on the qualitative effects of the food price shock on food consumption.

The evidence indicates that households with low levels of assets have been particularly adversely affected by the food price shock. Overall, we assign a more important role to assets than, for example, do Glewwe and Hall (1998) and Lanjouw and Stern (1993) who, in different settings, find returns to endowments more important. We also find that households headed by a casual worker have been vulnerable to the food price shock. From the point of view of the urban poor, these are troubling results. For this socio-economic group, consumption is oriented towards food items for which price increases have been particularly high, and employment is often unstable because individuals have low skills. Hence, the urban poor appear to have been very adversely affected by the food price shocks.

Education appears to play a small role for the ability to cope with higher food prices, hence there is little evidence in our study supporting Shultz's (1975) hypothesis that education reduces vulnerability. Similarly, household demographics appear to play a limited role for the ability of coping with shocks. This suggests labor supply constraints are not binding. For example, even though there are households in the sample with many children or elderly household members, there is only weak evidence that this has hampered the ability of such households to respond to the shock, relative to other households. Given that food consumption is of primary importance, this is perhaps not very surprising. One possible implication, however, is that the ability of adults to care for the young and the elderly has diminished. Consistent with this, we find that the effect of the food price shock is perceived to be more severe if there are many children in the household. Because we observe no relationship between the number of children and food consumption, this suggests there are other effects on the welfare of households with many children that make life more difficult in general. Almost

certainly there is a range of presumably adverse welfare effects of food price shocks that our empirical analysis fails to highlight.

The fact that aggregate (covariate) shocks are inherently not insurable limits the range of policy instruments that can be used to mitigate the effects of food price shocks. Findings like those in this paper can be used as a basis for the targeting of aid in response to such shocks. One option would be to subsidize the type of food consumed intensively by the poor, provided practical problems such as food leakage (Löfgren and El-Said, 2001) can be overcome. A more serious challenge for policy makers is to reduce the vulnerability of households to high food prices ex ante. One implication of our study is that the creation of good, well-paid and secure jobs reduces vulnerability. Recall that, analyzing the effects of idiosyncratic shocks, we found that experiencing a job loss has a large negative effect on consumption growth, suggesting that households are unable to insure themselves against this type of shock. We have also found that being a casual worker makes one vulnerable to food price shocks. Individuals at the fringe of the labor market may thus face large welfare fluctuations if food prices are volatile. This does not imply that such individuals are worse off on average that those out of the labor force. Rather, it implies that informal, uncertain employment does not provide individuals with a basis for accumulation of resources or stable levels of welfare. Seen in this light, from a welfare point of view the stagnation of the formal sector and the rapid expansion of the informal sector in Ethiopia during the last decade may be quite problematic (Bigsten, Gebreeyesus and Söderbom, 2009). Policies contributing to sustained growth and more jobs in the formal sector would have positive welfare effects through less volatile labor outcomes.

[1] Dessus et al. (2008), Ivanic and Martin, (2008), Wood et al. (2009) study the implications of rising world food prices on poor households in developing countries, especially the urban poor, and they argue that the negative welfare effects have been tremendous. The data used in these studies do not cover the period of the dramatic global food price increase in 2007-2008.

[2] There is evidence that the unprecedented high rate of inflation in Ethiopia in the past few years eroded living standard of the majority of the urban population. Woldemichael (2008) documents that cumulative salary increment in the government sector (which is the major employer of the labour force in urban areas) between July 2001 and 2007 was about 60 percent, while the general and food price inflation rates during the same period were 96 percent 125 percent respectively.

[3] This was a central theme in the World Development Report 2000/01 (World Bank, 2001).

[4] In empirical research, formulations based on the permanent income hypothesis of Friedman (1957) have been common. Friedman originally argued that rational households with access to perfect markets in insurance and credit will maximize the sum of expected lifetime discounted utility, constrained only by the sum of initial assets, and value of their future savings; their "permanent income".

[5] There are other coping mechanisms too. There is some evidence that households in developing countries attempt to share risk, see e.g. Coate and Ravallion, (1993) and Fafchamps and Lund (2003). Reardon et al. (2007) discuss how rural households may choose to engage in non-farm income generating activities to deal with risk and shocks. Porter (2008) reports some evidence that households in rural Ethiopia divert labour towards relatively higher return activities in order to smooth income during shocks.

[6] Vulnerability is defined by the World Bank (2001) as measuring "…the likelihood that a shock will result in a decline in well-being" (p.139). Note that vulnerability is not synonymous with poverty. For an excellent survey of the micro literature on risk, vulnerability and poverty, see Dercon (2006).

[7] There has been a longstanding debate about whether income or consumption expenditure should be used to measure household welfare. In the context of developing countries, using consumption measures appears to be favoured over using income measures, because income is often underreported and in many cases, volatile and difficult to remember. See Deaton (1997), Deaton and Grosh (2000) for further discussion.

[8] As noted by Glewwe and Hall (1998), household fixed effects in the consumption equation may be caused by heterogeneity across households in the rate of time preference or risk aversion, for example.

[9] The waves for 2000 and 2004 cover approximately 1,500 households in Addis Ababa, Awassa, Bahir Dar, Dessie, Dire Dawa, Jimma and Mekelle. Still earlier waves of data deriving from the EUSS exist for 1994, 1995 and 1997. See Bigsten and Shimeles (2008) for details on these data. Lack of funding prevented us from covering Bahir Dar, Dire Dawa and Jimma in the 2008/09 survey.

[10] The average share of energy expenditures in total household expenditures is about 6 percent in our sample. Hence, while energy prices have risen rapidly over the sample period, energy expenditures have remained relatively low. Moreover, the data shown in column 2 in Table 1 indicate that few households refer to energy price inflation as big problem. We therefore assume the energy price inflation is a less significant shock for households in urban Ethiopia than the food price inflation.

[11] This figure differs from that reported in Table 2, since new households are excluded here.

[12] This household asset variable includes assets such as TV, refrigerator, motor vehicles etc. To express these values in constant 2008 prices, one needs to multiply the prices in constant 1994 prices by 3.16 (authors' calculations based on the EUSS data; see note 9).

[13] We have also done a pooling test, by interacting the dummy for new households and the explanatory variables and adding these to the baseline specification. The coefficients on the interaction terms are insignificantly different from zero at the 5 percent level of significance, indicating no systematic difference between new households and panel households.

[14] We thank a referee for encouraging us to pursue this.

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Table 1. Incidence of shocks, 2004-2008

	Household experienced this type of shock	This was the most influential shock
Increase in food price	0.94	0.87
Increase in energy price	0.74	0.01
Death of husband	0.05	0.02
Death of wife	0.02	0.004
Death of another member	0.09	0.02
Serious illness of husband	0.04	0.01
Serious illness of wife	0.06	0.01
Serious illness of another member	0.04	0.01
Divorce/separation/abandonment	0.01	0.004
Loss of job of a household member	0.04	0.01
Imprisonment for political reason	0.004	0.003
Destruction or theft of assets	0.04	0.01
Other shock	0.03	0.01
No shock	0.04	
Observations	709	684

Note: The numbers in the first column do not add up to 1.0 since households could indicate more than one shock. Household indicating there was no shock during the period are excluded from the calculations in the second column.

Table 2. Coping mechanisms to deal with food price inflation

	Sample proportion
Cut back quantities served per meal	0.36
Received assistance from relatives and friends	0.20
Shifted resources from other consumption items	0.16
Engaged in extra income generating activities	0.09
Reduced quality and quantity of food purchased	0.06
Used own saving	0.04
Received assistance from others	0.01
Borrowed money against household possessions	0.02
Received assistance from NGOs	0.01
Sold household possessions	0.003
Other	0.01
Did nothing	0.04
Observations	684

Table 3. Summary statistics

	(1) Year 2008		(2) Year 2004		(3) Year 2000	
	Mean	Std Dev	Mean	Std Dev	Mean	Std Dev
Consumption						
Log consumption per adult equivalent	4.69	0.62	4.75	0.70	4.67	0.81
Log food consumption per adult equivalent	4.44	0.63	4.40	0.72	4.31	0.81
Share of food in total expenditure	0.78	0.08	0.72	0.11	0.71	0.14
Food consumption very negatively affected	0.60					
Food consumption negatively affected	0.29					
Consumed less food because of food price shock	0.32					
Household assets						
Owns a house	0.48		0.47		0.45	
log household assets	7.29	1.43	7.43	1.54	6.86	1.85
Head of the household						
Female	0.50		0.48		0.43	
Age	54.9	13.8	51.3	13.5	50.8	13.1
No schooling	0.39		0.37		0.54	
Primary schooling completed	0.39		0.40		0.20	
Secondary schooling completed	0.11		0.15		0.19	
Tertiary schooling completed	0.11		0.08		0.07	
Out of the labor force	0.43		0.45		0.41	
Self employed	0.23		0.25		0.24	
Public sector employee	0.17		0.18		0.19	
Private sector employee	0.12		0.08		0.10	
Casual worker	0.05		0.04		0.06	
Household size & occupation of household members						
Household size	5.39	2.58	5.69	2.46	6.06	2.50
Number of self-employed	0.23	0.48	0.19	0.47	0.23	0.69
Number of public sector employees	0.28	0.58	0.31	0.61	0.11	0.34
Number of private sector employees	2.03	1.99	2.13	1.63	2.33	1.76
Number of casual workers	0.59	0.92	0.36	0.70	0.27	0.60
Number of unemployed or out of the labor force	0.19	0.54	0.15	0.48	0.17	0.54
Number of children	1.03	1.08	1.53	1.36	1.90	1.59
Number of elderly	0.05	0.23	0.03	0.18	0.06	0.30
Location						
Addis Ababa	0.61		0.61		0.71	
Awassa	0.13		0.13		0.09	
Dessie	0.13		0.13		0.09	
Mekelle	0.13		0.13		0.10	
Observations	557		557		427	

Note: Standard deviations omitted for dummy variables.

Table 4: Covariates of Consumption 2008

	(1) Food consumption		(2) Food consumption		(3) Overall consumption		(4) Overall consumption	
	Coefficient	Std error	Coefficient	Std error	Coefficient	Std error	Coefficient	Std error
Household assets								
Owns a house	0.059	0.044	0.060	0.040	0.072*	0.042	0.077**	0.037
Log of household assets	0.190***	0.018	0.204***	0.018	0.207***	0.018	0.216***	0.017
Head of the household								
Female	-0.125**	0.053	-0.148***	0.047	-0.107**	0.048	-0.131***	0.043
Age	-0.008	0.013	-0.016	0.010	-0.011	0.011	-0.016*	0.009
Age squared / 100	0.008	0.012	0.014	0.009	0.010	0.010	0.015*	0.008
Primary schooling completed	-0.004	0.051	-0.025	0.046	0.001	0.048	-0.015	0.043
Secondary schooling completed	0.119	0.077	0.075	0.070	0.112	0.069	0.075	0.063
Tertiary schooling completed	0.308***	0.083	0.252***	0.077	0.315***	0.078	0.254***	0.072
Self employed	0.118**	0.058	0.061	0.053	0.109*	0.054	0.067	0.049
Public sector employee	-0.030	0.068	-0.036	0.062	-0.032	0.064	-0.033	0.058
Private sector employee	0.003	0.077	0.002	0.070	-0.004	0.071	-0.005	0.064
Casual worker	-0.132	0.109	-0.209**	0.093	-0.166	0.105	-0.229***	0.088
Household members								
Number of self-employed	-0.074*	0.038	-0.060*	0.034	-0.092**	0.036	-0.076**	0.031
Number of public sector employees	-0.009	0.032	-0.010	0.028	-0.017	0.031	-0.019	0.027
Number of private sector employees	-0.085***	0.022	-0.078***	0.019	-0.090***	0.021	-0.083***	0.017
Number of casual workers	-0.232***	0.037	-0.214***	0.034	-0.228***	0.034	-0.218***	0.032
Number of unemployed or out of the labor force	-0.114***	0.016	-0.105***	0.014	-0.117***	0.014	-0.110***	0.012
Number of children	-0.147***	0.018	-0.128***	0.016	-0.165***	0.018	-0.145***	0.016
Number of elderly	-0.046	0.072	-0.031	0.063	-0.082	0.074	-0.058	0.061
Location and sampling status								
Addis Ababa	-0.099	0.064	-0.118*	0.059	-0.034	0.060	-0.046	0.054
Awassa	-0.067	0.075	-0.087	0.065	-0.024	0.070	-0.029	0.060
Dessie	-0.093	0.078	-0.110	0.072	-0.064	0.071	-0.067	0.066
New household			-0.021	0.049			0.001	0.044
Observations	557		685		557		685	
R-squared	0.46		0.46		0.52		0.52	

Note: All models are estimated using OLS with the dependent variable expressed in logarithmic form. Standard errors are robust to heteroskedasticity.. Significance at the 1 percent, 5 percent, 10 percent level is indicated by ***, **, *, respectively. An intercept is included in all model specifications.

Table 5. Changes in Food Consumption

	(1) Consumption growth 2004-08		(2) Consumption growth 2000-04		(3) Difference in Difference	
	Coef	Std err	Coef	Std err	Coef	Std err
A. VARIABLES IN LEVELS						
Household assets						
Owns a house	-0.086	0.075	0.033	0.084	-0.120	0.133
Log of household assets	0.037	0.031	-0.080**	0.033	0.117**	0.052
Head of the household						
Female	-0.110	0.078	0.173**	0.087	-0.283**	0.131
Age	-0.023	0.015	0.008	0.021	-0.031	0.027
Age squared / 100	0.020	0.014	-0.003	0.020	0.023	0.025
Primary schooling completed	-0.145*	0.077	-0.035	0.106	-0.110	0.133
Secondary schooling completed	-0.204*	0.120	-0.018	0.113	-0.186	0.185
Tertiary schooling completed	-0.259*	0.139	0.001	0.159	-0.261	0.229
Self employed	0.004	0.102	0.162	0.128	-0.157	0.185
Public sector employee	-0.091	0.114	0.356**	0.138	-0.447**	0.201
Private sector employee	0.044	0.151	0.151	0.192	-0.107	0.267
Casual worker	-0.524**	0.221	0.219	0.266	-0.744**	0.378
Household members						
Number of self-employed	-0.046	0.088	0.028	0.083	-0.074	0.145
Number of public sector employees	0.048	0.061	0.077	0.114	-0.028	0.140
Number of private sector employees	0.061	0.053	-0.026	0.076	0.087	0.103
Number of casual workers	0.027	0.072	-0.069	0.096	0.096	0.122
Number of unemployed or out of the labor force	-0.002	0.023	0.013	0.029	-0.015	0.042
Number of children	0.000	0.030	0.007	0.037	-0.007	0.057
Number of elderly	0.016	0.148	0.063	0.205	-0.047	0.272
Location and time						
Addis Ababa	-0.095	0.107	0.246*	0.135	-0.342*	0.206
Awassa	-0.050	0.118	0.215	0.159	-0.265	0.229
Dessie	0.040	0.121	0.119	0.177	-0.079	0.251
2004-08 Period					0.807	0.779
B. VARIABLES IN FIRST DIFFERENCES						
Household assets						
Δ Owns a house	0.018	0.107	0.037	0.155	-0.019	0.177
Δ Log of household assets	0.115***	0.031	0.042	0.034	0.073	0.047
Head of the household						
Δ Self employed	0.075	0.096	0.081	0.112	-0.005	0.150
Δ Public sector employee	0.172	0.109	0.118	0.114	0.054	0.150
Δ Private sector employee	0.189*	0.111	0.123	0.165	0.066	0.195
Δ Casual worker	-0.053	0.176	0.220	0.252	-0.274	0.302
Household members						
Δ Number of self-employed	-0.018	0.064	-0.052	0.089	0.034	0.110
Δ Number of public sector employees	-0.021	0.051	-0.084	0.063	0.062	0.080
Δ Number of private sector employees	-0.059	0.036	-0.030	0.052	-0.029	0.065
Δ Number of casual workers	-0.109*	0.063	-0.078	0.078	-0.030	0.098
Δ Number of unemployed or out of the labor force	-0.103***	0.021	-0.102***	0.028	-0.001	0.034
Δ Number of children	-0.104***	0.035	-0.145***	0.039	0.041	0.054
Δ Number of elderly	-0.105	0.164	-0.046	0.198	-0.059	0.243
R-squared	0.16		0.20			
Observations	557		427		984	

Note: Standard errors in (1) and (2) are robust to heteroskedasticity. Standard errors in (3) are robust to heteroskedasticity and autocorrelation. Significance at the 1 percent, 5 percent, 10 percent level is indicated by ***, **, *, respectively. An intercept is included in all model specifications. Column (3) shows the estimated coefficients on interaction terms between a dummy for the period 2004/08 and all explanatory variables, in a regression pooling the data underlying (1) and (2).

Table 6. Perceived Effect of the Food Price Shock and Food Consumption Response

	(1) Perceived effect (ordered probit)		(1) Did not cut back on quantity of food consumed (probit)	
	Coefficient	Standard error	Coefficient	Standard error
A. VARIABLES IN LEVELS				
Household assets				
Owns a house	0.059	0.128	0.204	0.147
Log of household assets	0.407***	0.059	0.266***	0.065
Head of the household				
Female	0.052	0.147	-0.198	0.149
Age	-0.068***	0.025	-0.069**	0.032
Age squared / 100	0.067**	0.026	0.064**	0.030
Primary schooling completed	-0.027	0.159	0.158	0.151
Secondary schooling completed	-0.084	0.218	0.001	0.235
Tertiary schooling completed	0.303	0.277	0.225	0.321
Self employed	0.263	0.194	-0.121	0.202
Public sector employee	-0.009	0.224	-0.053	0.233
Private sector employee	0.033	0.247	-0.192	0.285
Casual worker	-0.826*	0.484	-1.034**	0.424
Household members				
Number of self-employed	-0.017	0.139	0.234	0.172
Number of public sector employees	0.006	0.118	-0.065	0.132
Number of private sector employees	0.039	0.093	0.115	0.098
Number of casual workers	0.019	0.146	0.025	0.153
Number of unemployed or out of the labor force	-0.007	0.040	-0.065	0.046
Number of children	-0.118**	0.061	-0.027	0.063
Number of elderly	0.336	0.277	-0.016	0.379
Location and time				
Addis Ababa	1.277***	0.256	-0.787***	0.209
Awassa	2.405***	0.306	-0.439*	0.253
Dessie	0.843***	0.290	0.010	0.258
B. VARIABLES IN FIRST DIFFERENCES				
Household assets				
Δ Owns a house	0.312	0.209	-0.001	0.217
Δ Log of household assets	0.326**	0.059	0.359***	0.067
Head of the household				
Δ Self employed	0.223	0.168	0.057	0.175
Δ Public sector employee	0.171	0.224	0.233	0.233
Δ Private sector employee	0.122	0.189	0.096	0.227
Δ Casual worker	-0.141	0.321	-0.095	0.298
Household members				
Δ Number of self-employed	-0.007	0.121	-0.049	0.140
Δ Number of public sector employees	-0.038	0.106	-0.079	0.115
Δ Number of private sector employees	-0.003	0.060	-0.091	0.073
Δ Number of casual workers	0.108	0.124	-0.026	0.116
Δ Number of unemployed or out of the labor force	0.003	0.035	-0.061*	0.037
Δ Number of children	-0.237***	0.068	-0.093	0.068
Δ Number of elderly	0.021	0.210	0.091	0.260
Pseudo R-squared	0.23		0.16	
Observations	557		557	

Note: Standard errors in (1) and (2) are robust to heteroskedasticity. Significance at the 1 percent, 5 percent, 10 percent level is indicated by ***, **, *, respectively. An intercept is included in both model specifications. The dependent variable in (1) is coded as follows: 0 – very negatively; 1 – negatively; 2 – not at all. The dependent variable in (2) is a dummy variable equal to 1 if the household did not cut back on the quantity of food consumed despite the food price shock.

Table 7: Food Consumption Patterns by Asset Levels and Food Price Indices

	Share in total food spending				
	Sub-sample: Assets high	Sub-sample: Assets low	Difference in means	H_0: Common mean (t-value)	Price Index December 2008[(a)]
Cereals	0.307	0.350	-0.044	-4.10	214.3
Pulses	0.080	0.093	-0.012	-2.54	162.9
Bread and Other Prepared Food	0.097	0.090	0.007	0.85	225.0
Meat	0.072	0.034	0.037	6.66	146.6
Milk, Cheese and Egg	0.025	0.014	0.011	4.35	150.6
Oils and Fats	0.110	0.091	0.019	4.23	166.2
Vegetables and Fruits	0.077	0.070	0.007	1.66	147.0
Spices	0.089	0.108	-0.020	-3.61	275.5
Coffee and Tea Leaves	0.042	0.062	-0.019	-5.27	138.6
Drinks	0.020	0.008	0.012	5.43	174.3
Other Food Items	0.081	0.080	0.001	0.17	158.4

Note: To compute the share spent on various food items in total food spending, we use the entire sample for 2004. We divide the sample into households with high and low levels of assets, using the median of asset values as the cut-off point.
[(a)] The price indices for the food items are from official data published by the Central Statistics Agency on September 9, 2009 using December 2006 as base year.

