The Resilience of the Poor: A Markov Chain Analysis of Heterogeneity in Subjective Poverty

Elizabeth Asiedu, Théophile T. Azomahou, and Eleni A. Yitbarek*

October 5, 2016

Abstract

This paper studies the dynamics of subjective poverty in urban Ethiopia. Poverty is measured as three points ordinal scales: rich, borderline and poor. We use a multinomial logit Markov chain with alternative specifications of unobserved heterogeneity as a random effect, which depends on: households and poverty departure state, household and transition poverty profile, and household heterogeneity only. We identify transitory and permanent effects, and frame-of-reference bias. We find that (i) human capital is a strong determinant of upward poverty, with intensity effect: the higher the level of schooling, the lower the probability of transiting to poor state; (ii) larger households enjoy greater economies of scale but the demographic structure of households matters; (iii) social capital has a positive effect on the downward mobility of poverty; (iv) own consumption raises self-welfare rating; (v) the initial level of poverty is an important determinant of future poverty.

Key words: Poverty transition, human and social capital, Markov chains, frame-of-reference bias

JEL classification: I32, J16, R20, C23, O55

1 Introduction

There is an extensive debate about measuring poverty and its persistence. Following the seminal contribution of Sen (1982), the consensus emerges that poverty extends beyond having insufficient income for securing basic goods and services. Given money metric misses other important attributes

* *Corresponding author.* Asiedu: The University of Kansas, Department of Economics (asiedu@ku.edu). Azomahou: UNU-MERIT and Maastricht University, University of Clermont Auvergne and CERDI (azomahou@merit.unu.edu). Yitbarek: UNU-MERIT and Maastricht University (e.yitbarek@maastrichtuniversity.nl)

of poverty, such as access to public services because of missing 'prices', more reliable and rich information can potentially be obtained by asking people directly about their economic welfare' on an ordinal scale: "Do you consider yourself poor?" (Ravallion and Lokshin, 2001; Deaton, 2010). However, just like money metric poverty measures, measurement errors also confound interpersonal comparisons using subjective poverty measures.

Individuals can have a different notion of what 'poor', 'rich', 'satisfied' or 'not satisfied' means. In reality, individuals respond to any subjective welfare survey questions relative to their personal 'frame-of-reference', which depends on their knowledge, experience, aspiration and other characteristics including income and education.[1] To illustrate the latter point, an individual living in rural areas of a given developing country might have limited information on the level of living standard in other parts of the world, hence, might rate her welfare higher than a counterpart with better living standards, higher level of aspiration and knowledge on the living standard in developed countries.

Research on subjective poverty dynamics is scant in developing countries. Bigsten and Shimeles (2011) investigate whether the covariate of subjective and consumption poverty differ, and found no significant difference. Alem, Köhlin and Stage (2014) also study the persistence of subjective and consumption poverty. They find that the relative economic position of a household, its past experience of poverty and types of employment are strong determinants of poverty. We depart from these studies in two main ways. First, by employing the concept of unobserved heterogeneity connected to the dynamics of transition, we offer a framework for studying poverty dynamics that accounts for households unobserved heterogeneity and frame-of-reference bias. The role of unobserved heterogeneity in subjective data is a key concern. An important source of this heterogeneity is that utility is unobservable (Senik, 2005). Individuals do not measure their *ex-ante* utility, but rather their *ex-post* Benthamian well-being (Kahneman, Wakker and Sarin, 1997). For instance, Winkelmann and Winkelmann (1998) noticed that the 'anchoring effect' or intercept heterogeneity is a source of potential estimation bias. Therefore, our framework unlike previous studies, allows relating the 'dynamics of transition' of poverty to both frame-of-reference bias and unobserved heterogeneity. A second important novelty of this paper is that, it assesses the role of human and social capital on subjective poverty dynamics. Surprisingly, social capital has rarely been explored within this literature. This is particularly important in developing countries where social capital is

[1] From now onwards following Beegle, Himelein and Ravallion (2012), we call this frame-of-reference bias for simplicity.

believed to play a crucial role on individuals' welfare.[2]

We use a panel of 1,500 households spanning over a decade (1994-2004) from urban Ethiopia.[3] Our specification includes three types of heterogeneity in the form of random effect which depends on i) households and poverty departure state, ii) household and transition poverty profile, meaning heterogeneity related to both departure and arrival poverty states and iii) household heterogeneity only. The main findings are as follows: (i) frame-of-reference bias is an important source of bias in modelling the determinants of subjective poverty; (ii) consumption has a positive effect on the upward mobility of poverty; (iii) human capital is a strong determinant of upward subjective poverty mobility. It displays an intensity effect: the higher the educational attainment, the lower the probability to transiting to poor state; (iv) social capital, measured by membership in volunteer institutions, raises the likelihood of downward mobility of subjective poverty; (v) family structure, having a higher number of children aged between 0 and 14 raises poverty; and (vi) congruent with the chronic poverty literature that uses monetary measures, we find that the initial level of poverty is an important determinant of future poverty.

2 Data

The study uses a longitudinal data set, the Ethiopian Urban Household Survey (EUHS). The sample includes households in seven major cities of the country: Addis Ababa, Awassa, Bahir Dar, Dessie, Dire Dawa and Jimma. See Appendix for further details.

2.1 Sample and Context

EUHS has five waves collected in 1994, 1995, 1997, 2000 and 2004. The period covered by the data is characterized by major macroeconomic and political changes in the country. The period 1994-1997 is marked by peace, recovery from the civil war and good weather. Between 1997 and 2000, the country experienced drought, a sharp decline in international coffee price, economic recession and war with Eritrea. Between 2000 and 2004, the economy has recovered from the 1999/00 crises and experienced a moderate growth.

[2]Relying on Portes (2000), we define social capital as membership in groups and networks from which individuals can access resources for individual or collective benefit.

[3]There is a risk that current urban households might have different characteristics than households that we have in our data set. In 2009 Alem, Köhlin and Stage (2014) collect a data from 128 random households in Addis Ababa, the city that contributes 60% of EUHS sample, and concludes that there is no significant difference.

2.2 Variables' Description

Subjective poverty is an ordinal measure of households' heads perception of their household poverty status. The head assesses the poverty status of the household on a three-point scale by answering the question: 'Do you consider your household as rich, middle income (borderline) or poor?'[4] Our sample includes about 5,000 households, of which 5% report to be rich, 43% borderline (base group) and 52% poor. Let j and j' represent the departure and arrival poverty status of a household, respectively. The three states lead to nine dummy variables $n_{i,t-1,t}(jj'), j, j' = 1, 2, 3$ describing the nine transitions in subjective poverty between t and $t-1$. We observe that the probability of a household's own poverty perception in a given year differs depending on the poverty status in the previous year. There is also little transition from state rich to state poor and borderline, due to the marginal proportion (5%) of rich households in the sample. The transition from state poor to rich is also very small, only 1.6%. There is a strong state dependence for borderline and poor states. The probability of staying on state borderline and state rich in two consecutive waves is 26% and 36%, respectively.

The control variables are grouped into four categories: i) household's characteristics (household consumption, number of household members engaged in income generating activities, household size, family demography, employment, expenditure, recipient of remittance), ii) characteristics of head of household (age, gender, type of employment, education), iii) human capital, and iv) social capital. We proxy human capital by the highest educational attainment of the head of a household. The proportion of household head declines with the level of education: about 30% completed primary schooling, 27% secondary schooling, and 12% tertiary education. Our social capital measures are being or not member of at least one voluntary association: 'Iddir' and/or 'Eqqub'. These informal structures are traditional and dominant risk sharing mechanisms in Ethiopia. Iddir and Eqqub are balanced reciprocity risk sharing mechanisms. Iddir is a voluntary association that is usually formed among friends, colleagues and neighbors, and insures in-cash or in-kind payout at the time of a funeral for a deceased member of the family or the member herself. Eqqub is a voluntary association that regularly pools fund and rotates among members, a scheme not typical to Ethiopia alone. Membership in Iddir and Eqqub is widespread in urban Ethiopia.

[4]The survey question is directed to collect information on self-assessed economic welfare, not to the broader concept of life satisfaction or happiness.

Table 1 – Distribution of households membership of 'Iddir' and/or 'Eqqub' by poverty status

Poverty status	Social network (%)				
	Iddir	Eqqub	Both	No	Total
Rich	4.2	9.4	6.3	5.4	4.9
Borderline	42.7	42.5	52.5	33.2	42.9
Poor	53	48.1	41.2	61.5	52.2
Total	64.2	2.1	17.6	16.1	100

From Table 1, 64% of the households are members of Iddir only, Eqqub only (2%), both Iddir and Equip (18%) and those who are neither members of Iddir nor Eqqub (16%). The distribution of households' membership to 'Iddir' and/or to 'Eqqub' by their subjective poverty status is also reported in the same table. We observe that those who declare themselves as poor represent the highest proportion of members to 'Iddir' only (53%) followed by middle-income households (43%) and rich (4%). Eqqub membership also shows the same trend. Regarding members of both Iddir and Eqqub, middle-income households are the largest members (53%) followed by poor (41%) and rich households (6%). From these figures, we see that those who declare themselves as being poor are those who are the most involved in these networks. The question remains whether the participation in these social networks, given their role, has an effect at all on the probability of poverty transition and what could be the direction of this potential effect.

