Simultaneous Random Effect Models of Poverty and Childbearing in Ethiopia

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Abstract

The incidence and severity of poverty in urban and rural Ethiopia are similar – both extremely high. In contrast, urban and rural fertility rates differ substantially. Whereas the Total Fertility Rate (TFR) in rural areas is as high as 5.5, it is as low as 1.9 in Addis Ababa. The declining fertility rate especially in the capital city is paradoxical to economic demographers. This paper analyses the complex relationship between childbearing and poverty in urban and rural Ethiopia. We model child bearing and poverty as joint random effect models, controlling for initial conditions. Using panel data for three (comparable) waves both for rural and urban Ethiopia, our analysis examines the inherent differences in the poverty and fertility relationship.

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Introduction

The relationship between poverty and fertility is a long contested issue among demographers and economists. The general empirical observation that poorer countries tend to have higher population growth rates and that larger households tend to be poorer, underlies the presumption of a positive causal relation between poverty and fertility at the national and household levels respectively. The macro level argument relies on the neo-classical paradigm that higher population growth rate depresses capital accumulation and wages, where poverty in turn is considered a key factor driving high fertility and therefore high rates of population growth, consequently delaying the demographic transition. The standard micro argument is that households relying on primitive farming technologies have a greater need for cheap labour, and therefore a higher demand for children. Lack of state benefits and pensions may also increase demand for children is a means of insurance or security in old age. Consequently perceived costs and benefits of children, and thus fertility behaviour, do not only depend on economic forces and social organisations, but also on cultural patterns.

The issue of poverty and fertility is of course highly relevant in most sub-Saharan countries, including Ethiopia. At an estimated population of 77 million people, Ethiopia is second only to Nigeria - currently sub-Saharan Africa's most populous nation. Moreover Ethiopia's population is growing at a rapid pace, adding some two million people every year. By the year 2050, Ethiopia's population is estimated to grow by an astounding 120 percent, implying that in 44 years, the population of Ethiopia is expected to be around 169 million (Population Reference Bureau). Given that poverty is already dramatically high in Ethiopia and that economic growth has remained modest over the last few decades, suggest that the country may not be prepared to handle the consequences of such a population boom.

In this paper we use longitudinal information and binary response models as means to tap into the causality issue underlying the observed positive correlation between poverty and fertility. A common observation in both developing and developed countries is that those currently poor are also more likely to be poor in the future. This might be due to the simple fact that these households have certain characteristics which might make them particularly prone to poverty. These characteristics may be observed, such as their health status or human capital accumulation, but also unobserved, such as ability, aspirations or intelligence. But the positive relationship between current and future poverty experiences may also be due to state dependence, which is interpreted as a direct causal effect running from current poverty itself. Identification of state dependence from heterogeneity is crucial in order

to assess the effectiveness of policies. In the case of strong state dependence (i.e. current poverty causes future poverty independent of other causes) then poverty reduction policies will be powerful since reducing current poverty will also reduce future poverty experiences. In a *poor* country with *high fertility* rates, such as Ethiopia, the key question is whether fertility provides a causal feedback mechanism onto future poverty experiences, and vice versa. Establishing such causal feedback mechanisms is crucial for appropriate implementation of sensible population and poverty reduction policies. For instance, if the aim is to reduce fertility levels in rural areas, say, then poverty reduction policies might be effective in doing so in so far there is a positive feedback effect from poverty onto fertility. Additionally (or alternatively), in so far fertility has a causal feedback mechanism on reducing future poverty experiences, fertility policies, such as improved family planning, will have an impact on reducing overall poverty. Establishing the magnitude of the two effects is informative since it tells us the extent to which poverty drives high fertility and vice versa.

By using panels from both rural and urban Ethiopia, we specify and estimate a simultaneous and dynamic random effect model of poverty and fertility, controlling for state dependence that allows for feedback mechanisms through poverty and fertility. Clearly, fertility and poverty are not the only intervening factors, so we include a range of background variables, as well as control for unobserved heterogeneity. Whereas poverty is very high in both rural and urban areas, there are substantial differences in terms of fertility. Total fertility rate is as high as 5.5 in rural Ethiopia, but only 1.9 in Addis Ababa, which is by far the largest urban concentration in Ethiopia. Given these rural/urban differentials, we make separate estimates for the two samples.