Table 8. Changes in Overall Consumption

	(1) Consumption growth 2004-08		(2) Consumption growth 2000-04		(3) Difference in Difference	
	Coef	Std err	Coef	Std err	Coef	Std err
A. VARIABLES IN LEVELS						
Household assets						
Owns a house	-0.104	0.068	0.060	0.083	-0.164	0.126
Log of household assets	0.037	0.028	-0.065**	0.031	0.102**	0.050
Head of the household						
Female	-0.069	0.069	0.159**	0.079	-0.228**	0.117
Age	-0.014	0.014	0.010	0.022	-0.024	0.027
Age squared / 100	0.012	0.013	-0.008	0.020	0.020	0.025
Primary schooling completed	-0.145**	0.069	-0.070	0.103	-0.074	0.123
Secondary schooling completed	-0.169	0.107	-0.022	0.113	-0.147	0.174
Tertiary schooling completed	-0.207	0.127	-0.083	0.167	-0.123	0.227
Self employed	0.012	0.091	0.071	0.129	-0.059	0.177
Public sector employee	-0.065	0.102	0.204	0.135	-0.268	0.188
Private sector employee	0.030	0.141	-0.032	0.162	0.062	0.240
Casual worker	-0.441**	0.207	0.122	0.255	-0.563	0.362
Household members						
Number of self-employed	-0.070	0.079	0.060	0.078	-0.130	0.129
Number of public sector employees	0.033	0.055	0.030	0.104	0.003	0.127
Number of private sector employees	0.035	0.047	-0.029	0.075	0.064	0.101
Number of casual workers	0.036	0.065	-0.058	0.091	0.094	0.118
Number of unemployed or out of the labor force	0.000	0.021	0.003	0.028	-0.002	0.040
Number of children	-0.013	0.027	0.013	0.035	-0.026	0.053
Number of elderly	0.040	0.135	-0.089	0.182	0.129	0.241
Location and time						
Addis Ababa	-0.060	0.099	0.177	0.131	-0.238	0.196
Awassa	-0.047	0.108	0.217	0.156	-0.265	0.219
Dessie	0.095	0.108	0.173	0.173	-0.078	0.238
2004-08 Period					0.396	0.780
B. VARIABLES IN FIRST DIFFERENCES						
Household assets						
Δ Owns a house	-0.019	0.101	0.147	0.151	-0.166	0.173
Δ Log of household assets	0.116***	0.028	0.045	0.032	0.071	0.044
Head of the household						
Δ Self employed	0.051	0.088	0.044	0.108	0.007	0.140
Δ Public sector employee	0.180*	0.099	0.063	0.109	0.117	0.141
Δ Private sector employee	0.197**	0.099	0.102	0.140	0.095	0.170
Δ Casual worker	-0.049	0.159	0.124	0.249	-0.173	0.290
Household members						
Δ Number of self-employed	-0.047	0.060	-0.037	0.083	-0.010	0.101
Δ Number of public sector employees	-0.026	0.045	-0.064	0.067	0.038	0.078
Δ Number of private sector employees	-0.073**	0.033	-0.038	0.051	-0.035	0.063
Δ Number of casual workers	-0.089	0.060	-0.081	0.067	-0.008	0.088
Δ Number of unemployed or out of the labor force	-0.108***	0.019	-0.109***	0.028	0.001	0.032
Δ Number of children	-0.122***	0.031	-0.151***	0.040	0.029	0.052
Δ Number of elderly	-0.097	0.159	-0.039	0.162	-0.058	0.217
R-squared						
Observations	557		427		984	

Note: Standard errors in (1) and (2) are robust to heteroskedasticity. Standard errors in (3) are robust to heteroskedasticity and autocorrelation. Significance at the 1 percent, 5 percent, 10 percent level is indicated by ***, **, *, respectively. An intercept is included in all model specifications. Column (3) shows the estimated coefficients on interaction terms between a dummy for the period 2004/08 and all explanatory variables, in a regression pooling the data underlying (1) and (2).

Table 9: The Effects of Idiosyncratic shocks

	(1) Food consumption		(2) Change in food consumption		(3) Overall consumption		(4) Change in overall consumption	
	Coefficient	Std error	Coefficient	Std error	Coefficient	Std error	Coefficient	Std error
Death of family member	-0.135	0.083	0.080	0.093	-0.111	0.078	0.085	0.085
Illness of family member	-0.027	0.069	0.030	0.114	0.006	0.062	0.029	0.104
Job loss of household member	-0.225*	0.129	-0.322*	0.167	-0.252**	0.124	-0.372**	0.166
Asset loss	0.129	0.092	-0.288	0.189	0.136	0.091	-0.230	0.161
Other idiosyncratic shocks	0.133	0.140	0.248	0.161	0.090	0.136	0.253	0.154
Control variables								
Household assets	Yes		Yes		Yes		Yes	
Characteristics of the head	Yes		Yes		Yes		Yes	
Household members	Yes		Yes		Yes		Yes	
Location	Yes		Yes		Yes		Yes	
Change in household size	Yes		Yes		Yes		Yes	
Change in number of children and elderly	Yes		Yes		Yes		Yes	
Observations	557		557		557		557	
R-squared	0.37		0.13		0.43		0.15	

Note: Standard errors are robust to heteroskedasticity. Significance at the 1 percent, 5 percent, 10 percent level is indicated by ***, **, *, respectively. An intercept and a set of control variables are included in all model specifications.

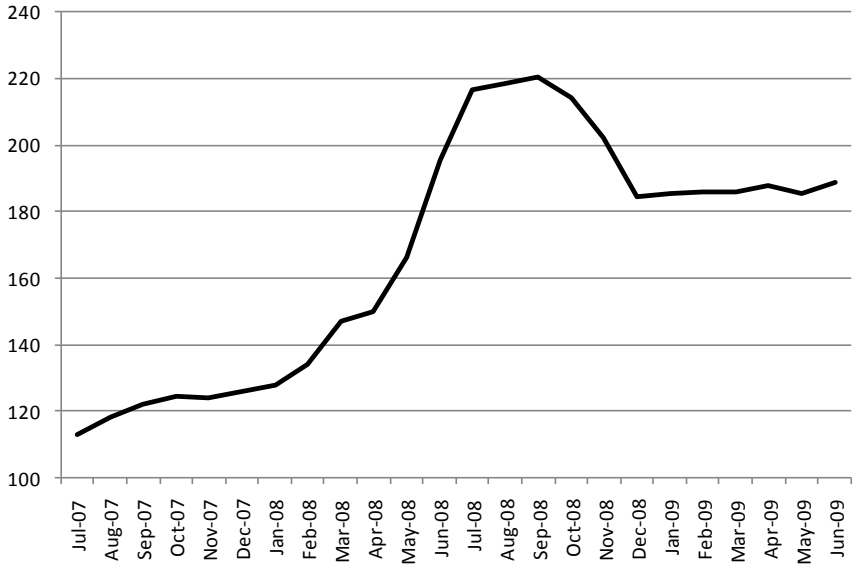

Figure 1: Food Price Index in Ethiopia, July 2007 – June 2009

Note: The graph shows the price index for food for Ethiopia. December 2006 = 100. Source: Central Statistics Agency (2008, 2009)

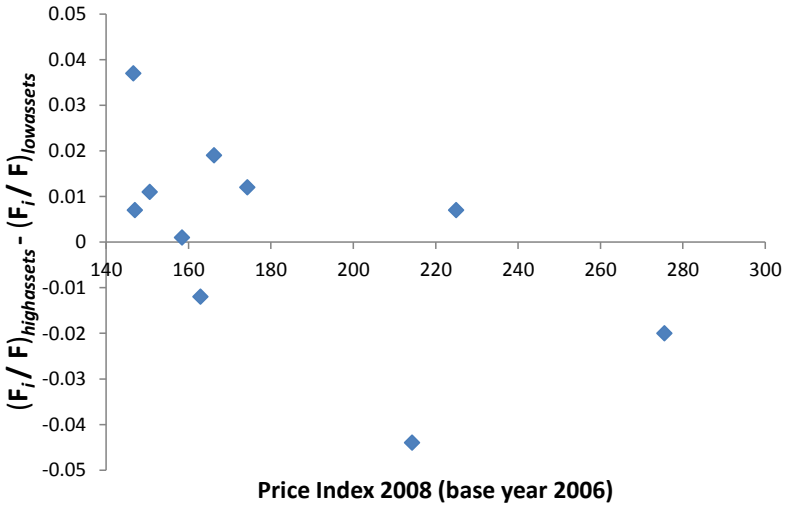

Figure 2: Food consumption patterns by economic status, and food price inflation

Note: The vertical axis measures the difference in average food shares across households with high and low levels of assets, for eleven food items as listed in Table 7. That is, $(\mathbf{F}_i/\mathbf{F})_{highassets} - (\mathbf{F}_i/\mathbf{F})_{lowassets}$ is defined as the "difference in means" for food item *i*, shown in the fourth column of Table 7. The horizontal graph measures the price index for these food items over the period December 2006 – December 2008.

Appendix

Consumption aggregation and adult equivalences

We computed aggregate household consumption expenditure by adding up reported household expenditure on food and non-food items. The non-food component of consumption includes expenditures on items such as; clothing, footwear, energy, personal care, utilities, health and education. We excluded expenditure on consumer durables. According to Deaton (2002), from the perspective of welfare analysis, it is the value of services that flows from ownership of these consumer durables that should enter the aggregation of consumption expenditure. This was not possible in our analysis because we didn't have information that is useful to impute depreciation rate of household fixed assets. This is unlikely to distort the values of the aggregated consumption expenditure because the value of expenditure that goes to durables goods in Ethiopia is insignificant (Tadesse, 1996).

Aggregate household consumption expenditure is converted into adult equivalences to adjust for household size and composition using the method proposed by Dercon and Krishnan (1998). Moreover, to allow for temporal and spatial comparisons of consumption among households, we computed real household consumption by deflating nominal consumption using price indices constructed from the survey.
We specifically took the poverty line of Addis Ababa (the capital city) as the reference city against which poverty lines in all other cities in all rounds are expressed and computed price indices accordingly. We then use the price deflators to convert nominal consumption expenditures to real. Thus our household consumption variable is adjusted for spatial as well as temporal price differences (see Ravallion, 1998, for a detailed discussion on the use of poverty lines as deflators).

Table A.1 Selected Macroeconomic Indicators of Ethiopia 2000-2008

Variable	Units	Scale	2000	2001	2002	2003	2004	2005	2006	2007	2008
GDP, constant prices	National currency	Billions	64.40	69.36	70.22	67.76	74.40	83.80	93.47	104.20	116.30
GDP, constant prices	Annual percent change		5.93	7.71	1.24	-3.51	9.80	12.64	11.54	11.47	11.61
GDP, current prices	National currency	Billions	64.40	65.69	63.46	68.90	86.66	106.47	131.67	170.92	239.13
GDP, current prices	U.S. dollars	Billions	7.90	7.88	7.43	8.03	10.05	12.31	15.17	19.43	25.66
GDP, deflator	Index		100.00	94.70	90.38	101.69	116.48	127.05	140.87	164.04	205.62
GDP per capita, constant prices	National currency	Units	1014.14	1,060.497	1,044.618	980.51	1,047.300	1,147.591	1,245.138	1,350.171	1,468.752
GDP per capita, current prices	National currency	Units	1014.14	1,004.317	944.10	997.05	1,219.941	1,458.011	1,753.967	2,214.790	3,020.055
GDP per capita, current prices	U.S. dollars	Units	124.40	120.47	110.51	116.20	141.53	168.52	202.05	251.79	324.05
GDP based on PPP	Current international dollar	Billions	29.59	32.63	33.61	33.12	40.76	47.24	54.39	62.26	71.00
GDP based on PPP per capita GDP	Current international dollar	Units	465.92	498.90	500.01	479.31	573.81	646.85	724.44	806.70	896.64
GDP based on PPP share of world total	Percent		0.07	0.08	0.07	0.07	0.08	0.08	0.09	0.10	0.10
Implied PPP conversion rate			2.18	2.01	1.89	2.08	2.13	2.25	2.42	2.75	3.37
Inflation, average consumer prices	Index, 2000=100		100.00	94.79	87.94	101.18	109.90	117.42	131.81	152.69	191.34
Inflation, average consumer prices	Annual percent change		6.16	-5.21	-7.22	15.06	8.62	6.84	12.26	15.84	25.32
Inflation, end of period consumer prices	Index, 2000=100		100.00	88.57	87.67	108.28	110.17	124.48	138.88	159.88	248.24
Inflation, end of period consumer prices	Annual percent change		0.27	-11.43	-1.02	23.51	1.75	12.99	11.57	15.12	55.27
Population	Persons	Millions	63.50	65.41	67.22	69.10	71.04	73.03	75.07	77.17	79.18
Current account balance	U.S. dollars	Billions	-0.34	-0.23	-0.35	-0.11	-0.40	-0.74	-1.39	-0.87	-1.49
Current account balance	Percent of GDP		-4.24	-2.96	-4.67	-1.36	-4.00	-6.00	-9.14	-4.48	-5.80

Source: IMF (2009).

Paper III

The Impact of Food Price Inflation on Consumer Welfare in Urban Ethiopia: A Quadratic Almost Ideal Demand System Approach

Yonas Alem[†]

Abstract

This paper investigates the impact of food price inflation on consumer welfare in urban Ethiopia 2004-2009. A quadratic almost ideal demand system (QUAIDS) is estimated using data from 2000 to 2009. Statistical tests suggest the QUAIDS is preferred over the conventionally used AIDS model. Compensating variation calculated using estimated price elasticities shows that from 2004 to 2009, households in urban Ethiopia lost an equivalent of 15 percent of their food budget annually due to the unprecedented food price inflation. Poor households, who spend a higher proportion of their budget on food, were affected more adversely than non-poor households. Moreover, with a more or less uniform increase in the price of major food items, households in urban Ethiopia appear to have limited options for substitution. These findings can provide important information to policy makers and can help aid organizations design and implement better social assistance schemes in the future.

JEL Classification: D12, Q19, R2

Keywords: urban Ethiopia, food price, consumer demand, welfare

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1. Introduction

The world has been experiencing unprecedented increases in the price of major food items since 2005. From 2005 to 2007 for instance, the price of maize, milk powder, wheat, and rice increased by 80 percent, 90 percent, 70 percent, and 25 percent, respectively (Ivanic and Martin, 2009). Although the prices fell in the summer of 2008 and then remained low for a while, they soared again in December 2010, reaching the highest levels ever with the exception of meat and dairy products. These peaks slightly surpassed the June 2008 levels (FAO, 2011). The FAO Food Price Index (FFPI) averaged 215 points in December 2010, which was 25 percent higher than in December 2009. Food price inflation has been a cause of social unrest and political instability in a number of developing countries, and has consequently attracted a great deal of attention[1].

The use of agricultural products, in particular maize, wheat, and vegetable oil, for biofuel production was the most important factor behind the rise of global food prices from 2005 to 2008 (FAO, 2008). Recent price hikes, however, have mainly been associated with floods in Australia, the summer 2010 drought in Russia, and bad weather in South America (The Washington Post, 2011). Regardless of the causes, food price inflation will have an adverse impact on food consumption and welfare across different socioeconomic groups, especially net food buyers in developing countries, who on average spend half of their total budget on food[2].

One of the countries that experienced an unprecedented increase in food prices from 2005 to 2008 is Ethiopia, one of the least developed countries in the world. Ethiopia's economy grew rapidly during this period with an average real growth rate of 11 percent per year (IMF, 2011). During the same period, however, the country experienced the worst inflation rate in history – the overall annual rate of inflation rose from 15.1 percent in June 2007 to a peak of 55.3 percent in June 2008. The general inflation was mainly driven by food price inflation, which measured in simple growth rates rose from 18.2 percent in June 2007 to a peak of 91.7 percent in July 2008 (CSA, 2009). Multiple factors have been identified as

[1] Arezki and Bruckner (2011) investigate the links between food prices and political instability. Using data for 120 countries spanning 1970-2007, they show that in low-income countries, increases in global food prices result in significant deterioration of democratic institutions and a significant increase in social and political unrest manifested by large-scale anti-government demonstrations, riots, and civil conflict. See Berger and Spoerer (2001) for an earlier attempt to show the links between rising food prices and instability in 19th century Europe. See http://www.thenewamerican.com/index.php/world-mainmenu-26/africa-mainmenu-27/4498-food-prices-spark-riots-in-mozambique for riots following food price increases in Mozambique and http://www.guardian.co.uk/world/2011/jan/07/algeria-riots-food-prices and http://www.marketoracle.co.uk/Article25912.html for recent riots in Algeria and Egypt, respectively.

[2] The share of food in total expenditure ranges from 33.7 percent in Latin America to 60.5 percent in Sub-Saharan Africa (De Hoyos and Lessem, 2008).

driving factors of inflation in Ethiopia: excess aggregate demand generated by expansionary monetary policy (World Bank, 2007; IMF, 2008a) and exchange rates and international food and goods prices (Loening et al., 2009).

While relatively much is known about the causes and magnitude of food price inflation, little is known about its impact. Using household level data from nine low-income countries, Ivanic and Martin (2008) show that the recent food price crisis raised overall poverty in low-income countries substantially. Similarly, Cranfield and Haq (2010) use household level data from countries at various levels of development and show that poor households in developing countries suffer the most from food price inflation. Klugman and Loening (2007) and Alem and Söderbom (2011) use household level data from Ethiopia to investigate the impacts on household level consumption and show that net food buyers and asset-poor households have been affected tremendously by food price inflation. Wood et al. (2010) study the impacts on the welfare of Mexican households and provide evidence showing that the recent food price hikes have significantly reduced the welfare of Mexican households, especially the poor. To investigate the impact of food price inflation, all these studies (except Alem and Söderbom) use data collected before the 2008 food price crisis. Moreover, given the methods used in these papers (except in Cranfield and Haq, and Wood et al. 2010), it is hard to infer the magnitude of the welfare effects. The impact of the recent food price inflation on consumer welfare, however, can be better understood from standard welfare measures such as compensating variation estimated using data covering the food price crisis period.

This paper investigates the welfare impact of food price inflation in urban Ethiopia by estimating a complete quadratic almost ideal demand system (QUAIDS) for food using pooled household level data spanning the years 2000-2009. The basic Engel's law in microeconomics postulates that poorer households spend a significant proportion of their budget on food, which implies that the welfare impact of an increase in the price of food affects them more severely than better-off households. We estimate expenditure and own-price elasticities of demand for major food items for both poor and non-poor households and compute welfare losses due to food price inflation. Statistical tests suggest the QUAIDS is preferred over the conventionally used AIDS model. Estimates of compensating variation based on estimated price elasticities indicate that households in urban Ethiopia experienced a reduction in welfare equivalent to that implied by a cut in the annual food budget by 15 percent, due to the unprecedented food price inflation the country experienced 2004-2009. Poor households who spend a higher proportion of their budget on food have been affected more adversely than non-poor households.

The remainder of the paper is organized as follows. In Section 2, the quadratic almost ideal demand system is defined, and its theoretical properties are shown. Section 3 presents the estimation strategy adopted to estimate a non-linear demand system. Section 4 describes the data and presents descriptive statistics of major variables. Section 5 presents estimation results and welfare impacts, and Section 6 concludes the paper.

2. Theoretical Framework

Estimation of welfare losses from change in income and commodity prices requires reliable price and income elasticities. First-order effects of price changes can easily be computed using information on the relative share of expenditure on certain commodities and on the change in the prices of the commodities (Friedman and Levinsohn, 2002). However, these measures, although informative, might overestimate welfare impacts since they ignore substitutability when relative prices change. The welfare impact of price changes depends on the size of the price changes and on the importance of a particular commodity in the household consumption basket. It is therefore important to estimate price and income elasticities of the consumer to compute a meaningful measure of welfare change.

In order to estimate consumer welfare from estimated price and income elasticities, economists have long been using the tools of demand analysis[3]. Stone (1954) made the first attempt to estimate demand equations using a linear expenditure system (LES). This demand system, which has attractive properties such as linearity, transparency, and the parsimony of the demand parameters, was the widely used tool in empirical consumer studies for some time[4]. However, due to the structure of the Stone-Geary utility function from which it is derived, the LES does not accommodate inferior goods and ignores specific interactions between commodities, and an even more serious problem is that the income elasticities estimated are theoretically implausible[5]. This gave rise to the development of the Rotterdam model of Barten (1964) and Theil (1965) and the translog model of Christeansen et al. (1975), which corrected some of the shortcomings of the LES but also introduced their own limitations. The major limitation of the Rotterdam model is its basic assumption of constant

[3] Refer to Clements et al. (1996) for an excellent survey of the literature on applied demand analysis.
[4] The book by Lluch et al. (1977) presents a summary of the application of the LES in a wide range of countries. Robinson (1989) and Clements et al. (1996) also argue that due to its simplicity, the LES is probably the dominant tool used in CGE models.
[5] The implausibility arises because the LES implies that as income increases, income elasticities of necessities rise and those of luxuries fall (Clements et al., 1996).

coefficients, which makes it consistent only for a Cobb-Douglas utility function. The translog model, on the other hand, involves elasticities lacking simple behavioral interpretation.

The almost ideal demand system (AIDS), which is the most popular demand system, was proposed by Deaton and Muellbauer (1980a). The AIDS possesses flexible functional forms as the translog model, yet also satisfies many of the desirable properties of a demand system and hence gives an arbitrary first-order approximation to any demand system. Due to its attractive features, it has been applied in a wide range of countries during the past three decades[6]. The AIDS model is a member of the Price-Independent Generalized Logarithmic (PIGLOG) class of demand models, and has budget shares that are linear functions of log total expenditure (Muellbauer, 1976)[7]. The budget shares are derived from indirect utility functions of the consumer, which are also linear in log total expenditure. Blanks et al. (1997) show that AIDS can be misleading if there is nonlinearity in the budget share equations, and thus developed the quadratic almost ideal demand system (QUAIDS). The QUAIDS has budget shares that are quadratic in log total expenditure. The intuitive explanation of the quadratic term is that goods can be luxuries at low levels of total expenditure, for instance, and necessities at higher levels. Consequently, researchers have been using the QUAIDS to estimate demand systems using data from a wide range of countries[8]. In this paper, we use the QUAIDS to estimate demand systems for food among consumers in urban Ethiopia.