3 Econometric Specification

Given that the measure of poverty is ordinal and reflects transitions from different departure states, Markov chains suit our purpose. We assume a multinomial logit Markov chain of order one with two specifications: a model without heterogeneity and a model with unobserved heterogeneity.[5]

3.1 Model without Heterogeneity

Let $\mathscr{J}_{it}$ denote the state of poverty in which a household i $(i = 1, \ldots, N)$ is at time t $(t = 1, \ldots, T_i)$; $\mathscr{J}_{it} = j$ if household i is in state j at time t. The probability of transition of household i from

[5]Markov chains of higher order could also be considered and tested. However, it would seriously decrease the sample size and complicates the econometric analysis considerably.

state j at time $t-1$ to state j' $(j, j' = 1, \ldots, J)$ at time t is given by:[6]

$$\mathbb{P}_{ijj'}(t) \equiv \mathbb{P}(\mathscr{J}_{it} = j' \mid \mathscr{J}_{it-1} = j) = \frac{\exp(\mathbf{x}_{itj}\boldsymbol{\beta}_{jj'})}{\sum_{l=1}^{J}\exp(\mathbf{x}_{itj}\boldsymbol{\beta}_{jl})} \tag{1}$$

We assume that the vector of characteristics $\mathbf{x}_{itj}$ influences the probability of transition to state j' in a way that depends on both the departure state j and the arrival state j'. For identification purposes, we impose the usual restriction $\boldsymbol{\beta}_{jj'} = 0$ for a given value of $j^{'}$ which yields the following expression:

$$\mathbb{P}_{ij1}(t) = \frac{1}{1 + \sum_{l=2}^{J}\exp(\mathbf{x}_{itj}\boldsymbol{\beta}_{jl})} \quad \text{and} \quad \mathbb{P}_{ijj'}(t) = \frac{\exp(\mathbf{x}_{itj}\boldsymbol{\beta}_{jj'})}{1 + \sum_{l=2}^{J}\exp(\mathbf{x}_{itj}\boldsymbol{\beta}_{jl})} \tag{2}$$

where $j = 1, \ldots, J$ and $j' = 2, \ldots, J$. We thus specify a multinomial logit model for each row of the transition matrix (i.e. for each $j = 1, \ldots, J$).[7] Let us define $n_{i,t-1,t}(jj') = 1$ if $\mathscr{J}_{it-1} = j$ and $\mathscr{J}_{it} = j'$ (and 0 otherwise). Then the log-likelihood conditional on the poverty state occupied at the initial date is:

$$\ln \mathscr{L} = \sum_{j=1}^{J}\sum_{j'=2}^{J} \ln \mathscr{L}_{jj'}, \text{ with } \ln \mathscr{L}_{jj'} = \sum_{i=1}^{N}\sum_{t=2}^{T_i} n_{i,t-1,t}(jj') \ln \mathbb{P}_{ijj'}(t) \tag{3}$$

Since $\sum_{j'=1}^{J} \ln \mathscr{L}_{jj'}$ only depends on the parameters $\boldsymbol{\beta}_{jj'}$, $j' = 2, \ldots, J$, an interesting property of this likelihood is that the maximum likelihood estimator, $\hat{\boldsymbol{\beta}}_{ML}$, can be obtained by a separate maximization of the quantities $\sum_{j'=2}^{J} \ln \mathscr{L}_{jj'}$.

3.2 Model with Heterogeneity

As in Nguyen Van, Laisney and Kaiser (2004), we consider two types of heterogeneity in the form of additional random effects connected to individual i: the one the departure state j only (termed u_{ij}), and the case with both departure and arrival states (termed $u_{ijj'}$). These two type of heterogeneity assume the Independence of Irrelevant Alternatives (IIA). To relax the latter, we also consider

[6] Bold characters represent vectors or matrices.

[7] It is worth to note that if we think of latent variables with i.i.d. extreme value error terms leading to these choice probabilities, similar to the familiar choice-specific random utilities in discrete choice models, these variables will be some propensities to move from one state to another, and will bear no link to the level of poverty.

heterogeneity in the form of individual-specific effect only u_i, which makes the separation property implied by the IIA infeasible. Conditioning on the heterogeneity term and regardless of the type of heterogeneity, the likelihood function takes the form:

$$\mathscr{L} = \prod_{j=1}^{J} \prod_{j'j=2}^{J} \prod_{i=1}^{N} \prod_{t=2}^{T_i} \left[\mathbb{P}_{ijj'}(t)\right]^{n_{i,t-1,t}(jj')} \tag{4}$$

Relying on simulated maximum likelihood, we integrate this function over the heterogeneity distribution corresponding to each special case (see Appendix for details).

4 Results

We estimated the two types of models. Relying on specification tests, the preferred models involve heterogeneity (see Appendix). The main findings are summarized below.

4.1 The Frame-of-Reference Bias: Transitory vs. Permanent Effects

The model with separable departure states is of a particular interest because it accounts for frame-of-reference bias. Households are heterogeneous not only in the perception of their current poverty state (departure state) but also how they transit to another state (arrival state). Regardless of the initial state, there are more significant coefficients when the arrival state is 'poor'. Thus, our specifications allow capturing the dynamics of poverty transition compared to the state 'borderline' (the base state). Depending on the departure and arrival states, we distinguish two types of effects: the transitory and the permanent effects. A transitory effect is a case where a departure state is different from the arrival state while the permanent effect is a case where arrival and departure poverty states remain the same into consecutive waves.

Relying on the model with the non-separable initial states, the coefficient of the initial poverty status variable is positive and significant, indicating the important role of the initial status of poverty on future poverty. The result is consistent with the chronic poverty literature hypothesis which suggests that poverty is state dependent. On the other hand, once we account for initial condition bias, the coefficient of the lagged dependent variable becomes insignificant, suggesting that temporary spells of poverty perception have little impact on future poverty perception, while the take-off state does.

Regardless of the departure state, an increase in household consumption has a positive and significant effect on the probability of transiting to state rich. Household consumption raises the probability to transit to the state rich by 13% (permanent effect), 3% and 6% when the departure state is borderline and poor, respectively. In contrast, this effect is negative when the transition is made towards the state poor. The decline is 33%, 25% and 18% for the states rich, borderline, and poor, respectively. This result is consistent with previous findings: subjective welfare is an increasing function of own income or consumption (Clark, Frijters and Shields, 2008). A permanent effect is also revealed by the employment status of the household head. Being own account employee raises the probability of staying in the state rich by 25% compared to the head of a family who is out of the labor force, the reference.

When the transition is made from the borderline, we only observe transitory effects to states rich and poor. Household characteristics such as having unemployed family members and children aged between 0 and 14, significantly increases the probability of moving to the state poor by 6% and 2%, respectively. This suggests that discounting the financial loss, being unemployed might has other welfare effects through social exclusion and loss of self-esteem. On the other hand, family size, the age of the household head and being employed in the private sector reduce the same probability. Having a higher number of children aged between 0 and 14 increases the chance to transit to state poor. The extent of the economies of scale of household size in households' subjective well-being may reflect a latent effect on the demographic characteristics of the respondent's household. Having a higher number of unemployed family members, having more children and being a casual worker significantly increase the probability of remaining poor by 3%, 2%, 7%, and 14%, respectively. The strongest permanent effect stems from having a casual job. This is consistent with previous findings that document unemployment and lack of permanent job as increasing factors of subjective poverty.

4.2 Human Capital and Poverty Transition

Human capital (highest educational attainment of household's head) has a negative and significant effect on the downward mobility of poverty perception. Compared to an illiterate household head, the probability of transiting to poor state decline by 5%, 8% and 9% when the household head completed primary, secondary and tertiary education, respectively. This finding is interesting for two reasons. First, human capital has an intensity effect: the higher the level of educational

attainment of a household head, the lower the probability of transiting from the borderline to the state poor. Second, for human capital to successfully reduce poverty, the departure state of a household matters, and according to our findings this state should be borderline. We do not observe significant effects of human capital for poor and rich departure states.

4.3 The Role of Social Capital

Being a member of Eqqup only and both Iddir and Eqqup has a positive and significant effect on downward mobility of poverty perception. Membership of Eqqub only and membership in both Iddir and Eqqub increase the probability of moving from borderline state to the poor state by 23% and 11%, respectively. Being a member of 'Iddir' only also increases the probability of becoming poor by 16%. At first glance, this might seem surprising. Often the membership to a social network is known to act as a safety net for struggling families by mitigating the effects of adverse shocks (e.g. consumption smoothing). However, our result might reflect the limited insurance provision of both mechanisms, given that households have to make a regular contribution which may in turn create an additional pressure on their already limited resources.

Based on members agreement, occasionally Iddirs offer a supplementary insurance against illness, destruction of households' assets among other calamities. To benefit from these schemes, there is a membership fee to be paid, and every member is obliged to make regular compulsory contributions. Households in this context face other substantial uninsured shocks. Thus, being a member of these networks may not necessarily create a big difference in terms of upward mobility of poverty perception. It rather contributes to a downward mobility of subjective poverty due to the compulsory regular contributions against very limited coverage. Moreover, most of the poorest and middle-income households are members of these institutions, far more than richer households. This might reflect a need for insurance against adverse shocks to poorer households than their richer counterparts who often have the capacity to deal with the aftermath of shocks using their savings or their valuable assets.