We find that…. Bla bla

Background

In the traditional micro-economic framework children are considered as an essential part of the household's work force to generate household income, as well as insurance against old age. In rural underdeveloped regions, which largely rely on primitive farming technology and with no or little access to state benefits, this argument makes a great deal of sense. Whereas newly born children may decrease the productivity of the mother either by taking more resources (such as food) from her or hampering her work prospects, children may bring more resources as they grow older through work. Thus deprived households, lacking essential state services and residing in highly primitive farming communities, might have higher demand for

children. However, a high number of children and their participation in household production are likely to impede investment in their human capital (i.e. education), maintaining the low-income status of the household, and thereby creating or perpetuating a poverty - fertility trap. As households gain higher income and wealth, they tend to have fewer children either through quantity-quality trade-off as suggested by Becker and Lewis (1973) or by higher opportunity cost of women associated with higher income as suggested by Willis (1973). These demand side arguments rely of course on the fact that couples are able to make choices and to control fertility outcomes. One crucial component in this respect regards access and take-up of family planning. Poor availability of family planning means that women are less able to plan their fertility careers, implying a significant amount of unintended pregnancies (Easterlin and Crimmins (1985)). In so far family planning is not available, the power of the demand side arguments become weaker, and it becomes difficult to identify the demand side effect from supply side effects. A related issue concerns women's status and empowerment in society. Expansion of female education, thereby reducing women's willingness to give up work for childbearing, is possibly the most important driver behind increased opportunity cost and fertility decline. Consequently fertility reduction is often seen as a direct result of increased empowerment of women through education. Educational infrastructure and educational policies are clearly important as higher compulsory childhood schooling will delay the onset of a young adult's working life, thereby reducing child labour (Livi-Bacci (2000); Badeer (2001)). Lack of education opportunities for women is also a factor that reinforces social norms of women's role and position in society. In many traditional and primitive societies, men's status depends very much on their ability to foster a large family and the household head is considered more successful if they have many children. Such perceptions are likely to be stronger in rural and primitive areas, where there is also stronger gender bias in terms of education (boys go to school – girls stay at home). The consequence is that women's role tend to be limited to childrearing and other household activities. With economic progress and urbanisation, women gain higher education and independence and empowerment (Drovandi & Salvini (2004)). Social norms become weaker, and traditional demographic patterns fade, which is reflected by the demographic transition. Moreover, economic progress reduces labour intensive technologies, which reduces the demand for child labour**.**

Table 1 gives summary data on the demographic and economic conditions prevailing in Ethiopia since 1980[1]. It is immediately clear that Ethiopia is a country where poverty is severe in which more than two-thirds of the population live on less than $2 per day. Despite a series of economic reforms gradually being introduced in the late eighties, the Ethiopian economy remains heavily agriculture-centred with around 85% of households being classified as farmers and by any measure the mode of production is primitive and labour intensive. Provision of family planning services is

also poor, especially in rural areas, and by 2000 the contraceptive prevalence rate (CPR) in rural Ethiopia was only six percent, whereas it was around 45 percent in urban areas[2]. The political history of Ethiopia has obviously hindered progress in health provision and promoting economic reforms. After the traditional monarchy was replaced in 1974 by the provisional military government, much of the Ethiopian economy was nationalised. The 1980s followed with political unrest and upheavals, and the country was plagued by a series of famines, all with devastating effects (Lindstrom and Berhanu (1999)). The fertility rates during this period remained high. However, fertility rates differ dramatically between urban and rural areas. For instance, TFR in Addis Ababa, by far the largest urban concentration in Ethiopia, is as low as 1.9, which is below replacement level. In rural areas, in contrast, the TFR is as high as 6.5 (Kinfu (2000); Sibanda et al (2003)). One issue concerns child labour which is still high in Ethiopia and remains critically important in a heavily agricultural based economy (Admassie (2002)). Moreover, school enrolment and literacy rates, though improving, remain critically low, especially in rural areas.

Table 1: Demographic and economic indicators, Ethiopia

	1980	1990	2000	2003
Total Fertility Rate (TFR)	6.6	6.9	5.7	5.7*
Life expectancy at birth (years)	42.0	45.0	42.3	42.1*
Population Growth (% annual)	2.7	3.7	2.4	2.1
Total Population (in millions)	37.7	51.2	64.4	68.6
Rural population (% of total)	89.5	87.3	85.1	84.4
GDP per capita ($US in 1995 prices)	..	107.3	115.1	115.0
Child labour (% of 10-14 age group)	46.3	43.5	41.1	40.4

*Data refer to 2002, last year available (Source: *World Development Indicators* database)