The QUAIDS, which is derived from a generalization of the PIGLOG preferences like the standard AIDS model, starts from the indirect utility function (V) given by

$$\ln V = \left\{ \left[\frac{\ln x - \ln a(\mathbf{p})}{b(\mathbf{p})} \right]^{-1} + \lambda(\mathbf{p}) \right\}^{-1} \quad , \qquad (1)$$

where x is total (income) expenditure, $\mathbf{p}$ is a vector of prices, $a(\mathbf{p})$ is a function that is homogenous of degree one in prices, and $b(\mathbf{p})$ and $\lambda(\mathbf{p})$ are functions that are homogeneous of degree zero in prices. $\ln a(\mathbf{p})$ and $\ln b(\mathbf{p})$ are specified as translog and Cobb-Douglas equations respectively as in the original AIDS model of Deaton and Muellbauer (1980a):

[6] See, e.g., Blanciforti and Green, 1983; Ray, 1982; Chester and Rees, 1987; Fulponi, 1989; Molina, 1994; Filippini, 1995; and Abdulai et al., 1999.

[7] Muellbauer (1976) defines PIGLOG demand functions as those with expenditure shares that are linear in log total expenditure. This class of demand systems includes the Almost Ideal Demand System (AIDS) of Deaton and Muellbauer (1980) and the exactly aggregable translog model of Jorgenson et al. (1982).

[8] Applications of QUAIDS includes: Abdulai (2002) in Switzerland; Abdulai and Aubert (2003) in Tanzania; Bopape and Myers (2007) in South Africa; Obayelu et al. (2009) in Nigeria; and Cranfield and Haq (2010) in a wide range of countries.

$$\ln a(\mathbf{p}) = \alpha_0 + \sum_{i=1}^{K} \alpha_i \ln p_i + \frac{1}{2} \sum_{i=1}^{K} \sum_{j=1}^{K} \gamma_{ij} \ln p_i \ln p_j \quad , \tag{2}$$

$$b(\mathbf{p}) = \prod_{i=1}^{K} p_i^{\beta_i} \quad , \tag{3}$$

where $i = 1,\ldots, K$ represent commodities. The function $\lambda(\mathbf{p})$ is specified as

$$\lambda(\mathbf{p}) = \sum_{i=1}^{K} \lambda_i \ln p_i \text{ where } \sum_{i=1}^{K} \lambda_i = 0 . \tag{4}$$

One can obtain QUAIDS budget share equations by applying Roy's identity to (1). Socioeconomic variables represented by $(\mathbf{z})$ can be incorporated into the QUAIDS model in order to control for differences in preference structures and heterogeneity across households. Thus, the QUAIDS budget share equations, which are quadratic in $\ln x$ can be specified as

$$w_i = \alpha_i + \sum_{j=1}^{K} \gamma_{ij} \ln p_j + \beta_i \ln\left[\frac{x}{a(\mathbf{p})}\right] + \frac{\lambda_i}{b(\mathbf{p})} \left\{\ln\left[\frac{x}{a(\mathbf{p})}\right]\right\}^2 + \sum_{h=1}^{L} \theta_{ih} z_h \quad , \tag{5}$$

where $z_h = (z_1,...,z_L)$ represents a vector of socioeconomic variables, such as household size, that affect preferences. Differentiating the budget share equations with respect to $\ln x$ and $\ln p_j$ gives expenditure and price elasticities respectively. Using the intermediate results (Blanks et al., 1997), we simplify the expressions for the elasticity formulas as follows:

$$\mu_i \equiv \frac{\partial w_i}{\partial \ln x} = \beta_i + \frac{2\lambda_i}{b(\mathbf{p})} \left\{\ln\left[\frac{x}{a(\mathbf{p})}\right]\right\} \tag{6}$$

$$\mu_{ij} \equiv \frac{\partial w_i}{\partial \ln p_j} = \gamma_{ij} - \mu_i \left(\alpha_j + \sum_{n=1}^{K} \gamma_{jn} \ln p_n\right) - \frac{\lambda_i \beta_j}{b(\mathbf{p})} \left\{\ln\left[\frac{x}{a(\mathbf{p})}\right]\right\}^2 . \tag{7}$$

The formula for expenditure elasticities in terms of μ_i is

$$e_i = 1 + \frac{\mu_i}{w_i} \quad , \tag{8}$$

and similarly, the Marshallian or uncompensated price elasticities of demand can be written as

$$e_{ij}^{u} = \frac{\mu_{ij}}{w_i} - \delta_{ij} \quad , \tag{9}$$

where δ_{ij} is the Kronecker delta with a value of 1 if $i = j$ and 0 otherwise. Using the Slutsky equation, the Hicksian or compensated price elasticities can be derived as

$$e_{ij}^{c} = e_{ij}^{u} + e_i w_j \quad . \tag{10}$$

To allow for integrability, one needs to impose equality (parametric) restrictions that allow homogeneity, symmetry, and adding-up to be globally satisfied. Blanks et al. (1997) prove that the QUAIDS satisfy these restrictions, which can be specified as

$$\sum_i \alpha_i = 1 \qquad \sum_i \beta_i = 0 \qquad \sum_i \gamma_{ij} = 0$$
$$\sum_i \lambda_i = 0 \tag{11}$$
$$\gamma_{ij} = \gamma_{ji}, \quad \forall i \neq j .$$

In addition, the parametric restriction $\sum_i \gamma_{ij} = 0$ ensures that the budget shares are homogenous of degree zero in prices and income.

Blanks et al. (1997) also show that the QUAIDS is rank 3, and that it nests both the AIDS model of Deaton and Muellbauer (1980a) and the exactly aggregable translog model of Jorgenson et al. (1982)[9].

Welfare

In order to estimate the welfare cost of food price inflation in urban Ethiopia, we compute compensating variation, which makes use of household budget shares, observed price changes, and the estimated price elasticities. Compensating variation (CV) refers to the amount of money a consumer would have to be compensated after a price change in order to reach the original level of utility.

The CV can be implicitly defined through the indirect utility function *V*:

[9] Lewbel (1991) defines the rank of any demand system to be the maximum dimension of the function space spanned by the Engel curves of the demand system. The rank of any exact aggregable demand system that is linear in functions of expenditure is at most three (Gorman, 1981).

$$V(x^0 + CV, p^1) = V(x^0, p^0) \quad , \qquad (12)$$

where *x* represents household expenditure and *p* is a vector of prices (Deaton and Muellbauer, 1980b). The superscripts (0) and (1) refer to the initial period and the period after price change respectively. The expression for CV in equation (12) can be re-expressed using the expenditure (or cost) function $e(p,u)$, where *u* is utility, as follows:

$$CV = e(p^1, u^0) - e(p^0, u^0) \quad . \qquad (13)$$

CV will be positive if welfare after the price change is lower than the initial level, and negative in the opposite case.

The CV for the first-order effect of price change, which does not take households' behavioral response (substitution between commodities) into account, can be approximated using first-order Taylor expansion of the minimum expenditure function as follows (Friedman and Levinsohn, 2002):

$$\Delta \ln e \approx \sum_{i=1}^{n} w_i \Delta \ln p_i \quad , \qquad (14)$$

where w_i is the budget share of commodity *i* in the initial period and $\Delta \ln p_i$ represents the proportionate price change of commodity *i*. However, since relative prices change when the prices of the different food items change, households substitute one commodity for another and, thus, first-order approximations of the welfare impact of food price inflation in urban Ethiopia might overstate welfare loss. Consequently, we use second-order Taylor series expansion approximation of the expenditure function, which accounts for substitution among commodities (Friedman and Levinsohn, 2002):

$$\Delta \ln e \approx \sum_{i=1}^{n} w_i \Delta \ln p_i + \frac{1}{2} \sum_{i=1} \sum_{j=1} w_i \varepsilon_{ij}^{*} \Delta \ln p_i \Delta \ln p_j \quad . \qquad (15)$$

3. Estimation strategy

The system of non-linear budget share equations specified in equation (5) can be estimated using either maximum likelihood (Poi, 2002) or nonlinear seemingly unrelated regressions (Poi, 2008). The latter can be estimated using iterative feasible generalized nonlinear least square estimators (*ifgnls*). With multivariate normal error terms, the two estimators result in the same parameter estimates (Poi, 2008). Due to computational advantages, however, researchers have mainly used *ifgnls* (see, e.g., Poi, 2008; Wood et al., 2010). *Ifgnls* can readily be estimated using the *nlsur* Stata command. In the present paper, we use this approach to estimate food demand systems for urban Ethiopia.

A nonlinear seemingly unrelated regression system can be viewed as a nonlinear variant of the seemingly unrelated regression model developed by Zellner (1962), Zellner and Huang (1962), and Zellner (1963). Let the system of budget share equations for the i^{th} individual (or household in our case) be given by

$$\begin{aligned} w_{i1} &= f_1(\mathrm{x}_i, \beta) + u_{i1} \\ w_{i2} &= f_2(\mathrm{x}_i, \beta) + u_{i2} \\ &\vdots \\ w_{iM} &= f_M(\mathrm{x}_i, \beta) + u_{iM} \end{aligned} \quad , \qquad (16)$$

where $m = 1,\ldots, M$ is a food item index of equations to be estimated, **x** represents all the exogenous variables in the system, and β is a $1 \times k$ vector of parameters. If there is correlation among the error terms, more efficient parameter estimates can be obtained by fitting the M equations jointly. In addition, cross-equation restrictions on the parameters can be imposed when fitting the equations jointly.

With an $M \times M$ positive-definite weight matrix $\Sigma = E(\mathrm{u}_i'\mathrm{u}_i)$, the generalized nonlinear least-squares system estimator is defined as

$$\hat{\beta} = \arg\min_{\beta} \sum_{i=1}^{N} \{\mathbf{w}_i - \mathbf{f}(\mathbf{x}_i, \beta)\} \boldsymbol{\Sigma}^{-1} \{\mathbf{w}_i - \mathbf{f}(\mathbf{x}_i, \beta)\}' \quad . \qquad (17)$$

Using the Choleskey decomposition of the inverse of the weight matrix, one can transform the multivariate generalized nonlinear least-square system estimator shown in equation (17) into a univariate nonlinear least-squares problem. Estimation is then possible

using an iterative feasible generalized least square estimator, which involves iteration and re-estimation of $\hat{\beta}$ until convergence is attained. When estimating demand systems such as the QUAIDS, however, the adding-up restriction implies that the error covariance matrix will be singular. Thus, one needs to drop one of the budget share equations, the parameters of which can later be recovered from the estimated *M-1* budget share equations using the parameter restrictions. Barten (1969) shows that it does not matter which equation is dropped.

4. Data and Descriptive Statistics

4.1 Data

In this study we use data pooled from three rounds of the Ethiopian Urban Socio-economic Survey (EUSS) – a panel data set collected in 2000, 2004, and 2008/09[10]. The EUSS is a rich data set containing several socio-economic variables at the individual and household level. The first two waves of the data used in this paper were collected by the Department of Economics of Addis Ababa University in collaboration with the University of Gothenburg, and covered seven of the country's major cities – the capital Addis Ababa, Awassa, Bahir Dar, Dessie, Dire Dawa, Jimma, and Mekelle. The cities were believed to represent the major socioeconomic characteristics of the Ethiopian urban population. About 1,500 households were distributed over these urban areas proportional to their population. Once the sample-size for each town had been set, the households were recruited from all woredas (districts) in each urban center. More exactly, households were selected randomly from half of the kebeles (the lowest administrative units) in each woreda, using the registrations of residences available at the urban administrative units.

A sixth round survey was collected by the author in 2008/09 from a sub-sample (due to lack of resources to cover all) of the original sample covering the four cities Addis Ababa, Awassa, Dessie, and Mekelle and comprising 709 households. The cities were carefully selected to represent major urban areas of the country and the original sample. All the panel households were surveyed except in Addis Ababa, which constituted about 60 percent of the original sample. About 350 of the original households in Addis Ababa were selected following the sampling procedure discussed in the preceding paragraph. Out of the total 709 households surveyed in 2009, 128 were completely new households randomly included in the survey. We surveyed these new households to address the concern that the panel households

[10] Data were also collected in 1994, 1995 and 1997 by the department of economics Addis Ababa University in collaboration with Department of Economics, University of Gothenburg.

may have become old and hence may not be very representative of the Ethiopian urban population. Alem and Söderbom (2011) show that there is no significant difference in economic status measured by consumption between the old and the new households, conditional on observable household socio-economic characteristics. The data set contains information on household living conditions including income, expenditure, demographics, health, educational status, occupation, production activities, asset ownership, and other variables on the household and individual levels. New sections on shocks and coping mechanisms, government support, and institutions were included in the 2008/09 survey.

The QUAIDS estimated for urban Ethiopia consisted of 52 food items in seven expenditure groups: teff[11], wheat, maize, pulses, animal products, fruits and vegetables, and other food items (including sugar, coffee, edible oil, spices, and drinks). An important advantage of this particular food-grouping approach is that it reduces the total number of parameters in the demand system, facilitating estimation. However, there is no theoretical basis on how to construct commodity groups. This decision is mostly made by the researcher on an *ad hoc* basis. We constructed our commodity groups by studying the consumption pattern of urban households in Ethiopia and partly based on previous studies (Keddir, 2005; Tafere et al., 2009). Implicit prices for individual commodities were derived from the purchased quantity and total expenditure data[12]. Prices for the aggregated commodity bundles were computed using the weighted mean with expenditure shares as weights. We used Cox and Wohlgenant's (1986) approach of substituting cluster (District) level prices computed from the data for households with zero levels of purchase. This implies that households with no reported price for a food item were assumed to face the average cluster price of the food item. In addition, since the data is pooled from three waves, we converted all nominal prices to real by deflating each price variable with a weighted price index using 1994 as a reference period and the capital, Addis, as reference. Thus, all prices are adjusted for spatial and common price changes over time. To account for demographic differences, we control for

[11] Teff is a major whole grain staple native to Ethiopia. It has been used as an important source of carbohydrates for centuries by Ethiopian highlanders. Teff was introduced in the US, Australia, and Western Europe in the last quarter of the 20th century and can be mainly found in health food stores and large grocers, either in the form of flour or in a whole grain format (http://www.wisegeek.com/what-is-teff.htm source).

[12] One conventional practice of estimating demand functions in developing countries is to use Deaton's (1987, 1988, 1990, 1997) approach, which uses cluster level market prices. However, such cluster level prices are absent in earlier waves of EUSS and hence we use implicit prices reported by households. Earlier studies (Abdulai and Aubert, 2002; Abdulai et al., 1999; Agbola 2003; Bopape and Myers, 2007; Obayelu et al., 2009) used implicit prices calculated from quantities and expenditure reported by households to estimate demand functions.

household size in the regression. Throughout the analysis, we assume separablity of food from non-food expenditure.

4.2 Descriptive Statistics

Table 1 presents summary statistics of budget shares, prices of the aggregate commodities, and inflation rates. We also present the same descriptive statistics for both poor (the bottom 50 percent) and non-poor (the top 50 percent) households defined based on per capita food expenditure. Households in urban Ethiopia on average spend 29 percent of their total food budget on one single staple crop (teff). Poor households spend a more proportionate share of food budget on teff than non-poor households. The poor also spend a higher proportion of their food budget on maize. Non-poor households spend a larger proportion (20 percent) of their food budget on animal products than poor households (5 percent), partly because dairy products are consumed mainly by better-off households. Households in urban Ethiopia spend on average about 71 percent of their total household budget on food.

Food prices in urban Ethiopia increased significantly 2004-2009. Annual changes in the log median prices of food items computed from EUSS-2004 and 2009 are presented in column [4] of Table 1. It can be seen that the cereals, which represent the major consumption basket of the average urban household, on average increased in price 22-25 percent over the five years. Similar differences in food price inflation among cereals and other food items are indicated in Column [5], which shows inflation rates reported by CSA (2009) for the period of unprecedented inflation in Ethiopia from December 2006 to November 2008[13].

[13] The Central Statistical Agency (CSA) of Ethiopia reports price indices for commodity groups. Thus, the price indices for teff, maize and wheat are reported under cereals, giving them similar growth rates.

Table 1. Summary Statistics

	[1] All		[2] Poor		[3] Non-poor		[4] Avg. Annual Inflation rate (%)	[5] Inflation rate (%)
	Mean	SD	Mean	SD	Mean	SD	2004-2009*	2006-Nov. 2008**
Share of Teff (%)	29.00	0.18	33.00	0.21	25.00	0.14	-	-
Share of Wheat (%)	5.00	0.09	5.00	0.09	6.00	0.09	-	-
Share of Maize (%)	2.00	0.07	3.00	0.09	1.00	0.04	-	-
Share of Pulses (%)	8.00	0.07	9.00	0.07	7.00	0.05	-	-
Share of Animal Products (%)	12.00	0.16	5.00	0.10	20.00	0.17	-	-
Share of Fruits and Vegetables (%)	10.00	0.08	9.00	0.08	10.00	0.08	-	-
Share of Other Food Items (%)	33.00	0.16	35.00	0.18	32.00	0.14	-	-
Share of food in total expenditure (%)	71.00	0.14	72.00	0.13	69.00	0.15	-	-
Household Size	5.75	2.73	6.40	2.85	5.10	2.43	-	-
Price of Teff	2.61	0.54	2.51	0.51	2.71	0.54	25.00	85.00
Price of Wheat	1.99	0.44	1.93	0.36	2.05	0.49	24.00	85.00
Price of Maize	1.49	0.27	1.48	0.27	1.50	0.27	22.00	85.00
Price of Pulses	3.89	1.25	3.76	1.25	4.02	1.23	19.00	70.00
Prices of Animal Products	11.43	5.07	11.37	4.39	11.49	5.67	16.00	60.00
Price of Fruits and Vegetables	2.31	1.84	2.19	1.58	2.42	2.06	15.00	43.00
Price of Other Food Items	7.92	3.76	7.85	3.86	7.98	3.65	14.00	78.00
Observations	2998		1499		1499			

Note: *Source: EUSS04 &09; ** Source: CSA, 2009.

5. Results

Table 2 presents parameter estimates of the QUAIDS with the theoretical restrictions imposed[14]. For all estimated equations, most of both the own- and cross-price parameters are statistically significant. Six of the seven expenditure parameters are also significant at one percent. The statistical significance of the squared expenditure term (λ) is clearly evident in all the equations except maize. Moreover, a Wald test has been performed on the squared terms, and the null hypothesis of zero squared expenditure terms is rejected at one percent. This provides evidence in favor of using the QUAIDS over AIDS. In addition, the coefficient of household size, which is introduced to capture taste differences across households, is positive and significant for teff and other food items, while it is negative and significant for food groups such as wheat, pulses, and animal products. This finding can be given an intuitively appealing interpretation. In order to feed a larger proportion of household members, spending patterns need to be re-adjusted. As household size increases for a given level of budget and prices, households tend to adjust their consumption pattern toward basic food items and away from expensive ones such as animal products. Parameter estimates for both poor and non-poor households are presented in Tables A.1 and A.2 in the appendix.

[14] The panel data is not long enough to estimate the demand systems using panel data econometrics. We therefore pooled data from the three rounds.

Table 2. QUAIDS parameter estimates- All households

Items	*Constant*	*Price of Teff*	*Price of Wheat*	*Price of Maize*	*Price of Pulses*	*Price of Animal Products*
Teff	0.155***	0.056***	0.001	-0.011***	-0.008***	-0.010***
Wheat	0.086***	0.001	-0.002	-0.002*	0.039***	0.059***
Maize	-0.012	-0.011***	-0.002*	-0.007***	-0.008***	-0.006***
Pulses	0.040***	-0.008***	0.039***	-0.008***	0.002	0.036***
Animal Products	0.265***	-0.010***	0.059***	-0.006***	0.036***	-0.021**
Fruits and Vegetables	0.137***	0.019*	-0.001	-0.002***	0.001	0.004***
Other Food Items	0.329***	-0.049***	-0.095***	0.035***	-0.061***	-0.063***

Items	*Price of Fruits & Vegetables*	*Price of Other Food Items*	*Food Expenditure*	*Food Expenditure Squared*	*Household Size*
Teff	0.019*	-0.049***	-0.043***	0.070***	0.062***
Wheat	-0.001	-0.095***	0.010***	0.002	-0.033***
Maize	-0.002***	-0.002	-0.015***	0.022***	-0.004
Pulses	0.001	-0.061***	-0.025***	0.010***	-0.012***
Animal Products	0.004***	-0.063***	0.114***	-0.060***	-0.022***
Fruits and Vegetables	-0.005***	-0.016	-0.001	-0.009***	-0.001
Other Food Items	-0.016	0.248***	-0.040***	-0.034***	0.011*

Note: ***p<0.01, **p<0.05, *p<0.1, Observations = 2998

Table 3 presents expenditure elasticities of households in urban Ethiopia computed at the mean. Expenditure elasticities estimated for all households show that the expenditure elasticity for teff and pulses are less than one, while those for wheat, animal products, and fruits and vegetables are greater than one. Other food items are unitary elastic. These findings suggest that as income increases, consumers tend to spend proportionately less on teff and pulses and more on animal products and fruits and vegetables. Maize appears to be an inferior food item with strong negative expenditure elasticity[15]. There appears to be a difference in the consumption pattern between poor and non-poor households. As expected, the expenditure elasticities of poor households are higher (in absolute terms) than those of non-poor households for most of the food items.