References

Alem, Yonas, Gunnar Köhlin, and Jesper Stage. 2014. "The persistence of subjective poverty in urban Ethiopia." *World Development*, 56: 51–61.

Beegle, Kathleen, Kristen Himelein, and Martin Ravallion. 2012. "Frame-of-reference bias in subjective welfare." *Journal of Economic Behavior & Organization*, 81(2): 556–570.

Bigsten, Arne, and Abebe Shimeles. 2011. "The persistence of urban poverty in Ethiopia: A tale of two measurements." *Applied Economics Letters*, 18(9): 835–839.

Clark, Andrew E, Paul Frijters, and Michael A Shields. 2008. "Relative income, happiness, and utility: An explanation for the Easterlin paradox and other puzzles." *Journal of Economic Literature*, 95–144.

Deaton, Angus. 2010. "Price indexes, inequality, and the measurement of world poverty." *American Economic Review*, 100(1): 1–34.

Kahneman, Daniel, Peter P Wakker, and Rakesh Sarin. 1997. "Back to Bentham? Explorations of experienced utility." *Quarterly Journal of Economics*, 112(2): 375–406.

Nguyen Van, Phu, François Laisney, and Ulrich Kaiser. 2004. "The performance of German firms in the business-related service sector: A dynamic analysis." *Journal of Business & Economic Statistics*, 22(3): 274–295.

Portes, Alejandro. 2000. "The two meanings of social capital." Vol. 15, 1–12, Springer.

Ravallion, Martin, and Michael Lokshin. 2001. "Identifying welfare effects from subjective questions." *Economica*, 68(271): 335–357.

Sen, Amartya. 1982. *Poverty and famines: An essay on entitlement and deprivation.* Oxford University Press.

Senik, Claudia. 2005. "Income distribution and well-being: What can we learn from subjective data?" *Journal of Economic Surveys*, 19(1): 43–63.

Winkelmann, Liliana, and Rainer Winkelmann. 1998. "Why are the unemployed so unhappy? Evidence from panel data." *Economica*, 65(257): 1–15.

APPENDIX

A Appendix for Data

A.1 Sample and Context

The sampling frame of the survey includes all the cities with inhabitants greater than 100,000. Cultural diversity, major economic activity and administrative importance of cities are additional criteria to select sample cities. Mekele and Dessie represent the northern part of the country that is often affected by drought. Bahir Dar is a representative city of cereal producing part of the country while Dire Dawa is a major trading center. The administrative city of the southern part, Awassa, represents high production of 'Enset', false banana. The capital and the largest city of all, Addis Ababa, represents a very diverse population. Last, Jimma represents major coffee producing part of the country. The predetermined sample size (1,500 households) was allocated to the selected cities and districts, in proportion to the number of habitats. Households were then selected by systematic sampling from half of the kebeles, the lowest administrative units in the country, in each district using the official registration of residences.

Addis Ababa, Dire Dawa, and Awassa contribute 60%, 8% and 5% sample households, respectively. The other remaining four cities contribute 7% of the sample households each. The surveys were conducted over four successive weeks during a month considered to represent average conditions. The sample, however, misses the homeless, residents of collectives and rural-urban migrants with no permanent address. The database provides a rich array of data on intra-household characteristics (socioeconomic, demographic, etc.) and on household, such as food and non-food expenditure; income by source; private transfers; consumption habits; employment; education; credit; health; anthropometrics; dwelling conditions. It also collects data on subjective assessment of welfare. The last wave of our data is collected in 2004. Given the rapid urbanization in the country, there is a risk that current urban households might have different characteristics than households that we have in our data set.[1] However, Alem and Söderbom (2012) collect a data from 128 random new urban households from Addis Ababa, the city that contributes 60% sample households, in 2009 and concludes that there is no significant difference between the existing panel and the new households based on observable household peculiarities.

Table A.2 and A.3

[1]For the period between 1994 and 2007 for instance Ethiopian urban population grew by 4.3% and more than half of this growth is attributed to rural - urban migration (CSA, 2010).

Tables A.2 and A.3 give the distribution of observations by transition and by discrete variables with descriptive statistics, respectively. The number subjective poverty transitions are shown at the bottom of Table A.2. The first part of Table A.3 provides the poverty transition probabilities. These figures give the propensity of households who perceive being rich, borderline or poor at t conditional on subjective poverty status of households at $t-1$. The table illustrates the chance of perceiving oneself poor in a given year highly differs depending on subjective poverty status of the household during the previous year. There are two notable points. First, there is a very low proportion of transition among rich to the other states (borderline and poor). This might be due to the fact that the proportion of rich people in the sample is very small (only 4.9%) compared to borderline and poor. The transition from poor state $n(31)$ to rich state is also very low, (1.6%). Second, there is a strong persistence in borderline state $n(22)$, 25.9%.

Consumption expenditure plays a special role in the study of poverty. It is the dominant welfare indicator in the literature, especially for the work that has been done in developing countries. Most studies use a threshold of consumption to define a poverty line. One of the main challenges using consumption indicators is that they are purely monetary and poverty is multidimensional, includes other non-monetary aspects, which are not directly measurable. In addition, poverty and welfare do not always tell the same story. Indeed, one can be poor and feels happy and vice versa. In our dataset, the association between consumption and poverty is far from complete confirming that the subjective poverty assessment encompasses other dimensions than monetary or financial aspects. Households were also asked if they are able to cover their monthly expense from their current income. The Cramer's V coefficient, which measures the strength of association between subjective poverty and the ability of households to cover their expense, indicates that there is a significant association between the two dimensions but the association is far from unitary (see Table A.4). This, again, suggests that subjective poverty indeed includes other welfare dimensions and own consumption is key factors that may explain the perception of poverty in our context. The Cramers V coefficient in urban Ethiopia (0.28) is higher than estimates documented on Russia (0.14) by Ravallion and Lokshin (2002), on Peru (0.19) by Herrera, Razafindrakoto and Roubaud (2006) and comparable to the estimate on Madagascar (0.27) by Herrera, Razafindrakoto and Roubaud (2006). These results support the argument in the existing literature that income or consumption are an important determinant of subjective poverty in developing countries than developed countries. This perception might also include 'relative deprivation aspects of poverty as we note below.

Table A.4

We use households consumption (food and non-food expenditure) per adult equivalent. Figure 1 displays the density of expenditure. The distribution shows a unimodal shape centered around 4.7.

Figure 1 and 2

We further use, consumption per adult equivalent determining the relative consumption position of households. As it has been widely documented in the literature relative consumption or income is

one of the important determinants of subjective poverty, meaning that self-assessed welfare tends to fall as social comparators become better off at a given own income (see for instance Clark and Senik, 2010; Clark, Frijters and Shields, 2008). We define the relative consumption position of a household as the difference between the log of a household per adult equivalent consumption and the log of median per adult equivalent consumption in a kebeles (the lowest administrative units in the country).[2] The objective is to see how the distance of household consumption from median consumption of kebele or village affects self-assessed poverty over time. This means that a given household will compare his consumption with the median consumption in a village/kebele. Figure 2 plots the distribution of the relative consumption position. We observe a unimodal distribution skewed to the left. This negative skew implies that the mass of the distribution is concentrated on the right of the figure. As a result, in comparing their consumption to the median consumption in a village, a high proportion of households are far below the average.

[2]Very little is known how reference groups should be built (Fafchamps and Shilpi, 2003). Different reference group is used in the literature, for instance Clark and Oswald (1994) uses peer group in the labor market, Ravallion and Lokshin (2002) and Herrera, Razafindrakoto and Roubaud (2006) define peer groups using area of residence. We cannot rule out the fact that there might be multiple reference groups, but in this study, we limit ourselves to a reference group that is comprised of the residential neighbors.

Table A.1 – List and definition of variables

Variable name	Definition	Nature
Poverty state	State of self reported subjective poverty, $\mathscr{J}_{i,t-1,t}(jj'), j, j' = 1, 2, 3.$ 1=rich, 2=borderline, 3=poor	discrete
Households in income activity	Number of household members involved in income earning activity	continuous
Households unemployed	Number of household members who are unemployed	continuous
Households size	Household family size	continuous
Family members aged 0-14	Number of family members aged between 0 and 14	continuous
Family members aged 64+	Number of family members aged 64+	continuous
Female household head	Household head if female	binary (yes=1)
Age of head in years	Age of head in years	continuous
Head: public employee	Head of household is public, civil or NGO sector employee	binary (yes=1)
Head: private employee	Head of household is public sector employee	binary (yes=1)
Head: own account employee	Head of household is own account employee	binary (yes=1)
Head: casual worker	Head of household is casual worker	binary (yes=1)
Head: out-of-the-labor-force	Head of household is out of labor (reference)	binary (yes=1)
Head: primary schooling	Head of household has completed primary schooling	binary (yes=1)
Head: secondary schooling	Head of household has completed secondary schooling	binary (yes=1)
Head: tertiary schooling	Head of household has completed tertiary schooling	binary (yes=1)
Head: no schooling	Head of household is illiterate (reference)	binary (yes=1)
Household expenditure	Real monthly expenditure of household per adult equivalent	continuous
Relative consumption	Kebele cluster real median monthly consumption per adult equivalent minus household consumption	continuous
'Iddir' membership only	Household membership of 'Iddir' but not 'Equip'	binary (yes=1)
'Eqqub' membership only	Household membership of 'Equip' but not 'Iddir'	binary (yes=1)
'Iddir' and 'Eqqub' membership	Household membership of 'Equip' and 'Iddir'	binary (yes=1)
Neither 'Iddir' nor 'Equip' membership	Household is neither membership of 'Equip' nor 'Iddir' (reference)	binary (yes=1)
Remittance	Household is local or international remittance recipient	binary (yes=1)
City	Household residing in Addis Ababa (reference), Awassa, Bahirdar, Dessie, Diredawa, Jimma, Mekele	binary (yes=1)

Continued on next page...