The dire population problems facing Ethiopia were laid out in the National Population Policy of Ethiopia (NPPE) introduced in 1993. One of the main problems facing Ethiopian Society is that the population has been growing at a faster pace than the economy itself, and the major demographic factor behind this development is the high fertility rate. It also voices concern over the fact there is little indication that fertility rates are bout to decline. A key element of the document is that the policy implications related to the ever growing population should not be limited to provision of health. Rather, population growth, and in particular high fertility rates, is a multifaceted issue that is both a cause and consequence of economic development issues, and is related to education, health provision, private investment, food insecurity, environmental problems, and last but mot least, issue concerning social norms and traditions related to women's role in society. In fact, the document emphasises that the economic, social and political status of women have direct

bearings on the level of fertility. In so far women's roles are defined in terms of household management and matrimonial duties, fertility decisions lies primarily with the household head. Although there are no laws restricting women attending school, the traditional roles of women are reflected and reinforced through a strong gender bias in school attendance. The weak role of women and its relationship to high fertility rates are exacerbated through inadequate family planning. Inefficiency in its delivery together with restrictive legislation has certainly not encouraged the use and spread of modern contraceptives. Objectives of the Ethiopian NPPE encapsulate a range of issues, including closing the gap between population growth and low economic productivity, reducing current TFR from 7.7 down to 4.0, raising the social and economic status of women and increase women's participation in education and removing legal customary practices which currently restrict women's economic and social rights.

Whereas the NPPE emphasises the importance of economic growth and poverty reduction as a means to tackle population growth, mainly through high fertility rates, the Sustainable Development and Poverty Reduction Program (SDPRP) introduced in 2002, and followed up by another SDPDR in 2005, does not say much about the role of population and fertility for poverty reduction. In fact, reduction in population growth through reduced fertility does not appear as a crucial policy instrument to combat poverty. The SDPRP does however make a strong commitment to combat and reduce gender imbalances in Ethiopian society. The SDRPR also put strong focus on education, through increasing enrolment rates and educational infrastructure, though not much emphasis is put on how to reduce strong gender imbalances in education. The SDPRP also emphasises the importance of improving health provision at the community level, but it also states that the health programmes will give priority to prevention of diseases. Very little is said about improving family planning and increasing the use of modern contraceptives. Though, the SDPRP does not mention the population issue specifically, clearly improvements in health provision and education, certainly if the gender dimension is properly addressed, its implementation should have an impact on reducing fertility which is line with the objectives stated in the NPPE.

Urban poverty in Ethiopia is on the increase, and is almost as high as it is in rural areas. The issue of poverty reduction urban areas is therefore important and specifically mentioned in the SDPRP. However, given that around 85 percent of the Ethiopian population lives in rural areas, the overriding priority is put on rural poverty reduction. Naturally agriculture plays a key role and numerous instruments are introduced to improve the economic situation for farmers. Land is state owned and the land policy states that anyone who wants to farm should be given access to land free of charge. This policy, at least in part, explains the domination of small holder

farms. Whereas the SDPRP highlights the importance of cooperation and the need for improved productivity in the agriculture sector, the structure of small land holdings is likely to persist. In other words, the labour intensive dimension of farming is likely to prevail in the future.

Given the data available, it is clear we are unable to address all the policy issues highlighted in the NPPE and the SDPRP. However, using longitudinal data and appropriate econometric techniques, we are able to assess the causal relationship between poverty and fertility, and we are able to do so separately for urban and rural areas. Consequently, the analysis will provide useful information which may complement the policy planning currently adopted.

Empirical Framework

Data

We use both the Ethiopia Urban Household Survey and the Rural Household Survey. Appendix II gives an overview of both surveys. Our analysis is based on the three waves for the urban survey which were conducted in 1994, 1995 and 1997. We also use three waves from the rural survey which are comparable in terms of the period of collection (i.e. first one of the two surveys conducted in 1994, 1995 and 1997). Ethiopia was at war with neighbouring Eritrea from 1998 – 2000. This represents important shock to the economy, and as a result we did not include waves coinciding with this period.

We use several measures of the economic wellbeing of the household. Given the continued focus on poverty, we construct a poverty variable that is based on households' level of consumption expenditure. Poverty status is specified as a discrete state, and is derived from the more general FGT family of poverty measures (Foster, Greer and Thorbecke (1984)). Let ν be the number of household members, *y* be the household's welfare indicator (per capita expenditure) and let τ be the poverty line. In population terms, the FGT index is defined as follows:

$$FGT_{\alpha} = \frac{E\left(\nu\delta_{\alpha}(y)\right)}{E\left(\nu\right)}$$

where *E* is the expectations operator and $\delta_{\alpha}(y)$ is the function:

$$\delta_\alpha(y) = \begin{cases} (1 - y/\tau)^\alpha & \text{if } y < \tau \\ 0 & \text{if } y \geq \tau \end{cases}$$

and $\alpha \geq 0$ is the coefficient of poverty aversion. We operate with two definitions of poverty status. The first is the headcount which is given by $\alpha = 0$ above. This assumes that each household member consumes equal amounts, which of course is a strong assumption. Rather, consumption levels will depend on the age and gender of the household members. Consequently we use the World Health Organisation (WHO) equivalence scale (see Appendix …). The poverty line τ is constructed using the 'cost of basic needs' approach following Ravallion and Bidani (1994). In brief this involves estimating the cost of a certain expenditure level which corresponds to a minimum calorie requirement. A food poverty threshold is defined as the expenditure needed to purchase a basket of goods that will give the required minimum calorie intake. Following FAO recommendations this threshold is set at 2100 calories[3]. Consumption expenditure includes auto-consumption. We use unit conversions as suggested by Dercon (####). More details needed here.