Table 3. Expenditure elasticities

	All		Poor		Non-poor	
	Coef.	SE	Coef.	SE	Coef.	SE
Teff	0.59***	0.04	1.05***	0.12	0.53***	0.04
Wheat	1.14***	0.09	1.03***	0.36	1.23***	0.11
Maize	-1.13***	0.30	-4.38***	0.98	0.59**	0.26
Pulses	0.55***	0.06	0.69***	0.22	0.70***	0.05
Animal Products	2.48***	0.06	3.31***	0.39	1.68***	0.05
Fruits and Vegetables	1.09***	0.05	1.37***	0.19	0.95***	0.05
Other Food Items	1.00***	0.03	1.03***	0.11	1.00***	0.03
Observations	2998		1499		1499	

Note: Standard errors are robust to heteroskedasticity. ***p<0.01, **p<0.05, *p<0.1

Uncompensated own-price elasticities are reported in Table 4, and Table A.3 in the appendix presents the complete estimates of uncompensated own-price elasticities. The negativity property is satisfied for all food items and all households, and all own-price elasticity estimates are statistically significant at one percent. The own-price elasticities of wheat, maize, animal products, and fruits and vegetables are found to be greater than unity, while the elasticities for teff and other food items imply inelastic demand. This indicates that a uniform price reduction, percentage-wise, of all commodities would result in a particularly greater demand for animal products and fruits and vegetables. Other food items and teff show the lowest (in absolute terms) own-price elasticities, reflecting their status as staple and basic

[15] A previous study by Tafere et al. 2009 also shows that maize is an inferior food item in urban areas of Ethiopia.

food items, while animal products and maize have the highest (in absolute terms) own price elasticities (1.39 and 1.48 respectively). Table 4 also shows the difference in the value of own-price elasticities between poor and non-poor households. The own-price elasticities for all food items are higher (in absolute terms) for poor than for non-poor households, with the exception of wheat and animal products. When it comes to substitutability, Table A.3 in the appendix shows that teff and wheat are substitutes, while teff and maize are complements. Table 5 below and Table A.4 in the Appendix present the results for compensated (Hicksian) own-price elasticities.

Table 4. Marshallian/uncompensated own-price elasticities

	All hhs		Poor hhs		Non-poor hhs	
	Coef.	SE	Coef.	SE	Coef.	SE
Teff	-0.77***	0.04	-0.98***	0.05	-0.63***	0.05
Wheat	-1.06***	0.06	-1.00***	0.1	-1.13***	0.05
Maize	-1.48***	0.12	-1.81***	0.19	-1.23***	0.18
Pulses	-0.96***	0.03	-0.94***	0.03	-0.96***	0.05
Animal Products	-1.39***	0.07	-1.47***	0.15	-2.13***	0.33
Fruits and Vegetables	-1.07***	0.02	-1.09***	0.03	-0.63***	0.31
Other Food Items	-0.26***	0.09	-0.60***	0.15	-0.25***	0.41
Observations	2998		1499		1499	

Note: Standard errors are robust to heteroskedasticity. ***p<0.01, **p<0.05, *p<0.1

Table 5. Hicksian/compensated own-price elasticities

	All hhs		Poor hhs		Non-poor hhs	
	Coef.	SE	Coef.	SE	Coef.	SE
Teff	-0.60***	0.04	-0.63***	0.04	-0.49***	0.05
Wheat	-0.99***	0.06	-0.95***	0.10	-1.06***	0.05
Maize	-1.51***	0.12	-1.93***	0.21	-1.22***	0.18
Pulses	-0.92***	0.03	-0.88***	0.04	-0.92***	0.05
Animal Products	-1.09***	0.06	-1.31***	0.14	-1.79***	0.33
Fruits and Vegetables	-0.96***	0.02	-0.96***	0.02	-0.53*	0.31
Other Food Items	0.08	0.09	-0.24*	0.14	0.07	0.41
Observations			1499		1499	

Note: Standard errors are robust to heteroskedasticity. ***p<0.01, **p<0.05, *p<0.1

In Table 6, we investigate the welfare impact of food price inflation in urban Ethiopia using two price increase scenarios. The first is the actual annual average food inflation rates 2004-2009: a 25 % increase in the price of teff, a 24% increase in the price of wheat, a 22%

increase in the price of maize, a 19% increase in the price of pulses, a 16% increase in the price of animal products, a 15% increase in the price of fruits and vegetables, and a 14% increase in the price of other food items. These price changes are computed from EUSS-2004 and EUSS-2009 using median prices. To compute the net welfare impact of the food price rise 2004-2009, one needs to compute the counterfactual inflation rate (the normal inflation rate, had there been no major inflation). Price data from EUSS shows that from 1997 to 2004, the prices of the food items considered here increased on average by about 3-6% per year, as shown in Table 6[16]. We therefore compute compensating variation under these two scenarios. Since data used in the demand system estimation also covers the period of large price increase, we re-estimated the elasticities by excluding data from 2008/09 and report them in Table A.5 in the appendix. We found no significant difference in the own-price elasticity estimates, and use the ones estimated with data including the inflationary period to investigate welfare impacts. The fact that price and expenditure elasticities do not change much when we exclude data from the inflationary round might indicate that consumption pattern of households in urban Ethiopia did not change much even in the face of such high increases in food prices.

Welfare losses due to food price inflation for households in urban Ethiopia are presented at the bottom of Table 6. The first-order welfare effect of food price inflation for all households is on average about 0.19 per year. This can be interpreted to mean that households in urban Ethiopia need to be compensated about 19 percent of their food expenditure annually in order to offset the effects of food price inflation in the period under analysis. First-order effects, though informative, might be biased since they do not take account of households' option of substituting one commodity for another when relative prices change. We therefore compute the full effects of compensating variation (as shown by equation 15) and report them in Table 6. There appears to be no difference in the welfare loss of consumers in urban Ethiopia as measured by the first- and second-order effects. This might indicate an inability of consumers to substitute away when the prices of major food items increase at similar rates, which has been the case in Ethiopia. Had there been the counterfactual inflation rate, however, the welfare impacts could have been only 4 percent of the consumer food budget.

[16] 2000-2004 was a deflationary period and thus might not provide a reasonable counterfactual rate of inflation. Instead, we considered the average inflation rate 1997-2004 to formulate the counterfactual inflation rate.

This shows that households in urban Ethiopia on average lost about 15% of their total food budget annually due to the unprecedented food price inflation 2004-2009[17].

Table 6. Food price inflation and welfare effects

	Average annual price changes	
Food Items	1997-2004	2004-2009
Teff	6.00	25.00
Wheat	4.00	24.00
Maize	6.00	22.00
Pulses	4.00	19.00
Animal Products	3.00	16.00
Fruits and Vegetables	0.00	15.00
Other Food Items	3.00	14.00

Source: EUSS1997-2009

Welfare effects (Compensating variations) 2004-2009 (%)

	All	Poor	Non-poor
First-order effect	19.00	19.00	18.00
Full effect	19.00	19.00	18.00

Welfare effects (Compensating variation) under normal rates of inflation(%)

	All	Poor	Non-poor
First-order effect	4.00	4.00	4.00
Full effect	4.00	4.00	4.00

Net welfare effects (Compensating variation) (%)

	All	Poor	Non-poor
First-order effect	15.00	15.00	14.00
Full effect	15.00	15.00	14.00

We also compute CV for both poor and non-poor households. The welfare loss is 19 percent for poor households (exactly equal to the first-order effect) and 18 percent for non-poor households. The welfare effects under the counterfactual inflation rate could have been 4 percent for both poor and non-poor households as well, which implies that poor and non-poor households lost about 15% and 14% of their budget share respectively. These differences do

[17] To check for the possibility of ability to substitute by households under relative price changes, we calculated first- and second-order effects under hypothetical price changes. When for instance we calculate welfare effects under the assumption that prices of all food items increase by the actual inflation rate reported except for teff, the second-order effect for poor households is 10 percent lower than the first-order effect.

not appear to be large. This might however be due to our definition of poor and non-poor households, i.e., the bottom and top 50% based on per capita food consumption. The results could have been significantly different had we had more observations and had we considered, say, the bottom and top 20 percent of households. At any rate, it is clear that the poor, who spend a higher proportion of their household budget on food, suffered more than the non-poor due to food price inflation.

As a robustness check, we also estimated the AIDS model of Deaton and Muellbauer (1980a) and present expenditure and own-price elasticities for all households in Table A.6. There appears to be significant differences in the magnitude of expenditure and own-price elasticities between the AIDS and QIAIDS models. The AIDS expenditure elasticities are greater (in absolute terms) than the QUAIDS ones for teff and pulses. Almost all the Marshallian own-price elasticities of the AIDS model are greater (in absolute terms) than the QUAIDS ones. Similar differences are evident in the Hicksian own-price elasticities. However, the CV for all households computed using the AIDS-compensated own-price elasticites at the considered price increase scenarios is the same as the QUAIDS' -0.19, possibly because there is little change in the relative prices of the considered food items.

6. Conclusions and discussion

This paper uses a quadratic almost ideal demand system (QUAIDS) and data from urban Ethiopia spanning 2000-2009 to model household demand for food and investigate the welfare impacts of food price inflation. Estimated price and cross-price elasticities are used to compute compensating variation for the observed unprecedented food price inflation in the country 2004-2009. The QUAIDS specification is adopted because of its attractive theoretical feature of incorporating a nonlinear component for the effect of income (expenditure) on consumer demand. Statistical tests show that the QUAIDS is preferred to the AIDS model.

All households in urban Ethiopia were affected by food price inflation during the analyzed period. Compensating variation (CV) computed from estimated food demand elasticities shows that due to food price inflation 2004-2009, households in urban Ethiopia on average lost an equivalent of 15 percent of their food budgets annually. We also compute CV for both poor and non-poor households and show that the annual net welfare loss for poor households was 15 percent, while it was 14 percent for non-poor households. This provides some evidence that the poor, who spend a larger proportion of their household budget on food, suffered more than the non-poor. We also found that the welfare impacts of food price inflation were the same regardless of whether or not we allowed for households' substitution

of food items, maybe due to the fact that households had limited options when the price of all goods increased by equal proportions. Thus, subsidy and other social support programs should consider these differences in impacts and target poor households.

Although informative, the compensating variations we computed might still overestimate the welfare impact of food price inflation in general. Two limitations in particular need to be noted. First, although the Ethiopian economy experienced a double digit inflation rate 2004-2009, the economy grew rapidly by about 11% annually in real terms during the same period. Hence, households might have coped with the price shock to some extent through income increases. Second, although urban households suffer from food price increases, rural households, in particular net sellers of food, might actually benefit. The net welfare impact of a macroeconomic shock such as inflation can be well understood from studies adopting computable general equilibrium models that incorporate all sectors of the economy. Future research can shed more light on this.

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Appendix

Table A.1. QUAIDS Parameter estimates- Poor households

Items	*Constant*	*Price of Teff*	*Price of Wheat*	*Price of Maize*	*Price of Pulses*	*Price of Animal Products*
Teff	0.300***	0.011	0.017	-0.008*	-0.003	-0.006*
Wheat	0.059***	0.017	0.0004	-0.001	0.031***	0.007**
Maize	-0.064***	-0.008*	-0.001	-0.014***	-0.002	-0.002
Pulses	0.056***	-0.003	0.031***	-0.002	0.005	0.018***
Animal Products	0.156***	-0.006*	0.007**	-0.002	0.018***	-0.009
Fruits and Vegetables	0.130***	0.030	0.0004	-0.003***	0.000	0.001
Other Food Items	0.363***	-0.041	-0.055***	0.030***	-0.048***	-0.010

Items	*Price of Fruits & Vegetables*	*Price of Other Food Items*	*Food Expenditure*	*Food Expenditure Squared*	*Household Size*
Teff	0.030	-0.041	0.052***	0.015	-0.011
Wheat	0.0005	-0.055***	0.008	0.003	-0.024**
Maize	-0.003***	0.008	-0.030***	0.049	-0.020*
Pulses	0.0004	-0.048***	-0.023***	0.003	-0.020***
Animal Products	0.001	-0.010	0.051***	-0.026	0.008
Fruits and Vegetables	-0.005***	-0.023	0.002	-0.014	0.009*
Other Food Items	-0.023	0.147***	-0.060***	-0.029	0.059***

Note: ***p<0.01, **p<0.05, *p<0.1, Observations = 1499

Table A.2. QUAIDS Parameter estimates- Non-poor households

Items	*Constant*	*Price of Teff*	*Price of Wheat*	*Price of Maize*	*Price of Pulses*	*Price of Animal Products*
Teff	0.218***	0.076***	-0.004	-0.013***	-0.013***	-0.010***
Wheat	0.094***	-0.004	-0.007***	0.0003	0.047***	0.082***
Maize	0.016***	-0.013***	0.0003	-0.002	-0.009***	-0.010***
Pulses	0.049***	-0.013***	0.047***	-0.009***	0.001	0.049***
Animal Products	0.208***	-0.010***	0.082***	-0.010***	0.049***	-0.232***
Fruits and Vegetables	0.133***	0.015**	0.046	-0.010	-0.028*	0.043
Other Food Items	0.282***	-0.049***	-0.163***	0.044***	-0.046***	0.078

Items	*Price of Fruits & Vegetables*	*Price of Other Food Items*	*Food Expenditure*	*Food Expenditure Squared*	*Household Size*
Teff	0.015**	-0.049***	-0.107***	0.057***	0.136***
Wheat	0.046	-0.163***	0.015***	0.004	-0.036***
Maize	-0.010	-0.015*	-0.003	0.003	0.0003
Pulses	-0.028*	-0.046***	-0.019***	0.005	-0.009
Animal Products	0.043	0.078	0.127***	-0.037***	-0.035***
Fruits and Vegetables	0.037	-0.102	-0.005	0.0003	-0.011***
Other Food Items	-0.102	0.239*	-0.008	-0.033***	-0.045***

Note: ***p<0.01, **p<0.05, *p<0.1, Observations = 1499

Table A.3. Marshallian/uncompensated own and cross-price elasticities -all households

	T	W	M	P	AP	FV	OF
T	-0.77***	0.04**	-0.06***	-0.01	0.03**	0.12***	0.04
W	0.01	-1.06***	-0.02	0.72***	1.06***	-0.03*	-1.82***
M	-0.38**	0.10*	-1.48***	-0.39***	-0.01	0.18***	0.94**
P	-0.06*	0.53***	-0.13***	-0.96***	0.52***	0.06	-0.53***
AP	-0.21***	0.35***	0.04	0.25***	-1.39***	-0.15***	-1.24***
FV	0.19*	-0.01	-0.01**	-0.01	0.03*	-1.07***	-0.21*
OF	-0.15***	-0.28***	0.10***	-0.18***	-0.18***	-0.05	-0.26***

Note: ***p<0.01, **p<0.05, *p<0.1

Table A.4 Hicksian/compensated own-price elasticities -all households

	T	W	M	P	AP	FV	OF
T	-0.597***	0.073***	-0.049***	0.032***	0.098***	0.176***	0.235***
W	0.348***	-0.994***	-0.001	0.810***	1.201***	0.083***	-1.436***
M	-0.716***	0.035	-1.506***	-0.486***	-0.151*	0.071	0.557
P	0.104***	0.556***	-0.121***	-0.915***	0.583***	0.109**	-0.352***
AP	0.515***	0.480***	0.083***	0.451***	-1.086***	0.087***	-0.415***
FV	0.511***	0.046***	0.007	0.083**	0.169***	-0.959***	0.150
OF	0.144***	-0.228***	0.123***	-0.103***	-0.061**	0.048	0.077

Note: ***p<0.01, **p<0.05, *p<0.1

Table A.5 Expenditure and own-price elasticities 2000-2004 (All households)

	Expenditure		Marshallian		Hicksian	
	Coef.	SE	Coef.	SE	Coef.	SE
Teff	0.45***	0.05	-0.77***	0.04	-0.64***	0.05
Wheat	0.99***	0.10	-1.04***	0.06	-0.99***	0.06
Maize	-1.32***	0.37	-1.36***	0.14	-1.38***	0.14
Pulses	0.59***	0.08	-1.01***	0.04	-0.96***	0.04
Animal Products	2.52***	0.08	-1.49***	0.08	-1.17***	0.08
Fruits and Vegetables	1.12***	0.06	-1.11***	0.02	-1.00***	0.02
Other Food Items	1.09***	0.04	-0.36***	0.11	0.01	0.11
Observations						

Note: Standard errors are robust to heteroskedasticity. ***p<0.01, **p<0.05, *p<0.1

Table A.6. Expenditure and own-price elasticities -AIDS model -all households

	Expenditure		Marshallian		Hicksian	
	Coef.	SE	Coef.	SE	Coef.	SE
Teff	0.88***	0.02	-1.05***	0.11	-0.09	0.11
Wheat	1.18***	0.05	-2.63***	0.29	-1.62***	0.28
Maize	0.23*	0.13	0.72	0.86	1.70**	0.86
Pulses	0.69***	0.03	-1.09***	0.20	-0.12	0.20
Animal Products	1.91***	0.03	-2.78***	0.12	-1.67***	0.12
Fruits and Vegetables	1.01***	0.02	-1.61***	0.20	-0.61***	0.20
Other Food Items	0.85***	0.02	-1.67***	0.06	-0.72***	0.06
Observations	2998		1499		1499	

Note: Standard errors are robust to heteroskedasticity. ***p<0.01, **p<0.05, *p<0.1

Paper IV

What do policymakers know about the factors influencing citizens' subjective well-being?*

Yonas Alem† and Peter Martinsson‡

Abstract

In light of the increased interest in using subjective well-being as an outcome variable beyond GDP, as for example argued by the Stiglitz Commission, there is an interest in analyzing policymakers' knowledge on what variables influence citizens' subjective well-being. We elicit what policymakers guess influence citizens' subjective well-being with a focus on environmental variables. Our study, conducted on policymakers in Addis Ababa, Ethiopia, shows large heterogeneity in their guesses. Overall, we find that the factors that correlate with citizens' subjective well-being in Addis Ababa are similar to those found in rich Western countries. Moreover, there is a low correlation between what policymakers guess affects citizens' subjective well-being and our empirical findings on the matter. As an alternative check for the similarities between citizens' and policymakers' preferences, we also undertook a ranking exercise of setting priority areas. Compared to the citizens, policymakers put more weight on longer-term projects. By and large, our study indicates that policymakers have a heterogeneous, and hence a non-negligible proportion of them have a fairly poor understanding of what correlates with citizens' subjective well-being.

JEL Classification: D61, Q58

Keywords: subjective well-being; policymakers; life satisfaction; environment; Ethiopia.

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1. Introduction

The discussion on how to measure development and growth has in recent years shifted from a strong focus on GDP per capita to an interest in measures that consider a broader spectrum of items that may affect people's well-being (e.g., Deaton, 2008; Fleurbaey, 2009). This shift has resulted in increased interest in studies using subjective well-being as an outcome variable. Over the last decade, the number of studies in economics that investigate what affects subjective well-being has increased substantially (for an overview see, e.g., Dolan *et al.*, 2008; Frey and Stutzer, 2002; Van Praag and Ferrer-I-Carbonell, 2008). This line of research has gone beyond pure economic factors and has provided new insights on what determines subjective well-being among people, including health, employment, and marital status.[1] From a more policy-oriented perspective, the interest in using subjective well-being as an outcome measure has also increased rapidly in recent years. One of the bridging contributions between academics and politicians was the report "Commission on the Measurement of Economic Performance and Social Progress", which was the output from a commission ("Stiglitz Commission") set up by the French president Sarkozy and led by the Nobel Prize laureates Joseph Stiglitz and Amartaya Sen (Stiglitz *et al*., 2008).[2] The commission discussed the problems of using GDP as the only measure of progress, and for example on page 41 the report states that "Quality of life is a broader concept than economic production and living standards. It includes the full range of factors that influences what we value in living, reaching beyond its material side."

[1] An interesting and intensely debated issue is the Easterlin paradox, which is based on the empirical findings from industrialized countries that the level of subjective well-being in the population has been pretty much constant over time despite high rates of real GDP growth (Easterlin, 1974; 1995). For an overview of the discussion on the impact of growth and GDP on subjective well-being, see Clark and Senik (2010), and on critical discussion on the Easterlin paradox, see Stevenson and Wolfers (2008).

[2] In the commission, we also find the Nobel Prize laureates Kenneth Arrow, James Heckman, and Daniel Kahneman, but also prominent subject experts such as Angus Deaton, Robert Putnam, Nicholas Stern, Andrew Oswald, and Alan Kreuger.

Given the rich information provided by subjective well-being studies, a relevant, and partly philosophical, question is to what extent these results should be used by policymakers (see the discussion in, e.g., Kahnemann and Sudgen, 2005). Other countries than France have shown a similar interest in using subjective well-being research in policy-making. The most recent and notable example is the British government under the leadership of Prime Minister David Cameron, who has established the "National Wellbeing Project." As part of this project, "The Office for National Statistics" will publish the U.K.'s first official subjective well-being index in 2012. Another example is Bhutan, which has used the subjective well-being approach for decades to both evaluate and plan public policies, and at country level using Gross National Happiness rather than GDP as an indicator. Thus, an interesting and highly relevant question is whether policymakers know what influences people's subjective well-being, and this question is particularly valid if we can expect an increasing number of subjective well-being-oriented policy decisions in the future. The present paper aims to investigate whether policymakers know what influences subjective well-being and whether their views are similar regarding what influences subjective well-being. As an alternative exercise, we also compare citizens' and policymakers' views on priority setting with respect to a number of distinct projects. We conducted the study in Addis Ababa, the capital of Ethiopia. In Addis Ababa, we also conducted a survey to explore what influences people's subjective well-being in order to obtain information to be used when evaluating policymakers' knowledge.