Table A.1 – continued

Variable name	Definition	Type
Time	Years 1995, 1997, 2000 (reference) and 2004	binary (yes=1)

Table A.2 – Distribution of observations by poverty transition type and by variable (discrete)

Variable	$n(11)$	$n(12)$	$n(13)$	$n(21)$	$n(22)$	$n(23)$	$n(31)$	$n(32)$	$n(33)$	Total
Gender of household head										
Female	4	12	19	12	197	145	16	186	464	1,055
Male	16	35	20	54	505	228	28	253	520	1,659
Head: public employee										
yes	11	11	8	16	207	90	13	93	164	613
no	9	36	31	50	495	283	31	346	820	2,101
Head: private employee										
yes	2	7	nto.[a]	10	82	22	1	33	75	232
no	18	40	39	56	620	351	43	406	909	2,482
Head: own account employee										
yes	5	14	12	22	164	89	14	98	264	682
no	15	33	27	44	538	284	30	341	720	2,032
Head: casual worker										
yes	nto.	2	6	2	18	24	2	23	99	176
no	20	45	33	64	684	349	42	416	885	2,538
Head: out-of-the-labor-force										
yes	2	13	13	16	231	148	14	192	382	1,011
no	18	34	26	50	471	225	30	247	602	1,703
Head: primary schooling										
yes	1	10	14	24	209	117	16	121	289	801
no	19	37	25	42	493	256	28	318	695	1,913
Head: secondary schooling										
yes	6	19	10	17	181	95	9	134	258	729
no	14	28	29	49	521	278	35	305	726	1,985
Head: tertiary schooling										

Continued on next page...

Table A.2 – continued

Variable	$n(11)$	$n(12)$	$n(13)$	$n(21)$	$n(22)$	$n(23)$	$n(31)$	$n(32)$	$n(33)$	Total
yes	9	8	1	14	171	39	2	47	52	343
no	11	39	38	52	531	334	42	392	932	2,371
Head: no schooling										
yes	4	10	14	11	141	122	17	137	385	841
no	16	37	25	55	561	251	27	302	599	1,873
'Iddir' membership only										
yes	4	29	26	40	464	248	31	296	653	1,791
no	16	18	13	26	238	125	13	143	331	923
'Eqqub' membership only										
yes	1	2	2	1	9	12	1	6	15	49
no	19	45	37	65	693	361	43	433	969	2,665
'Iddir' and 'Equip' membership										
yes	7	5	5	19	159	72	6	78	117	468
no	13	42	34	47	543	301	38	361	867	2,246
Neither 'Iddir' nor 'Equip' membership										
yes	8	11	6	6	70	41	6	59	199	406
no	12	36	33	60	632	332	38	380	785	2,308
Remittance										
yes	1	7	5	16	159	70	7	93	157	515
no	19	40	34	50	543	303	37	346	827	2,199
City										
Addis Ababa										
yes	5	24	22	26	470	249	20	292	628	1,736
no	15	23	17	40	232	124	24	147	356	978
Awassa										
yes	1	1	1	4	49	10	2	19	37	124
no	19	46	38	62	653	363	42	420	947	2,590

Continued on next page...

Table A.2 – continued

Variable	$n(11)$	$n(12)$	$n(13)$	$n(21)$	$n(22)$	$n(23)$	$n(31)$	$n(32)$	$n(33)$	Total
Bahirdar										
yes	7	11	8	18	12	24	10	11	50	151
no	13	36	31	48	690	349	34	428	934	2,563
Dessie										
yes	nto.	4	1	5	33	19	3	15	58	138
no	20	43	38	61	669	354	41	424	926	2,576
Diredawa										
yes	2	2	3	3	29	32	4	33	92	200
no	18	45	36	63	673	341	40	406	892	2,514
Jimma										
yes	3	2	2	3	54	27	3	33	82	209
no	17	45	37	63	648	346	41	406	902	2,505
Mekele										
yes	2	3	2	7	55	12	2	36	37	156
no	18	44	37	59	647	361	42	403	947	2,558
Time[b]										
Year 1997										
yes	15	8	16	27	267	143	26	141	410	1,053
no	5	39	23	39	435	230	18	298	574	1,661
Year 2000										
yes	3	20	15	20	205	116	14	139	300	832
no	17	27	24	46	497	257	30	300	684	1,882
Year 2004										
yes	2	19	8	19	230	114	4	159	274	829
no	18	28	31	47	472	259	40	280	710	1,885
Number of poverty state transitions $\mathscr{S}_{i,t-1,t}(jj'), jj' = 1,2,3$	20	47	39	66	702	373	44	439	984	2714

[a]: nto.: no transition observed.

Continued on next page...

Table A.2 – continued

Variable	$n(11)$	$n(12)$	$n(13)$	$n(21)$	$n(22)$	$n(23)$	$n(31)$	$n(32)$	$n(33)$	Total

[b]: No transition reported for year 1995: starting period.

Table A.3 – Descriptive statistics

Group	Variable	Mean	Std. Dev.[c]	Min.[a]	Max.[b]
Dependent: Poverty[d] $n_{i,t-1,t}(jj'), jj' = 1,2,3$					
	$n(11)$	0.007			
	$n(12)$	0.017			
	$n(13)$	0.014			
	$n(21)$	0.024			
	$n(22)$	0.259			
	$n(23)$	0.138			
	$n(31)$	0.016			
	$n(32)$	0.162			
	$n(33)$	0.363			
Controls					
	Households in income activity	1.747	1.229	0	12
	Households unemployed	0.629	1.041	0	10
	Households size (in log)	1.972	0.379	1.098	3.367
	Family members aged 0-14	1.852	1.571	0	10
	Family members aged 64+	0.213	0.459	0	3
	Female household head	0.390			
	Age of head in years (in log)	3.859	0.279	2.833	4.499
	Head: public employee	0.234			
	Head: private employee	0.086			
	Head: own account employee	0.258			
	Head: casual worker	0.065			
	Head: out-of-the-labor-force	0.356			
	Head: primary schooling	0.298			
	Head: secondary schooling	0.272			
	Head: tertiary schooling	0.122			
	Head: no schooling	0.307			
	Household expenditure (in log)	4.669	0.839	0.842	8.187
	Relative consumption (in log)	0.0004	0.203	-1.280	0.618
	'Iddir' membership only	0.642			
	'Eqqub' membership only	0.021			
	'Iddir' and 'Eqqub' membership	0.176			
	Neither 'Iddir' nor 'Eqqub'	0.161			
	Remittance	0.183			
	Addis Ababa	0.603			
	Awassa	0.055			
	Bahirdar	0.068			

Continued on next page...

Table A.3 – continued

Group	Variable	Mean	Std. Dev.[c]	Min.[a]	Max.[b]
	Dessie	0.063			
	Diredawa	0.075			
	Jimma	0.071			
	Mekele	0.065			
	Year 1995	0.235			
	Year 1997	0.243			
	Year 2000	0.277			
	Year 2004	0.245			

Note. Number of observations: 4,960 over all waves.

[a,b] Min. and Max. are not reported for binary variables as per 0 and 1 respectively.

[c] Standard Deviation for binary variables can be retrieved using $\sqrt{\pi(1-\pi)}$ where π is the probability of event.

[d] $n_{i,t-1,t}(jj'), jj' = 1, 2, 3$ are dummies of poverty transition profiles. Departure state: j, arrival state: j'.

Table A.4 – Correlation between subjective poverty and ability of households to cover monthly expense with current income

Poverty status	Expense coverage capacity	
	Yes	No
Rich	115	23
Borderline	1,632	465
Poor	1,229	1,139
Total	2,976	1,627

Cramér's V = 0.275

B Appendix for the Methodology: Multinomial Markov Chain with Unobserved Heterogeneity

We estimate three specifications with unobserved heterogeneity as random effects which depend on i) households and poverty departure state, ii) household and transition poverty profile, meaning heterogeneity related to both departure and arrival poverty states and iii) household heterogeneity only. The first two are inspired by Gourieroux (2000) and Nguyen Van, Laisney and Kaiser (2004).