The main novelty of our paper is that it investigates the knowledge of policymakers on what affects people's subjective well-being and besides that, it uses data on people living in a large city in a very poor developing country. In an interesting paper produced by "The Office for National Statistics", Dolan *et al.* (2011) discuss how subjective well-being studies can be used by policymakers, and they mention three purposes: (i) monitoring progress, (ii) informing

policy design and (iii) policy appraisal. In an earlier work, Dolan and White (2008) suggest how to use studies on subjective well-being by policymakers: (i) to support monetary quantification of different attributes to be used in cost-benefit analyses[3], (ii) to identify standard units of measurement to allow for easy comparison of different factors influencing subjective well-being, and (iii) to set default options.[4] In the present paper, we focus on the second application and especially on environmental goods. The first point is extra problematic in developing countries since the approach requires an accurate measure of income, while the latter implies a standpoint on the degree of how paternalistic policymakers should be. To our knowledge, people's preferences and decision makers' choices have not been compared to any great extent.[5] For environmental goods, Carlsson *et al*. (2011) investigate whether administrators at the Swedish Environmental Protection Agency, in their role of administrators, make decisions concerning the quality of the environment similar to the preferences of Swedish citizens. Using a choice experiment, they do find significant differences between these two groups. Yet, Colombo *et al*. (2009) compare preferences of U.K. experts and citizens regarding investment strategies for footpaths, bridleways, and other ways over private property covered under Public Rights of Way, while also considering issues such as local relevance, and found similar rankings of attributes between experts and citizens.

If subjective well-being is going to guide future policies, it is important to understand what factors affect it. The major sources of such information are surveys designed to collect information on reported subjective well-being and relevant covariates. However, most of our

[3] The approach to calculate the willingness to pay for an attribute, i.e., calculation of marginal rate of substitution between the attribute of interest (e.g., quality of the environment) and income, has been used by, e.g., Van Praag and Baarsma (2005) in the valuation of noise from airplanes and Ferrer-I-Carbonell and van Praag (2005) for chronic illnesses.

[4] Of course, this results in a discussion on how paternalistic policymakers should be. Kahneman and Sudgen (2005) discuss the issue of using experienced utility, i.e., self-reported happiness, to guide policymakers, and end up disagreeing with each other. Sudgen is more pro-use of experienced utility and on page 178 they write "Sudgen favors a conception of normative economics which emphasizes the satisfaction of individuals' preferences, even if preferences fail to meet conventional consistency conditions, and even if preference-satisfaction conflicts with well-being."

[5] For a general discussion on decision making by policymakers, see public choice theory in, e.g., Mueller (2003).

present knowledge related to factors affecting subjective well-being is almost exclusively based on studies using large data sets from rich western countries.[6]

As mentioned above, a number of robust results have emerged from the analyses of factors influencing of people's subjective well-being. Health seems to be one of the most important variables in studies on subjective well-being (e.g., Dolan *et al*., 2008). Age has been found to have a U-shaped relationship with subjective well-being, with on average the lowest level of subjective well-being being experienced in the 40s (e.g., Blanchflower and Oswald, 2008). Moreover, females are happier than men, married people are happier than the unmarried and divorced, and unemployed individuals are significantly unhappier than employed ones (e.g., Dolan *et al*., 2008; Frey and Stutzer, 2002; MacKerron, 2011). In recent years, environmental quality has begun to enter into the analyses of subjective well-being. Welsch (2002; 2006) uses cross-country data and find a significant negative effect of air pollution on subjective well-being in Europe. Using measurement data of sulphur dioxide concentration, Luechinger (2009) find that higher levels significantly reduce subjective well-being, and Rehdanz and Maddison (2005) find that climate variables, especially temperature and the amount of rainfall, also have a significant impact on subjective well-being. Ferreira and Moro (2010) find a significant impact of temperature and concentration of PM_{10} on subjective well-being in Ireland[7].

[6] Examples on happiness studies conducted in developing countries include Ravallion and Lokshin (2002) on Russia; Kingdon and Knight (2006); Bookwalter and Dalenberg (2009), and Dalenberg and Bookwalter (2004) on South Africa; Graham and Pettinato (2001; 2002) on Peru and Russia; Appleton and Song (2008) and Smyth and Qian (2008) on urban China; and Knight *et al.* (2009) on rural China.

[7] See Welsch and Kuehling (2009) for an excellent overview of research in the area of environmental quality and subjective well-being.

The rest of the paper is organized as follows. In the next section we describe the survey and empirical approach. The results are presented in the third section. Finally, section four summarizes the paper.

2. Survey and empirical approach

The empirical analyses in this paper use data from a household survey conducted in Addis Ababa, Ethiopia, in 2009. The survey was a part of the 2008/09 Ethiopian Urban Socio-economic Survey (EUSS-2009), which is a part of the household panel survey that has been collecting household and individual level information on various socio-economic variables in urban Ethiopia since 1994. In EUSS-2009, a total of 416 households in Addis Ababa were interviewed.[8]

In the survey, the following question on subjective well-being was asked: "Taking everything into account, how satisfied are you with the way you live these days?" The respondents responded on a five-point scale, where 5 was very satisfied and 1 very dissatisfied (for a discussion on how to ask questions related to subjective well-being, see, e.g., Dolan *et al*., 2008; MacKerron, 2011). In addition, the survey contained a wide range of socio-economic questions concerning, e.g., level of education, source of income, consumption, ability to raise a certain amount of money in a short period of time, and access to modern waste disposal facilities. Each respondent was selected from the adult members of the household.

[8] The surveys originally covered the seven major cities in Ethiopia Addis Ababa, Awassa, Dessie, Mekelle, Jimma, Bahir Dar, and Dire Dawa, which were selected to represent the major socioeconomic characteristics of Ethiopia's urban population (see AAU & UG for details on EUSS). EUSS-2009 was only conducted in Awassa, Dessie, and Mekelle in addition to Addis Ababa. Since sample size in other cities is small and there are possible differences among cities, we exclude the other cities from our analysis (see Alem and Söderbom, 2011, for details on EUSS-2009).

An individual's subjective well-being, SWB^*, is unobservable. Instead, one observes the self-reported subjective well-being on a discrete scale with the reported level corresponding to $SWB = j$ from a scale with J ($j = 1,...,J$) categories of subjective well-being. Thus, we can summarize the subjective well-being as

$$SWB_i^* = SWB_i(\mathbf{x}_i) + \varepsilon_i, \quad (1)$$

where subjective well-being is a function of $\boldsymbol{x}$, which is a vector containing income, socio-demographic characteristics of individual i, and an error term, ε. In regression terms, we assume a model that is linear in attributes, and since the subjective well-being is reported on a discrete scale, we apply an ordered probit model. This can be summarized as

$$SWB_i^* = x_i'\beta + \varepsilon_i. \quad (2)$$

The model is estimated using a maximum likelihood estimator, which can be summarized as

$$SWB_i = j \quad \text{if} \quad \mu_{j-1} < SWB_i^* \le \mu_j, \qquad j = 1,...,5 \quad (3)$$

$$\mu_0 = -\infty, \mu_j \le \mu_{j+1}, \mu_J = \infty, \quad (4)$$

where μ_j is the unknown upper cut-off point for category j of the ordered relationship to be estimated. The probability of falling into self-reported category j for an individual i is $P(SWB_i = j)$, which can be written as

$$P(SWB_{i,j} = j) = \Phi(\mu_j - x_i'\beta) - \Phi(\mu_{j-1} - x'\beta), \quad (5)$$

where Φ is the cumulative distribution function of the standard normal random variable.

As discussed in the introduction, the main objective of our paper is to assess whether policymakers agree on what affects and does not affect citizens' subjective well-being, and how their opinions correspond to our empirical findings on what influences subjective well-being among people living in Addis Ababa. This part of the study was developed after the

household survey had been conducted in order for us to construct both easier and more difficult choice scenarios for the policymakers. This is discussed in more detail in the next section following a presentation of the results from the regression on what affects subjective well-being. We asked the policymakers to rank two hypothetical persons in terms of their life satisfaction. More precisely, they were asked to compare two individuals who were similar in all respects except in terms of the mentioned attributes. They were then asked to indicate on a 6-point scale, where 1 meant "Person 1 has much higher life satisfaction" and 6 "Person 2 has much higher life satisfaction," who they thought had higher life satisfaction. The twelve choice sets used are described in Table 1 below[9]. In the first choice, Choice A, the question is whether Person 1 – a female – has higher life satisfaction than Person 2 – a male – or vice versa. We discuss this in more detail in section 3 after we have presented the regression results on life satisfaction.

As can be seen in Table 1, some of the included attributes are clear policy variables with a focus on environmental quality, while others were incorporated to measure policymakers' knowledge on the correlates of citizens' subjective well-being such as income, employment and marital status. Although there are variables that policymakers cannot directly affect, they can still consider different sub-groups differently when for example setting priorities in connection with the introduction of new policies. It should be noted, since we would like to assess the importance of policy variables, we do need to combine them with another variable. When we for example ask policymakers' view about citizens' subjective well-being related to the quality of environment variables, it is obvious which alternative is better than the other, and thus such a choice exercise is rather uninformative. For example in the third choice set, the environmental quality variables involved are "Burns or throws away solid waste" versus

[9] We mainly relied on our findings from the life satisfaction regressions to form these attributes of the hypothetical persons compared by policymakers.

"Municipal or private solid waste disposal service." In this case it is rather expected that most policymakers would say ceteris paribus that the citizens in the latter environment have higher subjective well-being. To avoid such obvious answers, we added the possibility to raise money for emergency purposes at a short notice, which from our survey, and from introspection, was indicated to be important. We selected seven of the ten sub-cities of Addis, namely Addis Ketema, Arada, Gullele, Kirkos, Bole, Yeka, and Lideta, since these sub-cities covered more than 95 percent of our respondents. In each sub-city, we randomly selected nine kebeles[10], which add up to the 63 kebele officials' responses that were used in our study. We surveyed kebele officials for our choice exercise because they have a better understanding of real life situations in their kebeles. More importantly, they provide useful policy input to city level policymakers, and thus effectively having a significant decision power on issues in their kebeles. In addition, kebeles are responsible for the provision of basic services to the community[11].

[10] kebeles are the lowest administrative units in Ethiopia. In Addis Ababa, kebeles are in the third level of administrative hierarchy next to the city administration and sub-cities.

[11] See http://www.addisababacity.gov.et for a detailed presentation of duties and responsibilities of kebeles in Addis Ababa.

Table 1 Choice situations presented to kebele officials

Choice	Person 1	Person 2
A	Female	Male
B	Divorced and has no chronic health problems or disabilities	Married and has chronic health problems or disabilities
C	Burns or throws away solid waste and is able to raise 300 birr for emergency purposes within a week	Municipal or private solid waste disposal service and is unable to raise 300 birr for emergency purposes within a week.
D	Municipal or private solid waste disposal facilities and disposes of liquid waste on the ground outside the person's house	Burns or throws away solid waste and uses open ditch to dispose of liquid waste.
E	Chronic health problems or disabilities and uses open ditch to dispose of liquid waste	Has no chronic health problems or disabilities and disposes of liquid waste on the ground outside the person's house
F	Divorced and is able to raise 300 birr for emergency purposes within a week[12]	Married and is unable to raise 300 birr for emergency purposes within a week
G	Burns or throws away solid waste and uses covered ditch to dispose liquid waste	Uses municipal or private solid waste disposal facilities and uses open ditch to dispose of liquid waste
H	30 years old	60 years old
I	Has chronic health problems or disabilities and is able to raise 300 birr for emergency purposes within a week	Has no chronic health problems or disabilities and is unable to raise 300 birr for emergency purposes within a week
J	20 years old female	40 years old male
K	Unemployed and has no chronic health problems or disabilities	A civil or public servant and has chronic health problems or disabilities
L	Burns or throws away solid waste and uses covered ditch to dispose of liquid waste	Uses municipal or private solid waste disposal facilities and disposes of liquid waste on the ground outside the person's house

[12] In our happiness survey, we asked respondents about their ability to raise 200 birr in two weeks time for emergency purposes. At the time we undertook our survey on policymakers (almost two years after the life satisfaction survey), the value of the Ethiopian birr against hard foreign currencies had declined significantly. Thus, we adjusted for such a decline in value.

Needless to say, it is fair to question the appropriateness of comparing regression results from a subjective well-being study and the choices made in our constructed choice exercise. For example, one might wonder whether we have the "correct" results from the regression, which include issues such as causality, validity of the subjective well-being question, and model specification. In our study, however, we have applied the standard approach of running a subjective well-being regression. Besides the comparison with the results from subjective well-being regression, it is of interest to explore whether policymakers have similar views regarding the prioritization of government projects. In addition to the indirect comparison method presented above, we asked both citizens and policymakers using exactly the same survey instrument to rank which areas they feel the government should focus on. Using the same ranking exercise both among citizens and policymakers enables us to study whether these two groups have the same preferences. The areas to be ranked were: (i) improved services in health education and housing, (ii) creation of employment opportunities, (iii) inflation control, (iv) improved solid waste disposal, and (v) improved liquid waste disposal.

3. Results

As stated in the preceding section, subjective well-being was reported as an answer to the question "Taking everything into account, how satisfied are you with the way you live these days?" using a five-point scale ranging from 5 for very satisfied to 1 for very dissatisfied. We provide descriptive statistics of the life satisfaction variable in Table 2. As can be seen, out of the 416 surveyed respondents, 10 percent are very dissatisfied with life, 28 percent are dissatisfied, 23 percent are neither satisfied nor dissatisfied, 36 percent are satisfied, and only 3 percent are very satisfied. This distribution of subjective well-being is similar to the distribution from the Ethiopian highlands reported in Akay and Martinsson (2011). Our own

analysis of the data from the World Value Survey from 2005 conducted in Ethiopia also shows a fairly similar distribution, with the proportion of respondents reporting to be not very happy and not at all happy being around 36 percent when a four-point scale was used. By and large, the distribution of subjective well-being for Ethiopia is skewed to lower values compared to the many studies conducted in richer Western countries.

Table 2 Percentage of respondents by level of satisfaction

Life satisfaction	**%**
Very dissatisfied (=1)	10
Dissatisfied	28
Neither satisfied nor dissatisfied	23
Satisfied	36
Very satisfied (=5)	3
Total (number)	416
Mean satisfaction	2.94

In the survey, a number of demographic and socio-economic variables were collected, and those used in the analyses are discussed below. The correlates of subjective well-being include age (including its square) and dummy variables for gender, marital status, type of employment, levels of schooling, and health status. Our health status variable is constructed from responses to the question "Do you suffer from any disability or major chronic health problem?" The economic variables include log of per capita consumption (proxy for income[13]). To measure the effect of perceived change in living standard and of expected future life satisfaction, we introduced two forms of comparison variables. These variables are perception of change in living standard compared to five years ago and expectation about what life will be like in a year. Finally, with the aim of capturing the role of informal

[13] The idea of measuring household welfare in developing countries using income or consumption is debatable. Many studies have found that income in developing countries is often underreported, and in many cases volatile and difficult to remember. However, consumption is both relatively easy to remember and smoothed, and is hence recommended as a measure of welfare (see Deaton (1997) and Deaton and Grosh (2000) for a more detailed discussion).

networks, we asked respondents the question "Is the household able to raise 200 Birr[14] for emergency needs in one week?" and constructed a dummy variable accordingly. This is an important factor in a country such as Ethiopia where social security is lacking and people often tend to have poor access to a credit market.

Environmental quality is often of great concern in larger cities. However, pollution from combustion-related sources is not a major problem in Addis Ababa due to the relatively low number of vehicles and limited industrialization in and around the city (e.g., Etyemezian *et al*. 2005). Instead, the major environmental problem in Addis Ababa is related to improperly managed solid and liquid household waste. This is documented by for example Forbes (2010), which states that the Ethiopian capital Addis Ababa is one of the 25 dirtiest cities in the world. Households in urban Ethiopia dispose of solid waste by using municipal or private solid waste disposal services or by burning it or throwing it away. We use a dummy variable with a value of 1 for those who use municipal and private services and 0 for the reference group (households that burn or throw away solid waste). Similarly, for liquid waste disposal, households have the option of either using an open ditch, a covered ditch or a private septic tank, or disposing of the waste on the ground. We established dummy variables with values of 1 for those who use an open ditch and another dummy variable for those who use covered ditch and/or private septic tank, with the group that disposes of solid waste on the ground being the reference group. Table A.1 in the Appendix shows the descriptive statistics of the variables used in the analyses.

We present the results from an ordered probit regression on life satisfaction and the corresponding marginal effects for respondents in Addis Ababa in Table 3. The findings are

[14] One US dollar equaled approximately 11 Ethiopian Birr at the time of the survey.

similar to those in other subjective well-being studies – marital status, gender, and health status have significant effects on subjective well-being in the expected direction. Consumption per capita has a significant and positive effect on life satisfaction, as do perceived change in living standard in the past five years and expectations for the future. Compared to respondents who do not expect any change in life in the coming year, respondents with positive expectations have higher life satisfaction and those with negative expectations have lower life satisfaction. Ability to raise 200 birr for emergency needs affects life satisfaction significantly and positively.

The environmental variables measured by access to municipal or private solid waste disposal facilities are statistically insignificant in affecting life satisfaction although the respondents live in a relatively less polluted area and expected to have higher life satisfaction. However, access to a liquid waste disposal facility has a significant and strong impact measured by the variables access to open ditch as well as to covered ditch and/or septic tank, compared to respondents who dispose of liquid waste on the ground. This shows that environmental quality has an important influence on life satisfaction. We used information on location of house along an asphalt road as a proxy for better access to social services such as police service and street lights, but this effect is insignificant.

Table 3 Determinants of life satisfaction (ordered probit regression) and marginal effects

			Marginal Effects			
Variable	**Coef.**	**SE**	**Very Dissatisfied**	**Dissatisfied**	**Neither Sat. Nor Dissat.**	**Satisfied**
Single	-0.342*	0.197	0.0416	0.0884*	-0.0072	-0.1228*
Widowed	-0.261*	0.152	0.0292	0.0685*	-0.0018	-0.0959*
Divorced or separated	-0.423*	0.234	0.0570	0.1061**	-0.0165	-0.1466**
Age	-0.037	0.024	0.0038	0.0099	0.0003	-0.0140
Age square	0.046**	0.022	-0.0047**	-0.0123**	-0.0004	0.0174**
Female	0.298*	0.165	-0.0347	-0.0778*	0.0040	0.1085*
Primary school complete	0.071	0.159	-0.0071	-0.0189	-0.0007	0.0267
Secondary school complete	0.343	0.232	-0.0292*	-0.0901	-0.0131	0.1324
Tertiary school complete	0.239	0.291	-0.0208	-0.0631	-0.0082	0.0921
Employer or own-account worker	-0.152	0.168	0.0167	0.0400	-0.0008	-0.0559
Civil or public sector employee	-0.132	0.244	0.0147	0.0348	-0.0009	-0.0486
Private sector employee	-0.504**	0.240	0.0710	0.1240**	-0.0232	-0.1717**
Casual worker	-0.476*	0.288	0.0686	0.1164*	-0.0240	-0.1610*
Unemployed	-0.015	0.203	0.0015	0.0040	0.0001	-0.0056
Disabled or suffer from a chronic health problem	-0.404**	0.165	0.0531*	0.1021***	-0.0140	-0.1412***
Log of consumption per capita	0.188*	0.114	-0.0192*	-0.0500	-0.0015	0.0707
Current living standard better than five years ago	0.645***	0.173	-0.0529***	-0.1653***	-0.0298	0.2481***
Current living standard worse than five years ago	-0.459***	0.138	0.0478***	0.1201***	0.0032	-0.1711***
Expect improvement in life over the next one year	0.084	0.168	-0.0083	-0.0224	-0.0012	0.0319
Expect deterioration in life over the next one year	-0.337***	0.126	0.0357**	0.0884***	0.0008	-0.1250***
Able to raise 200 birr in one week for emergency	0.463***	0.139	-0.0518***	-0.1201***	0.0025	0.1694***
Use municipal or private solid waste disposal facility	-0.115	0.158	0.0110	0.0304	0.0021	-0.0435
Has access to open ditch for liquid waste	0.661***	0.158	-0.0596***	-0.1702***	-0.0214	0.2512***
Has access to covered ditch/septic tank for liquid waste	0.390**	0.155	-0.0378**	-0.1026**	-0.0071	0.1474**
House located on edge of asphalt road	-0.143	0.127	0.0152	0.0377	0.0002	-0.0531
/cut1	-0.827	0.897				
/cut2	0.420	0.900				
/cut3	1.172	0.902				
Obs.	416					
Pseudo R-squared	0.17					

Note: standard errors – robust to heteroskedasticity. ***p<0.01, **p<0.05, *p<0.1

Table 4 shows the results of the choice exercises conducted by the kebele officials. The columns "Person 1" and "Person 2" show the differing characteristics between the two hypothetical persons; all other characteristics were assumed to be the same, and this was clearly stated in the survey. The "Estimates from life satisfaction" column shows the difference in estimated parameters between the two persons described in the choice-set, and a likelihood ratio test is conducted to test the hypothesis that there is no difference between the two hypothetical persons in the choice exercise. In the first choice exercise, where female and male individuals are compared, the result is -0.298, and it is significant at the 10% level. This means that men have lower life satisfaction than women since we compare Person 2 with Person 1. From the regression, the coefficient on the dummy variable for a female individual is +0.298, and we calculate the difference between the parameters on male (Person 2), which is the reference group (and hence zero), and on female (Person 1), which gives a result of -0.298 (0 - 0.298) as shown in Table 4. The results of the calculation exercise as shown in the column "Estimates from Life Satisfaction" make it easier to compare to the guesses made by the kebele officials. The officials made their guesses regarding which of the two persons have higher life satisfaction on a 6-point scale, where 1 meant that Person 1 (female in Choice A) had much higher life satisfaction than Person 2 (male), and 6 meant the opposite. Thus, for positive numbers in the column "Estimates from life satisfaction," we expect the guess to be four or higher, i.e., that Person 2 is guessed to have higher life satisfaction, while the opposite is true for negative numbers in the column "Estimates from life satisfaction."