B.1 Random Effect: Household and Poverty Departure State

We consider heterogeneity in the form of additional random effects connected with household i and the departure state j, termed u_{ij}. Let j' denotes the arrival state. The heterogeneity terms u_{ij}

are assumed to be mutually independent and independent of co-variates $\mathbf{x}$, with a standard normal distribution. Conditional on $\mathbf{x}$ and u_{ij} the transition probability is assumed to take the form:

$$\mathbb{P}_{ijj'}(t) = \frac{\exp\left(\mathbf{x}_{itj}\boldsymbol{\beta}_{jj'} + \sigma_{jj'}u_{ij}\right)}{\sum_{l=1}^{J}\exp\left(\mathbf{x}_{itj}\boldsymbol{\beta}_{jl} + \sigma_{jl}u_{ij}\right)} \tag{B.1}$$

where $i = 1, \ldots, N$, $t = 1, \ldots, T_i$ and $j, j' = 1, \ldots, J$. The rationale for the coefficient $\sigma_{jj'}$ is the same as for $\boldsymbol{\beta}_{jj'}$, as u_{ij} can be seen as some omitted regressor. Imposing the usual identifying restriction $\boldsymbol{\beta}_{jj'} = 0$ for a given value of $j^{'}$ (again, we choose $\boldsymbol{\beta}_{j1} = 0$) leads to:

$$\mathbb{P}_{ij1}(t) = \frac{1}{1 + \sum_{l=2}^{J}\exp\left(\mathbf{x}_{itj}\boldsymbol{\beta}_{jl} + \left(\sigma_{jl} - \sigma_{j1}\right)u_{ij}\right)} \tag{B.2}$$

$$\mathbb{P}_{ijj'}(t) = \frac{\exp\left(\mathbf{x}_{itj}\boldsymbol{\beta}_{jj'} + \left(\sigma_{jj'} - \sigma_{j1}\right)u_{ij}\right)}{1 + \sum_{l=2}^{J}\exp\left(\mathbf{x}_{itj}\boldsymbol{\beta}_{jl} + \left(\sigma_{jl} - \sigma_{j2}\right)u_{ij}\right)} \tag{B.3}$$

The parameters $\sigma_{jj'}$ have to be estimated. Thus one more identifying restriction is required, and we choose to set $\sigma_{j1} = 0$. Since the transition probabilities depend on unobservable variables, we have to integrate them out with respect to the heterogeneity distribution. Thus, we obtain:

$$\mathscr{L} = \prod_{j=1}^{J}\prod_{i=1}^{N}\int_{-\infty}^{+\infty}\left(\prod_{j'=2}^{J}\prod_{t=2}^{T_i}\left[\mathbb{P}_{ijj'}(t)\right]^{n_{i,t-1,t}(jj')}\right)\varphi\left(u_{ij}\right)\mathrm{d}u_{ij} \tag{B.4}$$

Therefore, the maximum likelihood (ML) estimator is obtained by separately maximizing the terms $\ln \mathscr{L}_j$:

$$\ln \mathscr{L}_j = \sum_{i}^{N}\ln\int_{-\infty}^{+\infty}\left(\prod_{j'=2}^{J}\prod_{t=2}^{T_i}\left[\mathbb{P}_{ijj'}(t)\right]^{n_{i,t-1,t}(jj')}\right)\varphi\left(u_{ij}\right)\mathrm{d}u_{ij},\ \ j = 1, 2, 3 \tag{B.5}$$

The integral in the likelihood function can be evaluated numerically using the Gauss-Hermite quadrature approximation:[3]

$$\int_{-\infty}^{+\infty}\exp(-x^2)f(x)\,\mathrm{d}x \approx \sum_{i=1}^{M}\omega_i f(x_i)$$

where M is the number of sample points to use for the approximation and the x_i denote the roots of the Hermite polynomial. Here, we use $M = 20$ to evaluate numerically the integrals.[4] A likelihood ratio test for the significance of unobserved heterogeneity (the null hypothesis is $\sigma_{jj'} = 0$, $\forall j'$) can

[3] See e.g. Abramowitz and Stegun (1972).

[4] An alternative method consists in simulating the maximum likelihood.

then be computed.[5]

B.2 Random Effect: Household and Poverty Transition Profile

Here, heterogeneity is connected to household and transition profile (departure and arrival poverty states): $u_{ijj'}$. The random effects are again assumed to be mutually independent and independent of $\mathbf{x}$, with a standard normal distribution. Conditional on $\mathbf{x}$ and the $u_{ijj'}$ the transition probability is assumed to take the following form, with the restriction $\boldsymbol{\beta}_{j1} = 0$:

$$\mathbb{P}_{ij1}(t) = \frac{1}{1 + \sum_{l=2}^{J} \exp\left(\mathbf{x}_{itj}\boldsymbol{\beta}_{jl} + \sigma_{jl}u_{ijl} - \sigma_{j1}u_{ij1}\right)} \tag{B.6}$$

$$\mathbb{P}_{ijj'}(t) = \frac{\exp\left(\mathbf{x}_{itj}\boldsymbol{\beta}_{jj'} + \sigma_{jj'}u_{ijj'} - \sigma_{j1}u_{ij1}\right)}{1 + \sum_{l=2}^{J} \exp\left(\mathbf{x}_{itj}\boldsymbol{\beta}_{jl} + \sigma_{jl}u_{ijl} - \sigma_{j1}u_{ij1}\right)} \tag{B.7}$$

Note that here σ_{j1} is identified separately, contrary to the previous case. The likelihood function becomes:

$$\mathscr{L} = \prod_{j=1}^{J} \mathscr{L}_j, \quad \text{with } \mathscr{L}_j = \prod_{i=1}^{N} \left(\iiint_{-\infty}^{+\infty} \left[\prod_{j'=2}^{J} \left\{ \prod_{t=2}^{T_i} \left[\mathbb{P}_{ijj'}(t)\right]^{n_{i,t-1,t}(jj')} \right\} \varphi\left(u_{ijj'}\right) \mathrm{d}u_{ijj'} \right] \right) \tag{B.8}$$

We can still separately maximize separately the terms $\ln \mathscr{L}_j$ using the Gauss-Hermite quadrature to evaluate numerically the integrals. A likelihood ratio test of the restricted model (without heterogeneity, i.e. with all $\sigma_{jj'}$ set to 0) is applicable against each of these two random effects specifications and performed below, but note that the two models with random effects are non-nested.

B.3 Random Effect: Household Only

As we outlined earlier, the separation property implied by the IIA makes feasible to maximize the likelihood separately. Albeit convenient, this assumption is restrictive. Here, we relax this assumption and we assume that the probability of being in poverty state j conditional on observed characteristics $\mathbf{x}_{it}$ and unobserved heterogeneity (individual effects) η_i has the structure:

$$\mathbb{P}(y_{it} = j | \mathbf{x}_{it}, y_{it-1}, y_{i0}, \eta_i) = \frac{\exp\left(\mathbf{x}_{it}\boldsymbol{\beta}_j + y_{it-1}\gamma_j + y_{i0}\delta_j + \eta_{ij}\right)}{\sum_{l=1}^{J} \exp\left(\mathbf{x}_{it}\boldsymbol{\beta}_{jl} + y_{it-1}\gamma_l + y_{i0}\delta_l + \eta_{il}\right)} \tag{B.9}$$

[5] The normality assumption is of course arbitrary, and alternatives are discrete mixtures (see, e.g., Heckman and Singer, 1984 and the local distribution-free approximation of Chesher and Silva, 2002). A comparison with these alternatives is out of the scope of this paper.

From Eq.(B.9), one observes that we address the initial condition problem.[6] Indeed, it is well known that in a dynamic setting (where the lag of the response variable is included as additional regressor), the observation period of transition probabilities will not coincide with the starting of the stochastic process that governing the poverty dynamics. Here we follow the approach of Wooldridge (2005) in assuming that the conditional expectation of the state specific unobserved effect, say, $\zeta(\vartheta_{ij}|y_{i0}, \mathbf{x}_i; \delta)$ is correctly specified conditional on the initial state y_{i0} and observed individual specific variables $\mathbf{x}_i$ that are time invariant such as sex, city, etc. To ease notation, we include such variables as part of $\mathbf{x}_{it}$. As a result, η will capture the remaining individual unobserved heterogeneity that is by definition uncorrelated with y_{i0} and $\mathbf{x}_i$.

We assume that the unobserved heterogeneity η is i.i.d over individual with a multivariate normal distribution with mean $\bar{\boldsymbol{\eta}}$ and covariance matrix $\boldsymbol{\Sigma}$. Let us define $\kappa_{ijt} = 1$ if household i is in poverty state j at time t and zero otherwise. The likelihood function associated with Eq.(B.9) is given by:

$$\mathscr{L} = \prod_{i=1}^{N} \left(\int_{-\infty}^{+\infty} \prod_{t=2}^{T_i} \prod_{j=1}^{J} \left[\mathbb{P}(y_{it} = j|\mathbf{x}_{it}, y_{it-1}, y_{i0}, \eta_i)\right]^{\kappa_{ijt}} \varphi(\eta_i)\, \mathrm{d}(\eta_i) \right), \quad j = 1, 2, 3 \tag{B.10}$$

where $\varphi(\eta)$ denotes the distribution of η. To maximize the likelihood function in Eq.(B.10), we must integrate over the distribution $\varphi(\eta)$. We use the simulated maximum likelihood which expression is given by:

$$\mathscr{L}_{\text{sim}} = \prod_{i=1}^{N} \frac{1}{R} \sum_{r=1}^{R} \prod_{t=2}^{T_i} \prod_{j=1}^{J} \left(\frac{\exp(\mathbf{x}_{it}\boldsymbol{\beta}_j + y_{it-1}\gamma_j + y_{i0}\delta_j + \eta_j^r)}{\sum_{l=1}^{J} \exp(\mathbf{x}_{it}\boldsymbol{\beta}_{jl} + y_{it-1}\gamma_l + y_{i0}\delta_l + \eta_{il}^r)} \right)^{\kappa_{ijt}} \tag{B.11}$$

where R is the number of draws values from the distribution of the unobserved heterogeneity distribution. Here, we use the procedure developed by Haan and Uhlendorff (2006).[7] For each draw, the likelihood is evaluated and averaged over the R draws. For identification purpose, we set $\boldsymbol{\beta}_1 = 0$ and we assume that unobserved heterogeneity differs across the other choices ($\eta_{i2} \neq \eta_{i3}$) and we allow for correlations in these terms.

The coefficients reported in the estimations are the marginal effects of the explanatory variables on the log odds ratios $[\mathbb{P}_{ijj'}(t)/\mathbb{P}_{ij2}(t)]$ for $j = 1, 2, 3$ and $j' = 1, 3$. For continuous control variable

[6] Another issue that we cannot address in this study is related to the panel attrition. Indeed, in our data, we only observe whether households leave the sample, but we have no information about the reasons of exit. The attrition issue doesn't matter as long as the unobserved individual heterogeneities influencing the dynamics of poverty are not correlated with the unobserved factors that determine the attrition process.

[7] The simulation is based on Halton sequences draws.

x_j^k, the marginal effect on the transition probability from state j to state j' is:

$$\tilde{\beta}_{jj'} = \frac{\partial \mathbb{P}_{jj'}}{\partial x_j^k} = \mathbb{P}_{jj'} \left(\beta_{jj'}^k - \sum_{l=1}^{J} \beta_{jl}^k \mathbb{P}_{jl} \right) \tag{B.12}$$

Relation (B.12) does not apply for discrete variables. In the later case, the marginal effects are computed as the difference in transition probabilities evaluated at the alternative values of the dummy variables. In the sequel, the marginal effects are computed at the true values and at zero unobserved heterogeneity. The later choice is consistent with our specification as expected value of the random heterogeneity effect is null.

C Appendix for Results

Given that the model without and with heterogeneity are nested, we can perform the LR test. Table C.1 presents the statistics of this exercise. It shows for each initial state the model without heterogeneity (constrained model) is rejected compared to models with heterogeneity (unconstrained model). The models with heterogeneity are not nested and can be tested using the Bayesian Information Criterion (BIC). However, these models do not reflect the same household behavior. A test of the specification with u_{ij} against the one with $u_{ijj'}$ is irrelevant.

Table C.1 – LR Test[a]

Departure state	Model	# parameters	Log-likelihood	LR (dof)[b]
Rich	constrained	54	-447.742	
	u_{ij}	56	-166.648	562.188 (2)
	$u_{i1j'}$	57	-162.730	570.024 (3)
Borderline	constrained	54	-3,235.049	
	u_{ij}	56	-794.693	4,880.614 (2)
	$u_{i2j'}$	57	-793.402	4,883.196 (3)
Poor	constrained	54	-4,184.236	
	u_{ij}	56	-1,025.447	6,317.578 (2)
	$u_{i3j'}$	57	-1,023.173	6,322.126 (3)
Non separable	constrained	58	-1,997.020	
	u_i	61	-1,970.640	52.76 (3)

[a] The null H_0 is the constrained model.
[b] dof: degree of freedom.

Table C.2 – Estimation results (marginal effects): Model with separable initial state. Departure state: Rich ($j = 1$). Reference state: Borderline ($j = 2$)

Variable	Without heterogeneity Coef.	Std. Err.	Heterogeneity u_{ij} Coef.	Std. Err.	Heterogeneity $u_{ijj'}$ Coef.	Std. Err.
Arrival state: Rich ($j' = 1$)						
Households in income activity	-0.043	0.026	-0.069	0.049	-0.069	0.049
Households unemployed	-0.039	0.055	-0.057	0.077	-0.057	0.077
Households size (in log)	-0.002	0.121	-0.002	0.150	-0.002	0.151
Family members aged 0-14	0.010	0.028	0.014	0.041	0.015	0.042
Family members aged 64+	0.161*	0.083	0.043	0.142	0.043	0.143
Female household head	-0.056	0.065	-0.077	0.091	-0.077	0.092
Age of head in years (in log)	0.037	0.109	0.066	0.160	0.066	0.160
Head: public employee	0.121	0.087	0.174	0.154	0.174	0.154
Head: private employee	0.044	0.106	0.018	0.165	0.018	0.165
Head: own account employee	0.233**	0.095	0.254**	0.114	0.254**	0.114
Head: casual worker	0.202	0.127	0.263	0.167	0.263	0.167
Head: primary schooling	-0.054	0.079	-0.085	0.100	-0.085	0.100
Head: secondary schooling	0.120*	0.066	0.119	0.103	0.119	0.103
Head: tertiary schooling	0.150	0.097	0.124	0.131	0.124	0.131
Household expenditure (in log)	0.164***	0.044	0.133**	0.066	0.133**	0.066
Relative consumption (in log)	0.057	0.106	0.0003	0.187	0.0003	0.187
'Iddir' membership only	-0.081	0.082	-0.065	0.098	-0.065	0.098
'Eqqub' membership only	-0.089	0.064	-0.121	0.160	-0.121	0.160
'Iddir' and 'Eqqub' membership	0.034	0.105	0.082	0.122	0.082	0.122
Intercept[a]	-18.128*	10.917	-18.128	12.582	-18.128	12.581
Arrival state: Poor ($j' = 3$)						
Households in income activity	-0.043	0.031	-0.070*	0.039	-0.070*	0.039
Households unemployed	-0.015	0.038	-0.035	0.043	-0.035	0.043
Households size (in log)	0.003	0.155	0.002	0.172	0.002	0.172
Family members aged 0-14	0.005	0.031	0.010	0.038	0.010	0.038
Family members aged 64+	-0.658***	0.162	-0.721***	0.190	-0.721***	0.190
Female household head	0.0001	0.074	-0.024	0.080	-0.024	0.080
Age of head in years (in log)	0.059	0.112	0.086	0.155	0.086	0.155
Head: public employee	0.043	0.122	0.111	0.144	0.111	0.144
Head: private employee	-0.167	0.118	-0.183	0.158	-0.183	0.158
Head: own account employee	-0.158**	0.073	-0.083	0.104	-0.083	0.104
Head: casual worker	-0.027	0.108	0.062	0.172	0.062	0.172
Head: primary schooling	-0.049	0.087	-0.080	0.098	-0.080	0.098
Head: secondary schooling	-0.159**	0.077	-0.152	0.112	-0.152	0.112

Continued on next page...

Table C.2 – continued

Variable	Without heterogeneity Coef.	Std. Err.	Heterogeneity u_{ij} Coef.	Std. Err.	Heterogeneity $u_{ijj'}$ Coef.	Std. Err.
Head: tertiary schooling	-0.243**	0.097	-0.250*	0.134	-0.250*	0.134
Household expenditure (in log)	-0.329***	0.069	-0.326***	0.060	-0.326***	0.060
Relative consumption (in log)	-0.291	0.203	-0.325	0.322	-0.325	0.322
'Iddir' membership only	0.159**	0.071	0.157*	0.094	0.157*	0.094
'Eqqub' membership only	-0.017	0.118	-0.053	0.223	-0.053	0.223
'Iddir' and 'Eqqub' membership	0.107	0.137	0.146	0.142	0.146	0.142
Intercept[a]	11.536	7.205	11.537*	6.750	11.537*	6.749
$\sigma_{1j'}$			1.53e-04	1.655	0.003***	0.001
$\sigma_{2j'}$					0.002**	0.001
$\sigma_{3j'}$			7.51e-09	1.018	0.004**	0.002
Log likelihood	-477.742		-166.648		-162.730	
Wald $\chi_2(52)$	46.820		46.820		46.820	
Prob $> \chi_2$	0.677		0.677		0.677	
# Observations			136			

Notes: [a] Coefficient on intercept is not marginal effect.

Regressions include years and city dummies, not reported here for brevity.