First, in the second last column "Proportion guessing Person 2 has higher Life Satisfaction", we show the proportion of policymakers who selected Person 2, i.e., picked any of the values 4, 5, or 6. In the first choice exercise, we find that 54% thought that males have slightly higher life satisfaction, and in the last column the corresponding mean value of 3.54 supports

this finding (note if policymakers on average think that the two persons have the same life satisfaction, we expect a value of 3.5). This is contrary to the life satisfaction regression showing that females have significantly higher satisfaction. In Figure 1, we show the distribution of the answer to the twelve choice situations. In the top left corner, a histogram over the picked values in Choice "A" is shown. Interestingly, there is a large heterogeneity in picked values among the officials including both extreme values in this choice situation. It should be noted that the large heterogeneity is found in a situation where both our regression results, as well as previous research, indicates that women have higher life satisfaction than men. The age effect is investigated in Choice "H" and "J" by comparing a 30-year old and a 60-year old, and a 20-year old and a 40-year old individual, respectively. Previous research has shown the relationship between subjective well-being and age to be U-shaped with a lowest subjective well-being around the age of 40. Choice "J" was created to test for the U-shaped pattern with a turnaround point, while Choice "H" to test for the effect of two age groups on each side of the turnaround point. As can be seen, a 20-year old individual has a much higher life satisfaction according to our life satisfaction regressions, contrary to what the kebele officials indicated. On the other hand, as shown in Choice "H", the kebele officials thought that a 30-year old individual has a much higher life satisfaction than a 60-year old, which again is contrary to our regression result as well as previous findings. In Choice "B", "I" and "K", the life satisfaction from health status are compared to marital status, ability to raise money for emergency purposes within a week, and employment status, respectively. Again, as shown in the histogram in Figure 1, the choices are heterogeneous but on average fairly accurate except for Choice "I", which included the attributes chronic health problem and ability to raise money for emergency purposes. On average, the officials thought no health problems and unable to raise money resulted in much higher life satisfaction than vice

versa, while or regression results indicate on average similar effects between these two people.

There are five choice situations, Choice "C" "D" "E" "G" and "L", which include environmental variables. In the choices where the relative importance of the environmental variables is to other attributes, i.e., Choices "C" and "E", the choices by the officials are on average in line with our regression results in the case of the former but not in the later. In the three remaining Choices "D", "G" and "L", the trade-offs are only between environmental attributes, and in these cases the officials make on average fairly poor guesses. For instance, in choice "D," where the results from the life satisfaction regressions show that Person 2, who burns or throws away solid waste but has access to an open ditch (a modern liquid waste disposal facility) has a much higher life satisfaction than Person 1, who has access to a modern solid waste disposal facility but disposes of liquid waste on the ground. However, the column "Choice by kebele officials" shows that only 51 percent chose Person 2, while the remaining 49 percent chose Person 1. The same inaccurate guesses apply for Choice "L" with different levels of the attributes of liquid and solid waste disposal.

Figure 1 presents histograms for choices made by the kebele officials for all the 12 choice situations. The horizontal lines indicate the values chosen by the officials indicating the life satisfaction of the hypothetical individual chosen and the vertical lines indicate the proportion that chose the specific values. It can be clearly seen from the histograms that, in most of the choice situations, there is large heterogeneity in the guesses made by the kebele officials.

Table 4 Guesses about life satisfaction by kebele officials

Choice	Person 1	Person 2	Estimates from Life satisfaction	Choice by kebele officials	
			H0: Person 2 – Person 1	Proportion guessing Person 2 has higher Life Satisfaction	Average
A	Female	Male	-0.298*	0.54	3.54
B	Divorced and has no chronic health problems or disabilities	Married and has chronic health problems or disabilities	-0.019	0.48	3.36
C	Burns or throws away solid waste and is able to raise 300 birr for emergency purposes within a week	Municipal or private solid waste disposal service and is unable to raise 300 birr for emergency purposes within a week.	-0.348***	0.53	3.56
D	Municipal or private solid waste disposal facilities and disposes of liquid waste on the ground outside the person's house	Burns or throws away solid waste and uses open ditch to dispose of liquid waste.	0.775***	0.51	3.38
E	Chronic health problems or disabilities and uses open ditch to dispose of liquid waste	No chronic health problems or disabilities and disposes of liquid waste on the ground outside the person's house	-0.258	0.32***	2.75***
F	Divorced and is able to raise 300 birr for emergency purposes within a week	Married and is unable to raise 300 birr for emergency purposes within a week	0.039	0.52	3.57
G	Burns or throws away solid waste and uses covered ditch to dispose liquid waste	Uses municipal or private solid waste disposal facilities and uses open ditch to dispose liquid waste	0.158	0.68	3.97**
H	30 years old	60 years old	0.270	0.33***	2.70***
I	Has chronic health problems or disabilities and is able to raise 300 birr for emergency purposes within a week	Has no chronic health problems or disabilities and is unable to raise 300 birr for emergency purposes within a week	-0.019	0.78***	4.19***
J	20-year old female	40-year old male	-0.486**	0.51	3.32
K	Unemployed and has no chronic health problems or disabilities	A civil or public servant and has chronic health problems or disabilities	-0.520	0.44	3.35
L	Burns or throws away solid waste and uses covered ditch to dispose liquid waste	Uses municipal or private solid waste disposal facilities and disposes liquid waste on the ground outside the person's house	-0.278**	0.49	3.43

Note. *, **, and *** indicate significant at 10%, 5%, and 1% respectively.

Figure 1. Histograms – choices by kebele officials

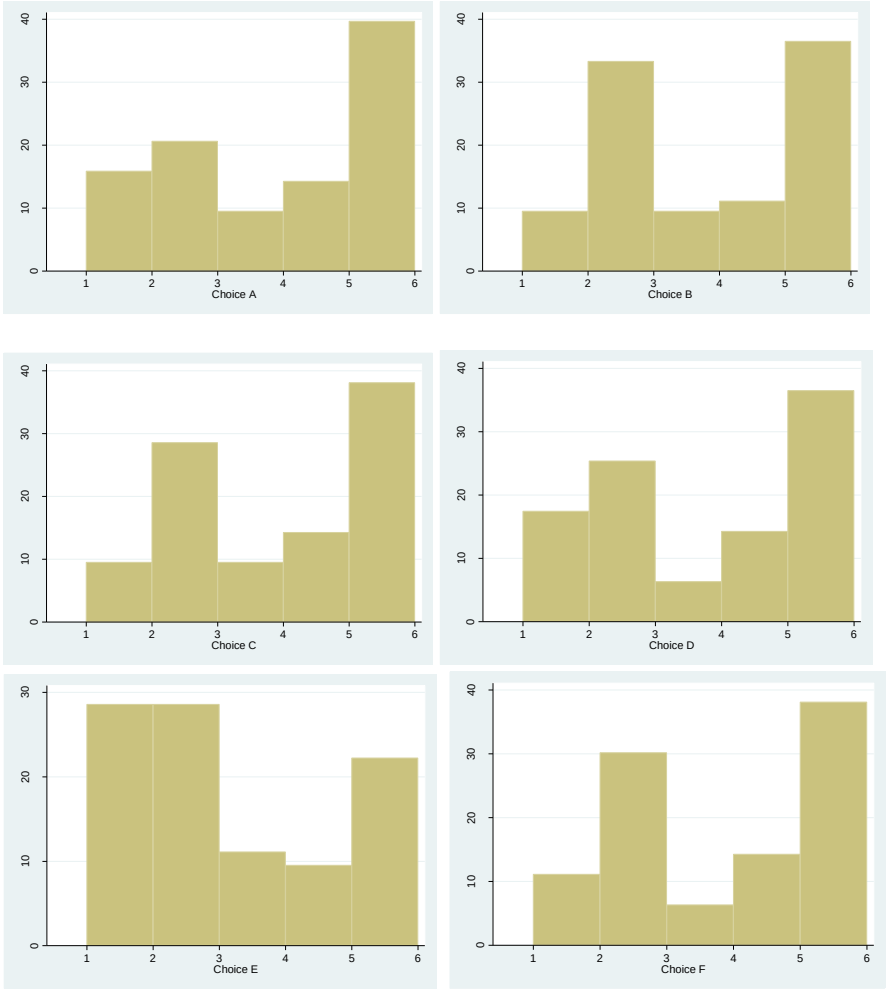
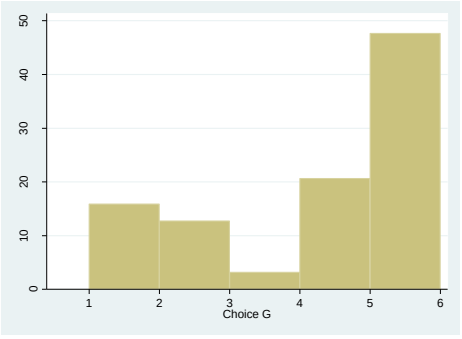
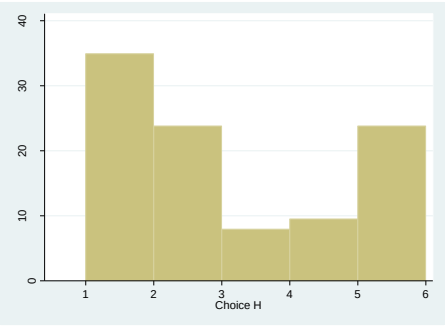
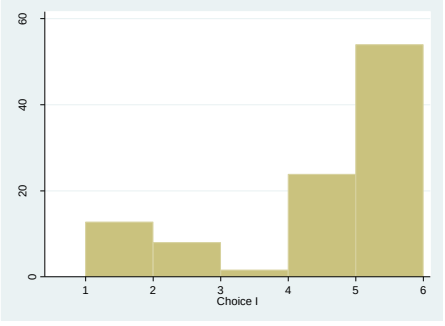
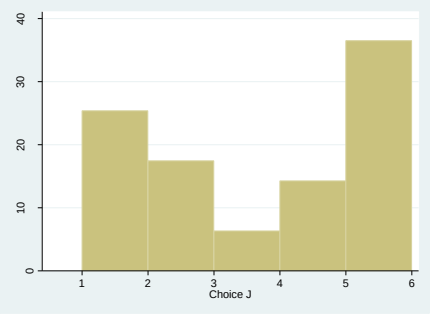


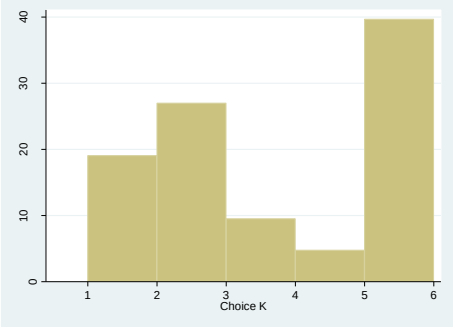
Figure 1. continued

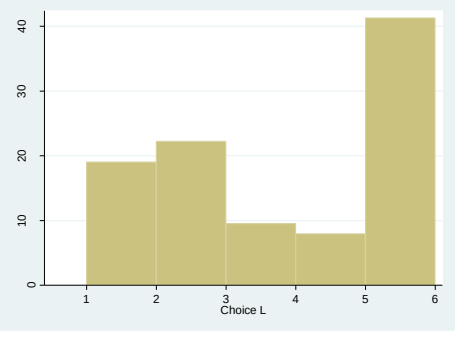












We also conducted an exercise to compare the views on priority setting between the citizens and the kebele officials. The purpose was to compare preferences between citizens and policymakers when both face similar choices of priority areas to rank. Table 5 shows the results of the ranking exercise by mean rank. There are differences in mean rank between the two groups. Among citizens, inflation control is the most important issue, whereas it is ranked only fifth by the kebele officials. Although environmental quality variables are important for people's life satisfaction, they are ranked the lowest, while the opposite is observed from the kebele officials, who guessed little effect on life satisfaction and yet ranked environmental quality as one of the higher priority areas. By and large, citizens and kebele officials differ in terms of the time horizon in their prioritizing; while citizens prioritize projects with short-term benefits, kebele officials tend to prioritize the longer-term projects.

Table 5 Mean rank of priorities (1=highest priority and 5=lowest priority)

	Citizens	Kebele officials are asked to rank the priority to be given by the government
Better services in health, education and housing	2.69	2.17
Creating employment opportunities	2.21	2.16
Inflation control	1.81	3.71
Improved solid waste disposal	4.05	3.63
Improved liquid waste disposal	4.23	3.32

4. Conclusion

The increased interest in using subjective well-being by policymakers requires more empirical studies on what correlates with subjective well-being, but also a more solid research agenda on how to tackle a number of methodological issues such as causality and how to ask questions related to subjective well-being (e.g., see discussion in MacKerron, 2011, and Stiglitz *et al*, 2008, on global subjective well-being (e.g., life satisfaction) versus time specific measures (e.g., life satisfaction at a specific time)) are needed. Besides these issues, an important question for policy appraisals and information to policy design relates to the knowledge among policymakers about what influences citizens' subjective well-being, especially before more knowledge has been accumulated from research and subjective well-being data have routinely been collected and published.

By using a tailor-made study with policymakers in Addis Ababa, Ethiopia, we conducted a comprehensive study related to knowledge among policymakers on what influences citizen's subjective well-being. Overall, we find that the standard factors correlating with subjective well-being in Western countries also seem to do so in Addis Ababa, but we also find that local environmental quality is important. Our survey of policymakers shows large heterogeneity regarding what factors policymakers think influence people's subjective well-being. In addition, and following from this heterogeneity, a non-negligible proportion of the policymakers have a fairly poor understanding of what influences people's subjective well-being. A supplementary ranking exercise of priority areas also shows that citizens and policy makers have different preferences. If this difference in knowledge is combined with a political system with low commitment to election promises, where politicians' own preferences are

likely to affect policies (see, e.g., Alesina, 1988), this may results in rather mixed and non-transparent public policies.

We believe that the heterogeneous results that we have obtained are quite reasonable, and that heterogeneity is a result of not having much knowledge regarding the issue. There are, of course, many ways to use the results from our study. To us, one important issue is, which naturally follows from the heterogeneous choices by policymakers, to let policymakers conduct survey experiments, and then to let them compare their results with other policymakers as well as to compare them to findings from empirical analyses on what subjective well-being correlates with. This is particular important since subjective well-being is likely to a part of the toolbox used by policymakers in the future when monitoring changes over time and making project appraisals. By and large, we believe that subjective well-being can be a promising instrument for future project appraisals and monitoring of development over time, but for this both an enlightened debate and enlightened policymakers are needed.

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APPENDIX

Table A.1 Descriptive statistics

Variable	Mean	Std. Dev.
Life satisfaction	2.91	1.03
Single	0.19	0.39
Widowed	0.29	0.45
Divorced or separated	0.09	0.29
Married*	0.43	0.50
Age	47.12	14.87
Female	0.76	0.43
Male*	0.24	0.43
Primary school complete	0.39	0.49
Secondary school complete	0.18	0.38
Tertiary school complete	0.10	0.30
Illiterate*	0.32	0.47
Employer or own-account worker	0.19	0.39
Civil or public sector employee	0.10	0.30
Private sector employee	0.10	0.30
Casual worker	0.04	0.20
Unemployed	0.12	0.32
Not in the labor force*	0.45	0.50
Disabled or suffer from a chronic health problem	0.11	0.32
No chronic health problem*	0.88	0.32
Log of consumption per capita	5.81	0.66
Current living standard better than five years ago	0.27	0.45
Current living standard worse than five years ago	0.49	0.50
Current living standard the same as five years ago*	0.24	0.42
Expect improvement in life over the next one year	0.25	0.43
Expect deterioration in life over the next one year	0.44	0.50
Expect life to be the same over the next one year*	0.30	0.46
Able to raise 200 birr in one week for emergencies	0.61	0.49
Unable to raise 200 birr in one week for emergencies*	0.39	0.49
Use municipal or private solid waste disposal facility	0.83	0.38
Throw away or burn solid waste*	0.17	0.38
Has access to open ditch for liquid waste	0.36	0.48
Has access to covered ditch/septic tank for liquid waste	0.40	0.49
Dispose liquid waste on the ground*	0.23	0.42
House located on edge of asphalt road	0.33	0.47
House not located on edge of asphalt road*	0.67	0.47
Observations	416	

Note: * denotes reference group.

Paper V

Poverty Dynamics and Intra-Household Heterogeneity in Occupations: Evidence from Urban Ethiopia

Yonas Alem[†]

Abstract

Using five rounds of panel data spanning 15 years, this paper investigates the dynamics and persistence of poverty in urban Ethiopia with a particular focus on the role of intra-household heterogeneity in occupations. Urban poverty measured by the head count index declined from 52 to 34 percent from 1994 to 2009. Regression results from dynamic probit models provide strong evidence of state dependence and show that education, labor market status of household heads, international remittances, and household demographic characteristics are important determinants of poverty. The paper also finds strong evidence of the role of labor market status of non-head household members. Regression results from discrete-time proportional hazard models of poverty spells also confirm the importance of labor market status of household members and remittances in determining poverty exit and re-entry rates of households. In addition to investigating the trends, dynamics and persistence of poverty in urban Ethiopia, the paper discusses important policy implications that can be useful for designing effective policies for poverty reduction and targeting.

JEL classification: I32, R20, D80

Keywords: urban Ethiopia, poverty dynamics, dynamic probit, hazard rate, labor market status

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1. Introduction

In this paper I use panel data on urban households in Ethiopia to study the determinants and dynamics of poverty. Most previous studies of poverty and poverty dynamics in Sub-Saharan Africa have focused on rural areas.[1] While important, the results and insights generated by these studies do not necessarily carry over to the urban context. For example, as discussed by Alem and Söderbom (2011), urban households may be more vulnerable than rural households to high food prices since there is little food production in urban areas. On the other hand, labor market opportunities are likely to be more diverse in urban than in rural areas, implying that urban households are less dependent on the developments in a single sector. Since the range of occupations available in urban areas is relatively wide (at least compared to in rural areas), it may be important to consider intra-household heterogeneity in labor market status when studying urban poverty. Previous studies of poverty have typically focused on the characteristics of the household head and use these as proxies for the underlying ability of the household to generate income. This may be appropriate in a rural context, where family members typically work on the farm. In urban Ethiopia, however, a focus solely on the characteristics of the household head may be too narrow. For instance, it could be that a household head is an uneducated housewife but has educated and working children residing in the same house. In this paper I use detailed data on the occupations of all household members to investigate the role of intra-household heterogeneity in jobs for poverty. I also study the effects of remittances, which have become important component of urban households' income over the last decade.

Much of the recent literature on poverty has focused on the dynamics of poverty. A household may fall into poverty for many reasons, and the factors that caused poverty incidence in the first place may impact the speed at which the household can find a pathway out of poverty. The literature makes an important distinction between transient and chronic poverty, where chronic poverty is of course the more serious state. In this paper I assume that chronic poverty depends on education and unobserved time invariant factors specific to the household. On the other hand, transient poverty is persistent but not permanent. This type of poverty may arise due to state dependence, i.e., that poverty today has a causal effect on the likelihood of poverty tomorrow. If the state dependence is strong, falling into poverty is likely to have adverse effects on future welfare. Exploiting the panel dimension in the data, I

[1] See, e.g., Dercon & Krishnan (1998), Dercon, (2004), Dercon et al. (2005), Harrower & Hoddinott (2005), Barrett et al. (2006), Dercon (2006), Dercon (2008), Beegle et al. (2008), and Litchfield & McGregor (2008).

estimate the state dependence to be moderately high in urban Ethiopia, although not as strong as estimators failing to control for initial conditions suggest.

Earlier studies analyzing the dynamics of poverty in urban Ethiopia are relatively few. Bigsten et al. (2003) used data on urban and rural households to investigate the impact of economic growth on poverty and showed that education, occupational status, dependency ratio and location are important determinants of poverty in urban areas. Similar analysis of the correlates of chronic urban poverty was made by Keddir and McKay (2005) using data for 1995-1997 who find that high dependency ratios, low levels of education, lack of asset ownership, insecurity in employment, and unemployment are important correlates of chronic poverty. However, these papers do not focus on the dynamics of poverty and state dependence, or on the effects of the labor market status of household members. Islam and Shimeles (2007) analyze the dynamics of poverty in rural and urban Ethiopia using a dynamic probit model and find that there is strong state dependence in poverty and a higher impact of transitory shocks on household poverty persistence in urban than in rural Ethiopia.

The paper most closely related to my study is Bigsten and Shimeles (2008). These authors study the dynamics and persistence of poverty in rural and urban Ethiopia using rural household data and an older version of the urban dataset that I adopt in the present paper. Their results indicate that households in urban Ethiopia have a higher degree of poverty persistence than rural households. They also find poverty to be closely related to household demographic characteristics and household head variables such as occupational status. Bigsten and Shimeles do not, however, investigate the relationship between poverty and the labor market status of household members. Moreover, the last year covered in their study is 2004, whereas my data span the period 1994-2009. Given the dramatic food price inflation in 2008 and the rapid economic growth in the country, extending the data to include this period is quite important. Finally, none of these previous studies look at the effects of remittances, which have recently become fairly common in urban Ethiopia.

The econometric techniques used in the present paper are reasonably well established in the literature. I model poverty using a dynamic probit allowing for unobserved time invariant heterogeneity across households in the underlying likelihood of poverty. I also use a discrete-time proportional hazard model to estimate two hazard rates: one for exit from and another for re-entry into poverty. Bigsten and Shimeles (2008) use a similar approach, which implies that it will be straightforward to compare my estimates to their results.

The remainder of the paper is structured as follows. Section 2 outlines the empirical framework and the econometric techniques applied in the paper. Section 3 discusses the data

and provides descriptive statistics. Section 4 presents estimation results from dynamic probit and discrete-time proportional hazard models. Finally, Section 5 concludes the paper.

2. Econometric approach

2.1 State dependence and other correlates of poverty

The main rationale behind modeling poverty using a dynamic probit model is the presence of state dependence. There is a large amount of evidence in several countries (mainly OECD countries) that an individual or a household that is experiencing a poverty spell today is much more likely to experience it again in the future (Duncan et al., 1993; Oxley et al., 2000; Mejer and Linden, 2000; OECD, 2001; Giraldo et al., 2006, and Biewen, 2009). Biewen (2009) presents five possible reasons for true state dependence in poverty: (i) an individual might lose the incentive to continue working or refuse to take up a job when unemployed if the income from the job is too low, which could leave the individual in poverty; (ii) a person's human capital could deteriorate during a spell of unemployment, and this can lead to demoralization and loss of motivation to find and take up a new job; (iii) poverty and low income might result in social exclusion, leading to problems of addiction to drugs and alcohol, which in turn could lead to deteriorating health conditions and hence difficulties finding a better paying job: (iv) a person could start accepting welfare support during unemployment as a way of living and consequently lose the incentive to look for a better paying job; (v) there may be an inability to engage in marriage or co-habitation during unemployment, which could reduce the probability of economies-of-scale in consumption within a household and increase the risk of poverty. Thus, a current state of poverty is modeled as a function of poverty in previous period. In addition, unobserved household or individual characteristics that make specific groups prone to poverty should be accounted for while modeling poverty. These unobservables can be factors such as individual motivation, parental effects, rate of time preference, and risk aversion parameters.

Since the outcome probability (poverty in my case) is hypothesized to depend on the outcome in the previous period (poverty in previous period), I use a dynamic probit model specified as

$$p_{it}^{*} = \gamma p_{it-1} + x_{it}^{'}\beta + \alpha_i + u_{it} \qquad (1)$$

$(i = 1,...,N; t = 2,...,T)$, where p_{it}^{*} is the latent dependent variable; p_{it} is the observed binary outcome variable, defined as

$$p_{it} = \begin{cases} 1 if \ p_{it}^{*} \geq 0 \\ 0 otherwise \end{cases}; \qquad (2)$$

x_{it} represents a vector of explanatory variables; α_i is a term capturing unobserved household heterogeneity; and u_{it} is a normally distributed error term with mean zero and variance normalized to one. The subscripts i and t refer to households and time periods respectively. It is assumed that N is large but T is small, which implies that asymptotics depend on N alone. In addition, in the standard random effects probit model, it is assumed that conditional on x_{it}, α_i is normally distributed with mean zero and variance σ_{α}^{2}, and independent of u_{it} and x_{it}. This implies that the correlation between the composite error term $\upsilon_{it} = \alpha_i + u_{it}$ in any two time periods can be shown to be[2]

$$\lambda = Corr(\upsilon_{it}, \upsilon_{is}) = \frac{\sigma_{\alpha}^{2}}{\sigma_{\alpha}^{2} + \sigma_{u}^{2}} \qquad t, s = 2,...,T; t \neq s \,. \qquad (3)$$

Under the above assumptions, the probability that individual *i* is poor at time *t*, given α_i, is specified as

$$P[p_{it} \mid x_{it}, p_{it-1}, \alpha_i] = \Phi[(\gamma p_{it-1} + x_{it}^{'}\beta + \alpha_i)(2p_{it} - 1)], \qquad (4)$$

where Φ is the cumulative distribution function of the standard normal distribution.

The presence of both the past value of the dependent variable and an unobserved individual heterogeneity term in equation (4) will result in what is called the "initial conditions problem." This problem arises because the start of the observation period (1994) does not coincide with the start of the stochastic process generating households' poverty experiences. The households in my data existed as households before 1994 and had already been at risk of poverty prior to the survey period. Thus, a household observed to be in a state of poverty in the initial period may be there because of an earlier history of poverty, or

[2] The standard random effects model also assumes that α_i is uncorrelated with x_{it}. However, one can allow correlation between α_i and x_{it} (Mundlak, 1978; Chamberlain, 1984) by including $x_i = (x_{i0},...,x_{iT})$, or alternatively averages of the *x*-variables over time as additional regressors in the model.

because of some observed and/or unobserved characteristics affecting its poverty status. Consequently, estimating equation (4) using the standard random effects probit, which assumes the initial state of poverty exogenous, will result in inconsistent estimates. In order to take care of the problem and estimate the equation consistently, the unobserved individual heterogeneity term should be integrated out. Three approaches have been suggested to do so: Heckman's (1981) two-step estimator, Orme's (1997, 2001) two-step estimator, and Wooldridge's (2005) conditional maximum likelihood estimator. In applied empirical research, the Heckman and Wooldridge estimators have been more common. The following paragraphs elaborate on how these estimators work.

Heckman's estimator

Heckman (1981) proposes a two-step maximum likelihood estimator that involves a likelihood function based on the Gauss-Hermite quadrature approximation for the resulting integral, as is used in standard random effect probit estimators. This estimator is unbiased and consistent provided that the error terms of the latent equation are serially uncorrelated.

Heckman's approach starts by specifying a linearized reduced-form equation for the initial value of the latent variable:

$$p_{i1}^{*} = z_{i1}^{'}\pi + \theta_1\alpha_1 + u_{i1}, \qquad (5)$$

where $\theta > 0$, α_i and u_{i1} are independent of each other, and $(i = 1,..., N)$. The vector z includes exogenous instruments that also include the initial values of the explanatory variables (i.e., x_{i1}). In addition, it is assumed that the u_{it} are independent of α_i and that both are distributed normally with variance 1 and σ_α^2, respectively. One can test whether initial conditions are exogenous through a test of $\theta_1 = 0$. Given equations (1) and (5), most applied researchers assume fixed correlation between $(\theta_1\alpha_1 + u_{i1})$ and the error terms in the equations for other periods (Arulampalam and Stewart, 2009).

With the assumption of serially independent u_{it}, the likelihood function for individual (household in my case) i given α_i can thus be given by

$$L_i = \int \{ \Phi\left[(z_i^{'}\pi + \theta_1\alpha)(2p_{i1} - 1)\right] \prod_{t=2}^{T_i} \Phi\left[(x_{it}^{'}\beta + \gamma p_{it-1} + \theta_t\alpha)(2p_{it} - 1)\right] g(\alpha)d\alpha \}, \qquad (6)$$

where $g(\alpha)$ represents the probability density function of α_i. Assuming that α is normally distributed, one can use the Gaussian-Hermite quadrature (Butler and Moffitt, 1982) to evaluate the integral.

Wooldridge's conditional maximum likelihood estimator

One other option proposed to take care of the initial conditions problem in dynamic non-linear panel data models is the conditional maximum likelihood (CML) estimator of Wooldridge (2005).

Let the joint density for the observed sequence of the dependent variable $(p_2, p_3,..., p_T \mid p_1)$ be written as $f(p_T, p_{T-1},..., p_2 \mid p_1, x, \alpha)$. By specifying an approximation for the density of the unobserved individual heterogeneity term α_i conditional on the initial period value of the dependent variable p_1, Wooldridge integrates α_i out from the equation and suggests the specification

$$\alpha_i \mid p_{i1}, z_i \approx N(\varsigma_0 + \varsigma_1 p_{i1} + z_i'\varsigma, \sigma_a^2), \tag{7}$$

where

$$\alpha_i = \varsigma_0 + \varsigma_1 p_{i1} + z_i'\varsigma + a_i. \tag{8}$$

Equation (8) alleviates the correlation between the initial value of the dependent variable and the unobservable (p_{i1} and α_i) and results in a new unobservable term a that is uncorrelated with the initial observation p_{i1}.

Substituting equation (8) into equation (1) gives

$$\Pr(p_{it} = 1 \mid a_i, p_{i1}) = \Phi\left[(x_{it}'\beta + \gamma p_{it-1} + \varsigma_1 p_{i1} + z_i'\varsigma + a_i\right], \qquad t = 2,...,T. \tag{9}$$

Consequently, the likelihood function for household *i* is given by

$$L_i = \int \left\{ \prod_{t=2}^{T} \Phi\left[(x_{it}'\beta + \gamma p_{it-1} + \varsigma_1 p_{i1} + z_i'\varsigma + a)(2p_{it} - 1)\right] \right\} g^*(a)da, \tag{10}$$

where $g^*(a)$ is the normal probability density function of the new unobservable term a_i introduced in equation (7). By incorporating a set of time dummies interacted with the initial value of the dependent variable, Wooldridge's CML estimator can be generalized to allow for the initial condition error to be freely correlated with the errors in the other periods like Heckman's estimator. Estimating Wooldridge's estimator is straightforward in standard econometric software for example, by using the *xtprobit* command in Stata.

2.2 A discrete-time duration model

Since the seminal work of Bane and Ellwood (1986), previous studies (Stevens, 1999; Davicienti, 2001; Biewen, 2006) on poverty dynamics have mainly focused on the analysis of poverty spells and the estimation of exit from poverty and re-entry into poverty hazards. Using panel data from industrialized countries, these studies investigate the persistence of poverty over individuals' or households' lifetimes by applying a hazard rate approach that allows for multiple spells of poverty, spell duration, individual and household characteristics, and unobserved heterogeneity. Thus, this parametric method of estimating exit from and re-entry into poverty spells uses the probabilities of ending a spell to model the distribution of poverty spell durations. Let $d = 1$ for households with completed spells of poverty and $d = 0$ for those that were still in a poverty spell when observed. Thus, the proportion with completed poverty spells is the hazard rate for that round. The hazard rate reflects the risk of exit from poverty and corresponds to the "survivor rate," which shows the proportion of households remaining in poverty at that time (Jenkins, 1995). Consequently, a discrete-time hazard rate h_{it} can be specified as

$$h_{it} = prob(T_i = t \mid T_i \geq t; \quad X_{it}), \tag{11}$$

where, X_{it} is a vector of explanatory variables, which can be either time variant or invariant, and T_i is a discrete random variable representing the time at which a poverty spell ends. Thus, the likelihood of ending a poverty spell at $T_i = t$ and at $T_i > t$ can be given by[3]

$$prob(T_i = t) = h_{it} \cdot \prod_{k=1}^{t-1}(1 - h_{ik}) = [h_{it} / (1 - h_{it})] \prod_{k=1}^{t}(1 - h_{ik}) \tag{12}$$

[3] Jenkins (1995) shows detailed derivation of equations (12) and (13).

and

$$prob(T_i > t) = \prod_{k=1}^{t} (1 - h_{ik}) \quad , \tag{13}$$

respectively. The proportional hazard model, which has been a common parametric model of analyzing spells, is given by

$$h_{it} = h_0(t) \exp(X_{it}^{'} \beta) \, , \tag{14}$$

where $h_0(t)$ is the baseline hazard function, which is assumed to be the same for all analyzed households, X_{it} is a vector of explanatory variables[4], and β is the vector of parameters to be estimated. One can control for unobserved individual heterogeneity by incorporating a multiplicative gamma-distributed random error term ν_i, which is assumed to be uncorrelated with any of the *X* variables, into the proportional hazard model given in equation (14) as

$$h_{it} = h_0(t) \nu_i \exp(X_{it}) = h_0(t) \exp\left[X_{it} + \log(\nu_i)\right]. \tag{15}$$

The corresponding discrete-time hazard function in the j^{th} interval can then be given by

$$h_j(X_{ij}) = 1 - \exp\{-\exp\left[X_{ij}^{'} \beta\right] + \gamma_j + \log(\nu_i) \} \, , \tag{16}$$

where γ_j is the parameter of the baseline hazard. Jenkins (1995) shows that the log likelihood of the hazard function presented in (16) is the same as the log likelihood for a generalized linear model of the binomial family with a complementary log-log link[5]. Proportional hazard models, with or without unobserved individual heterogeneity, can be estimated in Stata using the *pgmhaz8* command.

[4] This implies that individual hazard rates depend on the *X* variables, with the baseline hazard function h_0 remaining the same for all individuals (households in my case).

[5] A logistic form of a non-proportional hazard specification is also used in empirical research. However, in most cases the specifications yield similar estimates. This is mainly because as the hazard rates become smaller, the logistic model converges to a proportional hazard model, which is the case in many applications (Jenkins, 1995).

3. Data and descriptive statistics

3.1 Data

This study uses five rounds of the Ethiopian Urban Socio-economic Survey (EUSS) – a panel dataset collected in 1994, 1997, 2000, 2004, and 2008/09.[6] The first four waves were collected by the Department of Economics of Addis Ababa University in collaboration with the Department of Economics, the University of Gothenburg. Originally, it covered seven major cities in Ethiopia – the capital Addis Ababa, Awassa, Bahir Dar, Dessie, Dire Dawa, Jimma, and Mekelle, which were believed to represent the major socioeconomic characteristics of the Ethiopian urban population. About 1,500 households were included and each city was represented in proportion to population. Once the sample size for each city was set, the allocated sample-size was distributed over all woredas (districts) in each urban center. Households were then selected randomly from half of the kebeles (the lowest administrative units) in each woreda, using the registration for residences available at the urban administrative units.[7]

A sixth round survey was collected by the author from a sub-sample of the original sample covering four cities – Addis Ababa, Awassa, Dessie, and Mekelle – and comprising 709 households in late 2008 and early 2009.[8] The cities were selected carefully in order to represent major urban areas of the country and the original sample. All panel households were surveyed in three of the cities but not in Addis Ababa, which constituted about 60 percent of the original sample. About 350 of the original households in Addis Ababa were selected following the sampling procedure discussed in the preceding paragraph. Out of the total of 709 households surveyed in the sixth round, 128 are new households randomly included in the survey. These new households were surveyed based on the concern that the panel households might have become atypical since incorporated in the sample in 1994 and not very well representative of the Ethiopian urban population. No significant difference was found between the new and the panel households in welfare measured by consumption expenditure, conditional on observable household characteristics (Alem and Söderbom, 2011). The analysis includes a total of 377 households that were surveyed in all rounds since 1994.[9] The dataset is comprehensive and address household living conditions, including income, expenditure, demographics, health, educational status, occupation, production activities, asset

[6] Data was collected in 1995 as well. However, since the dynamic probit model is sensitive to the spacing of the data collection points, we excluded data collected in 1995 in order to maintain fairly even spacing between rounds.
[7] Refer to AAU & UG (1995) for details on sampling design.
[8] Households in the other cities were not surveyed due to lack of funding.
[9] The attrition rate in the round the author conducted was only 3 percent.

ownership, and other variables on household and individual levels. In addition, new sections on shocks and coping mechanisms, government support, and institutions were included in the 2008/09 survey.

To measure poverty, I used consumption expenditure on a monthly and weekly basis as reported by the households.[10] The definition of consumption used in the analysis is comprehensive and incorporates both food and non-food components. Food consumption includes the value of food purchased from the market and food obtained in the form of gifts or aid. The non-food component includes expenditures on clothing, energy, education, kitchen equipment, contributions, health, education, and transportation. One limitation of my consumption aggregation is that rent is excluded. This is because information on housing was not collected in the second and third rounds of the EUSS. Including housing expenditure and values in some waves but not in others would have resulted in inappropriate comparisons of household welfare. Thus, I decided to exclude this information in the more recent rounds as well.

The cost of basic needs (CBN) approach (Ravallion and Bidani, 1994) was used to estimate poverty lines. It consists of two steps: First the food poverty lines are estimated and then they are adjusted to account for basic non-food consumption. I therefore first estimated the food poverty line for each city in each round by valuing a basket of food items that yield a stipulated minimum energy requirement of 2,200 kcal of energy per person per day, as stipulated by the World Health Organization (WHO). This basket of goods was borrowed from earlier studies on urban poverty in Ethiopia (Dercon and Tadesse, 1999; Tadesse, 1999; Gebremedihin and Whelan, 2005).[11] These studies established the food basket by first estimating the average quantities of the different food items most frequently consumed by households in the lower 50 percent of the per capita consumption expenditure distribution and then adjusting the calorie contrition of the different food items so that they yield the minimum stipulated caloric requirement. Thus, the food basket was anchored to the bottom 50 percent of the urban population in the year 1994 and remained the same throughout the study period and in all analyzed cities. I then valued the basket using current median market prices derived from the survey in each city.

In order to estimate the non-food component of the poverty line, one can use two approaches: divide the food poverty line in each city by the average food share of households

[10] The idea of using consumption or income as a measure of household welfare is still debatable. In the context of developing countries, it has been a conventional practice to use consumption rather than income since income is often underreported and difficult to remember. Consumption on the other hand tends to be more stable due to the availability of consumption-smoothing options. See Ravallion (1994), Deaton (1997), and Deaton and Grosh (2000) for detailed discussions.
[11] See Appendix for the basket of goods used.

deemed to be below the food poverty line, or use the non-food share of people whose total expenditure is equal to the food poverty line through estimation of an Engel curve for each of the cities (Ravallion and Bidani, 1994). In this paper, I use the first approach.[12] There are also two approaches to classifying households that are unable to reach the poverty line as poor: One is to simply classify households in any given city with nominal expenditures below the poverty line for that city and round as poor. Alternatively one can use the poverty line of one of the cities in the initial period (1994) as reference and divide all the other cities' poverty lines by the poverty line of the reference city, which yields price deflators of the nominal expenditures of households in the different cities.[13] One can use these deflators to convert nominal household consumption to real household consumption, and a household can then be classified as poor if its real consumption per capita is below the poverty line of the reference locality in the initial period.[14] I follow the second approach and use the poverty line of Addis Ababa (the capital) as reference against which the poverty lines of all other cities are expressed,[15] and compute price indices accordingly. I then use the price deflators to convert nominal consumption expenditures to real consumption expenditures, and use the poverty line of Addis in 1994 for all cities in all rounds to classify households with real per capita consumption below the poverty line as poor. [16]

3.2 Descriptive statistics

The evolution of poverty and inequality in urban Ethiopia is presented in Tables 1 and 2. Table 1 shows the head count index for the study period for the unbalanced panel, whereas Table 2 shows the same figure in the same period for the panel households that have been observed in all rounds. Table 1 shows that the poverty incidence as measured by the head count index was about 52 percent in 1994 but then declined consistently and reached 34 percent in 2009. Adjusting for adult equivalent units, the head count index in 1994 and 2009

[12] Application of the Engel function approach resulted in underestimation of the food share in richer cities because of low and insignificant coefficients of the city dummies and demographic variables.
[13] Ravallion (1998) presents a detailed discussion on the use of poverty lines as deflators.
[14] This step results in adjusting household consumption expenditure for both spatial and temporal price differences.
[15] Addis Ababa has been chosen because of the fact that about 60 percent of the households in the sample are located there. Moreover, the city contains diverse cultures and socio-economic groups, which makes it a better representative of other cities when it comes to patterns of household consumption.
[16] Previous studies of poverty in Ethiopia (Kebede et al. 2005; Gebremedihin & Whelan, 2005; Bigsten & Shimeles, 2008) used a similar approach to classify households as poor in Ethiopia.

appears to be 43 and 27 percent, respectively.[17] Income inequality as measured by Gini coefficient of per capita consumption expenditure has also been declining over time.

Table 1 Trends in poverty incidence (head count ratio): 1994-2009, all observations (%)

	1994		1997		2000		2004		2009	
City	**PC**	**PAEU**	**PC**	**PAEU**	**PC**	**PAEU**	**PC**	**PAEU**	**PC**	**PAEU**
Addis	52.57	44.85	48.96	40.39	42.22	35.61	39.40	32.41	36.10	31.12
Awassa	47.89	43.66	40.98	31.15	31.94	26.39	26.04	20.83	25.00	16.67
Dessie	47.19	37.08	61.73	51.85	50.54	36.56	47.42	40.21	35.42	28.13
Mekelle	51.55	32.99	42.05	34.09	29.79	18.09	35.79	27.37	30.21	20.83
Overall	51.78	43.18	48.90	40.20	41.19	33.60	38.64	31.66	33.71	27.36
Gini coeff.	45.71		45.85		45.26		43.09		37.82	
Obs.	1151		1000		1107		1118		709	

Note: PC = head count ratio per capita; PAEU = head count ratio per adult equivalent.