Significance levels: $*$: 10% $**$: 5% $***$: 1%

Table C.3 – Estimation results (marginal effects): Model with separable initial state. Departure state: Borderline ($j = 2$). Reference state: Borderline ($j = 2$)

Variable	Without heterogeneity Coef.	Std. Err.	Heterogeneity u_{ij} Coef.	Std. Err.	Heterogeneity $u_{ijj'}$ Coef.	Std. Err.
Arrival state: Rich ($j' = 1$)						
Households in income activity	0.003	0.007	0.004	0.007	0.003	0.007
Households unemployed	0.00003	0.010	0.002	0.011	0.001	0.010
Households size (in log)	-0.011	0.036	-0.018	0.037	-0.018	0.037
Family members aged 0-14	-0.005	0.007	-0.004	0.007	-0.004	0.007
Family members aged 64+	0.020	0.019	0.020	0.020	0.020	0.020
Female household head	-0.013	0.021	-0.013	0.021	-0.013	0.021
Age of head in years (in log)	0.012	0.043	0.012	0.045	0.012	0.045
Head: public employee	-0.011	0.029	-0.014	0.030	-0.014	0.030
Head: private employee	0.024	0.040	0.021	0.040	0.021	0.040
Head: own account employee	0.042	0.031	0.042	0.031	0.042	0.031
Head: casual worker	0.084	0.096	0.087	0.100	0.087	0.100

Continued on next page...

Table C.3 – continued

Variable	Without heterogeneity Coef.	Std. Err.	Heterogeneity u_{ij} Coef.	Std. Err.	Heterogeneity $u_{ijj'}$ Coef.	Std. Err.
Head: primary schooling	0.035	0.031	0.035	0.032	0.035	0.032
Head: secondary schooling	0.018	0.031	0.018	0.032	0.018	0.032
Head: tertiary schooling	0.029	0.036	0.029	0.037	0.029	0.037
Household expenditure (in log)	0.034***	0.012	0.030**	0.013	0.030**	0.013
Relative consumption (in log)	0.013	0.059	0.018	0.061	0.018	0.061
'Iddir' membership only	0.025	0.029	0.025	0.031	0.025	0.031
'Eqqub' membership only	0.108	0.121	0.121	0.132	0.121	0.132
'Iddir' and 'Eqqub' membership	0.029	0.041	0.031	0.043	0.031	0.043
Intercept[a]	-6.940**	3.199	-6.411*	3.301	-6.412*	3.302
Arrival state: Poor ($j' = 3$)						
Households in income activity	0.003	0.011	0.004	0.012	0.004	0.012
Households unemployed	0.055***	0.012	0.058***	0.013	0.058***	0.013
Households size (in log)	-0.320***	0.052	-0.337***	0.056	-0.337***	0.056
Family members aged 0-14	0.020*	0.011	0.022*	0.011	0.022*	0.011
Family members aged 64+	0.028	0.031	0.032	0.033	0.032	0.033
Female household head	0.021	0.029	0.021	0.031	0.021	0.031
Age of head in years (in log)	-0.122**	0.062	-0.129*	0.066	-0.129*	0.066
Head: public employee	-0.060	0.043	-0.069	0.046	-0.069	0.046
Head: private employee	-0.101**	0.049	-0.111**	0.051	-0.111**	0.051
Head: own account employee	-0.040	0.033	-0.043	0.036	-0.043	0.036
Head: casual worker	0.067	0.073	0.059	0.078	0.059	0.078
Head: primary schooling	-0.057*	0.032	-0.058*	0.034	-0.058*	0.034
Head: secondary schooling	-0.082**	0.033	-0.082**	0.036	-0.082**	0.036
Head: tertiary schooling	-0.092**	0.041	-0.093**	0.044	-0.093**	0.044
Household expenditure (in log)	-0.237***	0.017	-0.245***	0.019	-0.245***	0.019
Relative consumption (in log)	0.066	0.088	0.076	0.096	0.076	0.096
'Iddir' membership only	0.052	0.040	0.053	0.043	0.053	0.043
'Eqqub' membership only	0.216**	0.102	0.231**	0.108	0.231**	0.108
'Iddir' and 'Eqqub' membership	0.107**	0.049	0.110**	0.052	0.110**	0.052
Intercept[a]	12.915***	1.751	14.004***	2.064	14.004***	2.063
$\sigma_{1j'}$			0.581	0.534	0.125***	0.035
$\sigma_{2j'}$					0.420**	0.203
$\sigma_{3j'}$			0.719***	0.277	0.820***	0.223
Log likelihood	-3235.049		-794.693		-793.402	
Wald $\chi_2(52)$	275.560		209.210		209.320	
Prob $> \chi_2$	0.000		0.000		0.000	
# Observations			1185			

Continued on next page...

Table C.3 – continued

Variable	Without heterogeneity Coef.	Std. Err.	Heterogeneity u_{ij} Coef.	Std. Err.	Heterogeneity $u_{ijj'}$ Coef.	Std. Err.

Notes: [a] Coefficient on intercept is not marginal effect.

Regressions include years and city dummies, not reported here for brevity.

Significance levels: $*$: 10% $**$: 5% $***$: 1%

Table C.4 – Estimation results (marginal effects): Model with separable initial state. Departure state: Poor ($j = 3$). Reference state: Borderline ($j = 2$)

Variable	Without heterogeneity Coef.	Std. Err.	Heterogeneity u_{ij} Coef.	Std. Err.	Heterogeneity $u_{ijj'}$ Coef.	Std. Err.
Arrival state: Rich ($j' = 1$)						
Households in income activity	-0.005	0.010	-0.005	0.011	-0.005	0.011
Households unemployed	-0.006	0.013	-0.006	0.014	-0.006	0.014
Households size (in log)	0.076	0.046	0.070	0.053	0.070	0.053
Family members aged 0-14	-0.014	0.010	-0.014	0.011	-0.014	0.011
Family members aged 64+	0.005	0.026	0.006	0.028	0.006	0.028
Female household head	-0.004	0.024	-0.002	0.027	-0.002	0.027
Age of head in years (in log)	-0.021	0.049	-0.021	0.054	-0.021	0.054
Head: public employee	0.029	0.044	0.032	0.048	0.032	0.048
Head: private employee	0.030	0.061	0.031	0.067	0.031	0.067
Head: own account employee	0.038	0.034	0.043	0.038	0.043	0.038
Head: casual worker	0.031	0.068	0.040	0.077	0.040	0.077
Head: primary schooling	-0.006	0.027	-0.005	0.030	-0.005	0.030
Head: secondary schooling	-0.027	0.026	-0.030	0.028	-0.030	0.028
Head: tertiary schooling	-0.046	0.031	-0.053	0.034	-0.053	0.034
Household expenditure (in log)	0.062***	0.012	0.062***	0.014	0.062***	0.014
Relative consumption (in log)	-0.011	0.078	-0.006	0.087	-0.006	0.087
'Iddir' membership only	-0.002	0.032	-0.005	0.036	-0.005	0.036
'Eqqub' membership only	0.033	0.083	0.033	0.090	0.033	0.090
'Iddir' and 'Eqqub' membership	-0.019	0.034	-0.024	0.039	-0.024	0.039
Intercept[a]	-7.672**	3.132	-7.128**	3.229	-7.130**	3.231
Arrival state: Poor ($j' = 3$)						
Households in income activity	0.005	0.010	0.007	0.011	0.007	0.011
Households unemployed	0.028**	0.011	0.031**	0.012	0.031**	0.012

Continued on next page...

Table C.4 – continued

Variable	Without heterogeneity Coef.	Std. Err.	Heterogeneity u_{ij} Coef.	Std. Err.	Heterogeneity $u_{ijj'}$ Coef.	Std. Err.
Households size (in log)	-0.253***	0.049	-0.274***	0.055	-0.274***	0.055
Family members aged 0-14	0.018*	0.010	0.019*	0.011	0.019*	0.011
Family members aged 64+	-0.029	0.027	-0.030	0.030	-0.030	0.030
Female household head	0.029	0.025	0.034	0.027	0.034	0.027
Age of head in years (in log)	0.038	0.049	0.043	0.055	0.043	0.055
Head: public employee	-0.003	0.039	-0.004	0.044	-0.004	0.044
Head: private employee	0.046	0.043	0.044	0.048	0.044	0.048
Head: own account employee	0.067**	0.027	0.071**	0.030	0.071**	0.030
Head: casual worker	0.132***	0.039	0.141***	0.041	0.141***	0.041
Head: primary schooling	0.012	0.029	0.015	0.031	0.0153	0.031
Head: secondary schooling	-0.024	0.029	-0.024	0.032	-0.024	0.032
Head: tertiary schooling	-0.048	0.049	-0.057	-0.054	-0.057	0.054
Household expenditure (in log)	-0.179	0.016	-0.184***	0.018	-0.184***	0.018
Relative consumption (in log)	0.120	0.076	0.140	0.087	0.140	0.087
'Iddir' membership only	-0.026	0.031	-0.034	0.033	-0.033	0.033
'Eqqub' membership only	-0.028	0.095	-0.034	0.103	-0.034	0.103
'Iddir' and 'Eqqub' membership	-0.066	0.044	-0.078	0.049	-0.078	0.049
Intercept[a]	7.068***	1.301	7.566***	1.509	7.565***	1.509
$\sigma_{1j'}$			0.593	0.761	0.593***	0.201
$\sigma_{2j'}$					0.4268***	0.121
$\sigma_{3j'}$			0.847***	0.250	1.032**	0.447
Log likelihood	-4184.236		-1025.447		-1023.173	
Wald $\chi_2(52)$	253.82		204.780		205.020	
Prob > χ_2	0.000		0.000		0.000	
# Observations			1591			

Notes: [a] Coefficient on intercept is not marginal effect.

Regressions include years and city dummies, not reported here for brevity.

Significance levels: *: 10% **: 5% ***: 1%

Table C.5 – Estimation results (marginal effects): Model with separable initial state: Reference state: Borderline ($j = 2$). Heterogeneity: household only

Variable	Without heterogeneity Coef.	Std. Err.	Heterogeneity u_i Coef.	Std. Err.
Equation: Rich				

Continued on next page...

Table C.5 – continued

Variable	Without heterogeneity Coef.	Std. Err.	Heterogeneity u_i Coef.	Std. Err.
Initial poverty status (1995)	-0.006	0.017	0.007	0.016
Lag of poverty status ($t-1$)	0.005	0.015	-0.005	0.015
Households in income activity	-0.0007	0.006	-0.0003	0.006
Households unemployed	0.004	0.009	0.006	0.008
Households size (in log)	0.007	0.030	-0.003	0.028
Family members aged 0-14	0.005	0.006	0.006	0.006
Family members aged 64+	-0.010	0.018	-0.013	0.016
Female household head	0.002	0.017	0.004	0.016
Age of head in years (in log)	-0.008	0.034	-0.003	0.032
Head: public employee	-0.008	0.027	-0.010	0.025
Head: private employee	-0.008	0.032	-0.010	0.031
Head: own account employee	-0.046*	0.024	-0.045**	0.023
Head: casual worker	-0.064	0.060	-0.060	0.055
Head: primary schooling	-0.006	0.020	-0.003	0.019
Head: secondary schooling	0.015	0.019	0.014	0.018
Head: tertiary schooling	0.003	0.024	0.002	0.023
Household expenditure (in log)	-0.049***	0.009	-0.053***	0.009
Relative consumption (in log)	-0.0001	0.048	0.005	0.043
'Iddir' membership only	0.012	0.022	0.011	0.021
'Eqqub' membership only	-0.045	0.064	-0.029	0.054
'Iddir' and 'Eqqub' membership	0.004	0.024	-0.005	0.022
Intercept[a]	6.651***	2.180	6.761***	1.993
Equation: Poor				
Initial poverty status (1995)	0.080***	0.018	0.056***	0.018
Lag of poverty status ($t-1$)	-0.0008	0.016	0.022	0.017
Households in income activity	0.002	0.007	0.002	0.007
Households unemployed	0.026***	0.009	0.026***	0.009
Households size (in log)	-0.153***	0.034	-0.139***	0.032
Family members aged 0-14	0.016**	0.007	0.014**	0.006
Family members aged 64+	-0.017	0.019	-0.021	0.018
Female household head	0.020	0.018	0.016	0.017
Age of head in years (in log)	-0.007	0.037	-0.009	0.035
Head: public employee	-0.025	0.031	-0.020	0.029
Head: private employee	-0.038	0.039	-0.028	0.036
Head: own account employee	-0.032	0.023	-0.034	0.022
Head: casual worker	0.015	0.040	0.009	0.039
Head: primary schooling	-0.008	0.021	-0.009	0.021

Continued on next page...

Table C.5 – continued

Variable	Without heterogeneity Coef.	Std. Err.	Heterogeneity u_i Coef.	Std. Err.
Head: secondary schooling	-0.006	0.022	-0.007	0.022
Head: tertiary schooling	-0.027	0.031	-0.027	0.029
Household expenditure (in log)	-0.159***	0.012	-0.152***	0.011
Relative consumption (in log)	0.069	0.055	0.050	0.050
'Iddir' membership only	0.007	0.024	0.011	0.023
'Eqqub' membership only	-0.004	0.052	-0.001	0.048
'Iddir' and 'Eqqub' membership	0.005	0.026	0.008	0.025
Intercept[a]	16.029***	2.269	14.802***	2.076
σ_1			0.032**	0.015
σ_2			0.024**	0.011
ρ_{12}			-0.999***	0.014
Log likelihood	-1997.020		-1970.640	
Wald $\chi_2(28)$	130.35		144.550	
Prob $> \chi_2$	0.000		0.000	
# Observations	2912			

Notes: [a] Coefficient on intercept is not marginal effect.

Regressions include years and city dummies, not reported here for brevity.

Significance levels: $*$: 10% $**$: 5% $***$: 1%

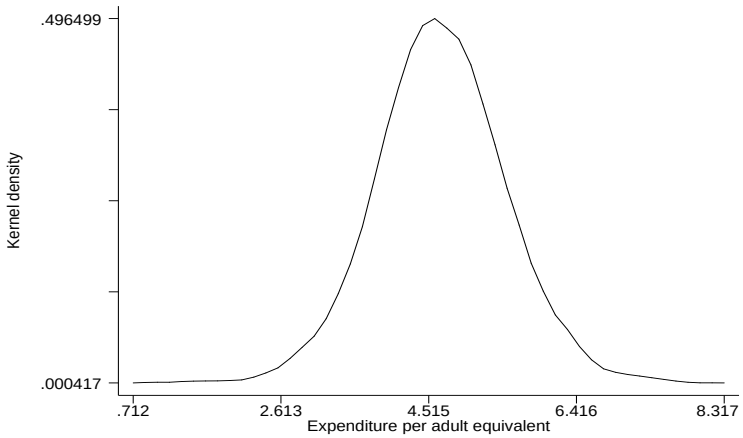

Figure 1 – Distribution of household expenditure per adult equivalent

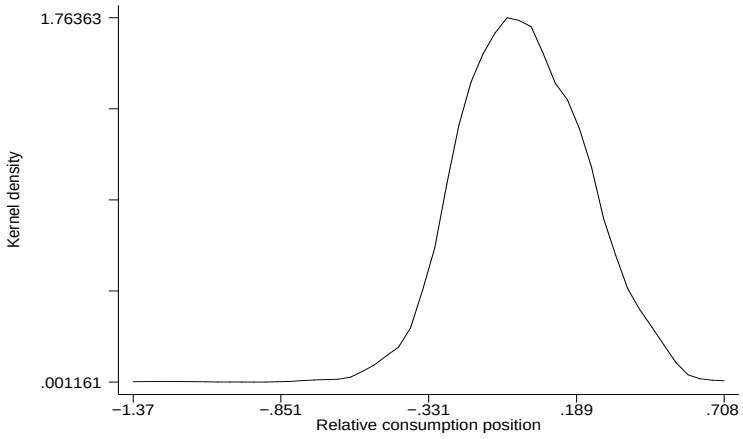

Figure 2 – Distribution of household relative consumption position per adult equivalent

References

Abramowitz, Milton, and Irene Stegun. 1972. *Handbook of Mathematical Functions with Formulas, G raphs, and Mathematical Tables.* New York: Dover Publications.

Alem, Yonas, and Måns Söderbom. 2012. "Household-level consumption in urban Ethiopia: The effects of a large food price shock." *World Development*, 40(1): 146–162.

Chesher, A., and J.M.C. Santos Silva. 2002. "Taste variation in discrete choice models." *Review of Economic Studies*, 147–168.

Clark, Andrew E, and Andrew J Oswald. 1994. "Unhappiness and unemployment." *The Economic Journal*, 104(424): 648–659.

Clark, Andrew E, and Claudia Senik. 2010. "Who compares to whom? the anatomy of income comparisons in Europe." *The Economic Journal*, 120(544): 573–594.

Clark, Andrew E, Paul Frijters, and Michael A Shields. 2008. "Relative income, happiness, and utility: An explanation for the Easterlin paradox and other puzzles." *Journal of Economic Literature*, 95–144.

CSA. 2010. "Population and Housing Census Report-Country." Central Statistical Agency, Federal Democratic Republic of Ethiopia , Addis Ababa.

Fafchamps, Marcel, and Forhad Shilpi. 2003. "Subjective well-being, isolation and rivalry." *Department of Economics, University of Oxford, Oxford*.

Gourieroux, Christian. 2000. *Econometrics of Qualitative Dependent Variables.* Cambridge University Press.

Haan, Peter, and Arne Uhlendorff. 2006. "Estimation of multinomial logit models with unobserved heterogeneity using maximum simulated likelihood." DIW-Diskussionspapiere.

Heckman, James, and Burton Singer. 1984. "A method for minimizing the impact of distributional assumptions in econometric models for duration data." *Econometrica*, 1219–1240.

Herrera, Javier, Mireille Razafindrakoto, and François Roubaud. 2006. "The determinants of subjective poverty: A comparative analysis between Madagascar and Peru." *Document de Travail DIAL. Paris, France: Développement Institutions et Analyses de Long Terme.*

Nguyen Van, Phu, François Laisney, and Ulrich Kaiser. 2004. "The performance of German firms in the business-related service sector: A dynamic analysis." *Journal of Business & Economic Statistics*, 22(3): 274–295.

Ravallion, Martin, and Michael Lokshin. 2002. "Self-rated economic welfare in Russia." *European Economic Review*, 46(8): 1453–1473.

Wooldridge, Jeffrey M. 2005. "Simple solutions to the initial conditions problem in dynamic nonlinear panel data models with unobserved heterogeneity." *Journal of Applied Econometrics*, 20: 39–54.