Table 2 Trends in poverty incidence (head count ratio): 1994-2009, panel households (%)

	1994		1997		2000		2004		2009	
City	**PC**	**PAEU**	**PC**	**PAEU**	**PC**	**PAEU**	**PC**	**PAEU**	**PC**	**PAEU**
Addis	57.00	47.84	53.85	42.86	44.15	39.20	42.00	37.21	37.12	32.23
Awassa	57.00	46.43	46.43	35.71	42.86	42.86	32.00	25.00	32.14	25.00
Dessie	54.00	38.46	53.85	46.15	53.85	38.46	46.00	38.46	30.77	23.08
Mekelle	40.00	28.57	40.00	28.57	22.86	17.14	34.00	20.00	25.71	17.14
Overall	55.00	45.62	52.00	41.11	42.40	37.40	41.00	34.75	35.47	29.97
Gini coeff.	42.46		42.81		44.79		42.14		39.06	
Obs.	377		377		377		377		377	

Note: PC = head count ratio per capita; PAEU = head count per adult equivalent.

Table 3 presents the poverty status of the panel households over time. It can be seen that the proportion of households that have never been poor is about 21 percent, while 13 percent have always been poor (the chronic poor). Hence, most poor households experience poverty for a short period of time, which makes the analysis of poverty dynamics important.

[17] See Table A.2 in the appendix for adult equivalence units used in this analysis.

Table 3 Percentage of households by poverty status: 1994-2009

Poverty status	Households	Percent
Never poor	78	20.69
Once poor	67	17.77
Twice poor	62	16.45
Three times poor	70	18.57
Four times poor	51	13.53
Always poor	49	13.00
Total	**377**	**100.00**

Table 4 presents descriptive statistics for socioeconomic variables of households by poverty status. Some important trends can be noted. Education and international remittance variables show distinct differences between households who have never been poor and those who have always been poor. For instance, only 6 percent of the heads in the "always poor" category have completed secondary level schooling, while the figure is about 30 percent for the "never poor." Similarly, 20 percent of the household heads in the "never poor" category have completed tertiary level education, whereas the figure for the "always poor" is only 1 percent. This provides some evidence on the relationship between education and poverty status in urban Ethiopia.

Table 4 Descriptive statistics of major variables by poverty status 1994-2009

Variable	Never poor	Poor once	Poor twice	Poor 3 times	Poor 4 times	Always poor
Age of head	51.14	52.33	50.17	50.85	50.50	50.97
Head, male (%)	68.72	51.04	55.16	43.71	47.45	52.24
Head, primary schooling completed (%)	27.18	30.15	33.55	32.57	46.27	36.73
Head, jun-sec schooling completed (%)	12.05	15.52	19.03	18.29	11.37	8.57
Head, secondary schooling completed (%)	29.74	25.67	18.06	14.00	9.41	6.12
Head, tertiary schooling completed (%)	20.00	5.67	7.42	2.00	1.18	0.82
Head, employer (%)	2.31	3.28	0.65	0.86	0.39	0.00
Head, own-account worker (%)	20.26	25.97	29.35	25.71	22.75	28.57
Head, civil/public servant (%)	26.67	17.61	10.97	14.57	11.37	8.16
Head, private sector employee (%)	5.90	8.06	8.71	6.86	9.80	9.80
Head, casual worker (%)	6.41	4.48	11.61	12.29	14.51	17.55
No. of own-account worker members	0.15	0.19	0.15	0.16	0.24	0.29
No. of civil/public servant members	0.35	0.37	0.25	0.25	0.24	0.09
No. of private sector employee members	0.47	0.31	0.37	0.33	0.32	0.28
No. of casual worker members	0.05	0.11	0.13	0.20	0.29	0.34
No. of unemployed members	0.50	0.55	0.63	0.79	0.72	0.58
No. of out of labor force members	1.39	1.53	1.62	1.45	1.77	1.67
No. of children	1.45	1.49	1.66	1.82	2.19	2.83
No. of elderly	0.07	0.05	0.10	0.09	0.07	0.07
Real value of remittances from abroad	875.79	554.39	383.47	215.27	104.76	31.88
Real value of remittances from domestic sources	121.58	166.57	82.44	64.98	97.05	60.17
Resides in Addis (%)	79.49	70.15	74.19	87.14	86.27	83.67
Resides in Awassa (%)	6.41	10.45	8.06	7.14	5.88	6.12
Resides in Dessie (%)	1.28	4.48	6.45	2.86	1.96	4.08
Resides in Mekelle (%)	12.82	14.93	11.29	2.86	5.88	6.12

One can also note that the poverty status of households varies with the value of international remittances received by households[18]. On average, the "never poor" households received about 875.79 birr/year in real terms from international remittances during the analyzed period, while the figure was only 31.88 birr for the chronic poor.[19] The growing role of international remittances in urban Ethiopia is clearly evident from Table 5 as well. The proportion of households that received international remittances in, e.g., 1994 was only 3.5 percent, while it reached 31.3 percent in 2009. A significant jump in the flow of remittances

[18] The remittance section of the data in 1994 was not entered and I therefore used the value of remittances received in 1995 for 1994. This approach appears to be justifiable since the questions on remittances in EUSS referred to the past 12 months, and 1994 and 1995 share about 5 months in the Ethiopian calendar according to which the survey questions were asked.

[19] Remittances are expressed in real terms using 1994 prices. One US dollar was approximately 5 Ethiopian birr in 1994.

from foreign sources was observed from 2004 to 2009.[20] One can finally note that there has not only been an increase in the number of households receiving international remittances, but also in the mean value of remittances received over the past 15 years.

The differences in labor market status of both heads and other members of the household are also clearly evident from Table 4. Twenty-seven percent of the household heads who have never been poor are either civil or public sector employees, whereas for the "always poor" the figure is only 8 percent. Only six percent of the heads of the "never poor" households are casual workers, while 18 percent of those of the "always poor" households depend on casual work to earn a living. There are also clear differences in terms of labor market status and demographic characteristics of other household members. "Never poor" households have on average 0.35 individuals working as civil/public sector employees, whereas those in the "always poor" category have only 0.09 individuals in this sector of activity. There are more casual worker household members (0.34) among the "always poor" than among the "never poor" households (0.05). Similar differences are noticeable in the case of household demographic variables. All this implies a close association between poverty status of households and the characteristics of household heads and other household members.

Table 5 Trends in international remittance: panel households

Year	No. of Households	(%)	Mean ETB 1994 prices
1994	13	0.03	81.40
1997	23	0.06	213.69
2000	42	0.11	487.18
2004	49	0.13	420.17
2009	118	0.31	798.58

Note: ETB = Ethiopian Birr

4. Results

Table 6 presents estimation results for a model of the probability of being poor as given by equation (1). Column [1] presents the random effects probit estimates, which treat initial conditions as exogenous. Having been a poor household in the previous period; having a higher number of own-account workers, casual workers, unemployed members, out-of-the-

[20] Table 5 shows the flow of international remittances only in the form of cash. The reported values could be much higher if in-kind remittances were included.

labor-force members, and/or children members; and residing in Addis Ababa all raise the probability of being a poor household. On the other hand, being headed by educated, employer, and/or civil/public sector worker individuals reduces the probability of being poor. The probability of being a poor household is negatively and strongly related to the value of remittances received from abroad.

Table 6 Determinants of poverty; regression results from different models

	[1]		[2]		[3]	
	RE probit		**Heckman**		**Wooldridge**	
	Coefficient	**SE**	**Coefficient**	**SE**	**Coefficient**	**SE**
Lagged poverty	0.745***	0.077	0.451**	0.128	0.324***	0.13
Age of head	-0.011	0.015	-0.006	0.017	0.025	0.023
Age of head squared	0.00007	0.0002	0.00003	0.0002	0.0002	0.0002
Head, male	-0.162*	0.088	-0.147	0.100	-0.102	0.107
Head, primary schooling completed	-0.198**	0.100	-0.149	0.109	-0.095	0.112
Head, jun-sec schooling completed	-0.326***	0.130	-0.301**	0.142	-0.279**	0.146
Head, secondary schooling completed	-0.453***	0.129	-0.389***	0.141	-0.334**	0.146
Head, tertiary schooling completed	-0.890***	0.218	-0.850***	0.238	-0.724***	0.256
Head, employer	-1.498***	0.600	-1.439**	0.622	-1.360**	0.645
Head, own-account worker	-0.083	0.101	-0.083	0.111	-0.053	0.115
Head, civil/public servant	-0.289**	0.134	-0.329**	0.149	-0.279*	0.151
Head, private sector employee	0.045	0.149	0.047	0.164	0.088	0.169
Head, casual worker	0.072	0.141	0.055	0.153	0.046	0.158
No. of own-account worker members	0.205***	0.063	0.230***	0.071	0.230***	0.090
No. of civil/public servant members	-0.091	0.072	-0.100	0.078	0.054	0.098
No. of private sector employee members	-0.026	0.052	-0.030	0.057	0.081	0.072
No. of casual worker members	0.352***	0.074	0.370***	0.080	0.273***	0.097
No. of unemployed members	0.176***	0.039	0.199***	0.044	0.249***	0.055
No. of out of labor force members	0.133***	0.028	0.159***	0.033	0.261***	0.043
No. of children	0.196***	0.027	0.220***	0.032	0.233***	0.044
No. of elderly	0.145	0.135	0.194	0.150	0.205	0.198
Log of real value of remittances from abroad	-0.085***	0.017	-0.086***	0.018	-0.057***	0.022
Resides in Addis	0.274***	0.099	0.339***	0.122	0.274**	0.124
2000	0.071	0.111	0.044	0.117	-0.021	0.123
2004	0.058	0.111	0.036	0.117	-0.050	0.126
2009	0.133	0.122	0.105	0.130	-0.074	0.149
Intercept	-0.938***	0.415	-1.172***	0.471	-0.783	0.688
Theta	-0.938		0.662	0.56		
Poverty_1994					0.468***	0.123
Rho	0.000	0.0002	0.168	0.085	0.077	0.072
Log-likelihood	-756.055		-981.272		-696.167	

Note: ***p<0.01, **p<0.05, *p<0.1.

Estimation results for the Heckman estimator are presented in column [2], with the initial period equation including three exogenous geographical location variables and the full set of period-specific versions of the time-varying explanatory variables. I treat only age of

household head and characteristics of other household members as time-varying. Compared to the random effects estimator, the coefficient of the lagged dependent variable declined from 0.75 to 0.45 but is still statistically significant at one percent. Column [3] of Table 6 presents the corresponding Wooldridge conditional maximum likelihood estimator. The Wooldridge estimator uses the time varying x variables in the z vector. This yields an estimate of 0.32 for the coefficient of the lagged dependent variable. The initial state of poverty (poverty in 1994) is statistically significant at one percent.

When it comes to the covariates of poverty, in general, there are similarities in the estimation results of all the dynamic probit models. There is a strong state dependence in poverty. A household that has been poor in any round is more likely to be poor in the next round. Consistent with the descriptive statistics presented in previous tables, education reduces the probability of being poor. Compared to households headed by illiterate individuals, households headed by individuals with any education have a lower probability of being poor. The same kind of negative relationship with poverty is observed in the case of being headed by an employer or a civil/public sector employee.

Table 6 also shows evidence on the role of occupation and demographic characteristics of other household members in addition to those of the heads. Results from all the dynamic probit estimators show that households with more own-account workers, casual workers, unemployed members, out-of-the-labor-force members, and/or children members are prone to poverty.[21] This reflects the adverse welfare impact of depending on volatile sources of income in the labor market, of being unable to have an income-generating job, and of having more dependent members. All these results imply the importance of considering the occupational and demographic characteristics of other household members in addition to those of heads when designing anti-poverty policies. Finally, the regression results from all models show that households that receive international remittances have a higher likelihood of being non-poor. However, none of the time dummies introduced to capture macroeconomic conditions of the country appeared to be statistically significant in any of the models.[22]

The results of the multivariate discrete-time proportional hazard models for poverty exit and re-entry for households in urban Ethiopia are shown in Table 7, columns [1] and [2],

[21] A significant proportion of own-account worker household members in urban Ethiopia are engaged in low paying and unstable jobs. For instance, in 2009, 67 percent were engaged in activities such as petty trading and preparing and selling food and drinks. Previous studies (Bigsten et al., 2003; Kedir and McKay, 2005; and Bigsten and Shimeles, 2008) find a negative and significant relationship between being headed by an own-account worker and poverty.

[22] The time dummies introduced appear to be statistically significant without controlling for labor market and demographic characteristics of other household members. However, once I control for these variables all the time dummies become insignificant.

respectively. Both regressions are estimated with unobserved heterogeneity, which assumes a gamma distribution. However, the likelihood ratio test of model (1) presented in equation (14) versus model (2) in equation (15) shows that unobserved heterogeneity is not significant. In addition, the size of the variance of the gamma-distributed random error term is very small, which supports the results from the likelihood ratio test.[23]

Table 7 Poverty exit and re-entry rate regressions; proportional hazard models with heterogeneity

	Poverty Exit		Poverty Re-entry	
Variable	**Coef.**	**SE**	**Coef.**	**SE**
Log duration of poverty	-1.371***	0.297	-2.119***	0.276
Age of head	0.005	0.005	-0.017***	0.003
Head, male	0.051	0.258	0.195	0.171
Head, primary schooling completed	0.069	0.271	-0.616***	0.233
Head, jun-sec schooling completed	-0.029	0.347	-0.317	0.264
Head, secondary schooling completed	0.09	0.338	-0.636*	0.349
Head, tertiary schooling completed	0.006	0.636	-	-
Head, employer or own-acct. worker	-0.21	0.292	-0.133	0.231
Head, civil/public servant	-0.425	0.446	-0.49	0.347
Head, private sector employee	0.403	0.372	-0.72	0.514
Head, casual worker	0.571	0.367	-0.676*	0.369
No. of own-account worker members	0.045	0.214	0.314	0.238
No. of civil/public servant members	0.188	0.168	-0.352	0.221
No. of private sector employee members	0.075	0.110	0.318**	0.100
No. of casual worker members	-0.251	0.222	0.098	0.154
No. of unemployed members	-0.240**	0.119	0.291***	0.074
No. of out of labor force members	-0.117	0.094	0.209***	0.043
No. of children	-0.354***	0.089	0.031	0.051
No. of elderly	0.065	0.304	-1.005	0.730
Real value of remittance from abroad/100	0.026**	0.010	-0.020	0.013
Resides in Addis	-0.354	0.254	-0.026	0.139
Variance of gamma	0.000	0.000	0.000	0.000
LR test of Variance of gamma=0 (Chibar2)	0.000		0.000	
Prob>=Chibar2	0.500		0.500	
Log-likelihood	-162.682		-167.191	

Note: ***p<0.01, **p<0.05, *p<0.1.

Looking at the results for poverty exit, one can see that the hazard rate of exiting poverty is negatively related to the duration of the poverty spell and having a higher number of

[23] The estimation results from the two models are thus identical. I therefore report only the poverty exit and re-entry regressions for Model (2) given in equation (15).

unemployed and children members, whereas it is positively related to the value of remittances received from abroad. The negative sign of the duration in poverty variable provides evidence on the fact that the longer the household stays in poverty, the harder it becomes to get out of it. Previous studies (Devicienti, 2003; Hansen & Whalberg, 2004; Makovec, 2005; and Bigsten and Shimeles, 2008) find similar results. The regression results for poverty re-entry, on the other hand, show that duration of poverty spell, age of household head, and having a head with completed primary and secondary education are negatively related to the hazard rate of re-entering into poverty. However, having a higher number of private sector employees, unemployed members, and out-of-the-labor-force members contribute positively to the probability of falling into poverty.

5. Conclusions

The main objective of this paper is to investigate the dynamics and persistence of poverty in urban Ethiopia during the period 1994-2009 with a particular focus on household composition. In order to understand the correlates of poverty, the paper uses five rounds of data and alternative dynamic probit models that take state dependence, unobserved individual heterogeneity, and the initial conditions problem into account. In addition, discrete-time proportional hazard models are used to estimate hazard rates of exit out of and re-entry into poverty.

It has been shown that urban poverty has declined over time, with the head count index falling from 52% in 1994 to 34% in the year 2009. Estimation results from dynamic probit models show that the likelihood of being poor in any round is a direct function of previous poverty, implying strong evidence of state dependence. In addition, the results point to the importance of education of household heads in protecting households from being poor. Compared to households headed by illiterate individuals, households headed by individuals with any education have a lower probability of being poor. The same kind of negative relationship with poverty is observed in the case of having employer or civil/public sector employee heads, which shows the importance of engaging in stable jobs. Finally, households that receive remittances from international sources are less likely to be in poverty, a finding consistent with falling poverty and a significantly increasing inflow of international remittances during the analyzed period.

The paper takes a more comprehensive view of the household than most previous studies, allowing poverty to depend on the occupational and demographic characteristics of all

household members. The results suggest that households with a higher number of own-account workers, casual workers, unemployed members, out-of-the-labor-force members, and/or children members are more likely to be in poverty. This probably reflects the adverse welfare impact of depending on volatile sources of income in the labor market, of being unable to have an income-generating job, and of having a higher number of dependent household members. These results imply that it may be important to consider occupational and demographic characteristics of *all* household members when designing poverty reduction policies.

Finally, estimation results from a proportional hazard model show that the hazard rate of exiting poverty is negatively related to the duration of the poverty spell and having a higher number of unemployed and children members, whereas it is positively related to the value of remittances received from abroad. The negative sign of the duration in poverty variable shows that the longer the household stays in poverty, the harder it becomes to get out of it. Estimated hazard rates of re-entry into poverty show that duration of time out of poverty, age of head, and being headed by an individual with completed primary or secondary education are negatively related to the hazard of entering into poverty. Having more unemployed and/or out-of-the-labor-force members contributes positively to the probability of falling into poverty.

A number of policy implications follow from the findings of the paper. First, the findings that labor market status and demographic characteristics of other household members are important determinants of the likelihood of being in and out of poverty imply that effective poverty reduction and targeting strategies should take these household characteristics into consideration. For instance, policies aimed to support children in schools located in low income areas, and those focusing on skill and job creation for the unemployed and casual workers can be welfare enhancing. In addition, the fact that households with a higher number of children are prone to poverty and are less likely to exit from it highlights the importance well-designed family planning programs. Second, since remittances from international sources play a positive role in poverty reduction, it would to be useful for policy makers to investigate the mechanisms through which these remittances flow into the country and design policies that encourage the flow, which could in the long-run be combined with appropriate redistribution mechanisms.

Additional lessons can be learned from future research in relation to the underlying reasons for the reduction in poverty in recent years and the impacts of education, international remittances, and labor market access on poverty. The 2004-2009 period was characterized by

rapid economic growth, but also by double digit inflation, which had a significant negative impact on the welfare of households in urban Ethiopia (Alem and Söderbom, 2011). During the same period, the proportion of households receiving remittances from abroad and food items from relatives/friends increased by 141 and 163 percent, respectively. This poses the important question of whether the poverty reduction in urban Ethiopia is driven by economic growth or by the households' own efforts to diversify income. Other interesting questions remain to be answered as well: Why are households with educated members more likely to come out of poverty than households headed by uneducated ones? Is it because of better coping mechanisms due to education or have the returns to education permanently changed in urban Ethiopia? How are decisions to send a household member abroad made? What determines households' likelihood of receiving international remittances? Why are casual worker household members unable to engage in stable jobs? Is self-employment a way out of poverty or a manifestation of poverty? These important questions are left for future research.

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Appendix A

Table A.1 Food basket composition for the Ethiopian Urban Poverty Line

Food Item	Grams/day	Edible Share	Calories/gram	Total Kcal	(gms/day)	Kg/month
Teff	216.05	1.00	3.58	772.52	202.06	6.06
Barley	68.14	0.83	3.72	210.12	63.72	1.91
Wheat	79.79	0.98	3.57	279.37	74.63	2.24
Maize	96.47	0.93	3.79	340.31	90.23	2.71
Lentils	21.23	1.00	3.55	75.39	19.86	0.60
Cow peas	31.55	1.00	3.54	111.63	29.51	0.89
Chick peas	17.84	1.00	3.78	67.37	16.69	0.50
Horse beans	18.09	0.77	3.53	49.18	16.92	0.51
Shiro	32.65	1.00	3.62	118.24	30.53	0.92
Pepper	11.45	0.49	0.91	5.12	10.71	0.32
Milk	53.33	1.00	0.74	39.30	49.88	1.50
Salt	9.53	1.00	0.00	0.00	8.91	0.27
Oil	10.06	1.00	8.96	90.21	9.41	0.28
Sugar	28.48	1.00	3.85	109.66	26.64	0.80
Potato	39.30	0.63	1.04	25.67	36.75	1.10
Tomato	17.45	0.74	0.31	3.97	16.32	0.49
Carrot	19.27	0.72	0.42	5.83	18.03	0.54
Onion	14.25	0.90	0.71	9.14	13.33	0.40
Garlic	7.29	0.69	1.38	6.96	6.82	0.20
Orange	36.06	0.52	0.34	6.36	33.72	1.01
Banana	28.43	0.58	0.88	14.48	26.59	0.80
Coffee	10.46	1.00	1.10	11.54	9.78	0.29
				2352.34		

Source: Gebremedihin and Whelan (2005).

Table A.2: Nutrition (calorie) based equivalence scales

Age (years)	Men	Women
0-1	0.33	0.33
1-2	0.46	0.46
2-3	0.54	0.54
3-5	0.62	0.62
5-7	0.74	0.70
7-10	0.84	0.72
10-12	0.88	0.78
12-14	0.96	0.84
14-16	1.06	0.86
16-18	1.14	0.86
18-30	1.04	0.80
30-60	1.00	0.82
60 +	0.84	0.74

Source: Dercon and Krishnan (1998).

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