A drawback of the two surveys is that they do not include full retrospective fertility histories. Instead we rely on the household roster which gives the number and ages of children living in the household in addition to recording new births between waves. For the initial conditions (to be explained shortly) we use the number of children as the dependent variable. Clearly this is an approximation to the number of children actually born to the household head, and is strictly speaking not a direct measure of fertility. Children might have died or moved away from the household head, which is not well controlled for in a retrospective sense. However, childbearing between waves refer to actual births and are a reasonable precise measure of fertility outcomes.

Tables 1 to 3 provide descriptive statistics of children and poverty and how they are related to some key variables. Starting with Table 1, which includes the urban sample only, shows that poverty increases with the number of children. Homeownership is also positively associated with children whereas the household head's subjective poverty assessment does not vary much with children. Interestingly, deprivation is lower the more children present in the household. Moving onto Table 2, which gives similar statistics for the rural sample, shows again a positive relationship with the number of children, though the gradient is not as strong as it is in the urban sample. Both land size and amount of livestock are positively related with children, whereas deprivation again declines with higher number of children.

Table 1:

Descriptive statistics urban sample: Means

# children	Poverty	Ownership	Subjective poverty	Deprivation
0	0.261	0.381	0.555	0.668
1	0.335	0.416	0.543	0.642
2	0.393	0.424	0.563	0.650
3	0.462	0.443	0.525	0.630
4	0.503	0.470	0.563	0.630
5	0.604	0.527	0.538	0.629
	0.453	0.456	0.546	0.640

Table 2:

Descriptive statistics rural sample: Means

# children	Poverty	Land size	# livestock	Deprivation
0	0.309	0.774	23.680	0.688
1	0.457	0.796	23.840	0.686
2	0.445	0.846	25.436	0.674
3	0.522	0.995	30.973	0.641
4	0.592	0.936	27.340	0.623
5	0.516	0.947	30.724	0.613
	0.485	0.899	27.905	0.645

Table 3:

Descriptive statistics: Correlations

		Deprivation	High education	Ratio of high education	Land size	Livestock	Subjective poverty	Owner of dwelling
URBAN	Number of children	**-0.069**	**-0.111**	0.045	-	-	-0.01	0.104
	Poverty	**0.395**	**-0.215**	**-0.181**	-	-	**0.334**	**-0.063**
RURAL	Number of children	**-0.258**	-0.045	**0.061**	**0.091**	**0.217**	-	-
	Poverty	**0.210**	**-0.073**	**-0.132**	**-0.096**	**-0.143**	-	-

Table 3 shows simple correlations between key variables where figures in bold are significant at the five percent level. The figures suggest that education is negatively associated with both poverty and childbearing, though the correlation is stronger in urban areas. Interestingly, land size and livestock is positively associated with children in rural areas, but at the same time negatively correlated with poverty.

The econometric specification

There are numerous studies tackling the issue of state dependence and heterogeneity. Examples range from unemployment issues (e.g. Heckman (1978, 1981); Arulampalan et al. (2000)), studies of persistence in low pay (Stewart and Swaffield (1999)) and analysis of poverty persistence (Biewen (2004)). A common approach in these studies is to employ a dynamic binary response model with controls for unobserved heterogeneity. The approach taken here is based on Woodridge (2005), but we make extensions in order to facilitate possible reversed causality between fertility and poverty, and as such the approach is similar to that of Biewen (2004). We start by specifying a simple dynamic random effect probit model for poverty[4]:

$$\Pr(p_{it}=1 \mid x) = \Phi\left(\beta^{p} x_{it}^{p} + \delta^{p} p_{it-1} + \gamma^{p} k_{it-1} + \eta_{i}^{p}\right) \qquad (1)$$

where x_{it}^{p} is the set of assumed exogenous variables, p_{it-1} is the lagged poverty status, k_{it-1} is an indicator for lagged child bearing events, possibly endogenous with respect to poverty status, whereas η_{i}^{p} is the time-invariant and unobserved household effect. As was outlined in the previous section, poverty status is based on the household consumption expenditure, whereas the poverty threshold is derived from a food basket equivalent of 2100 Kcal. Since the consumption expenditure is readily available, we also estimate a specification where economic wellbeing is defined by the log consumption expenditure of the household:

$$\log\left(E_{it}\right) = \beta^{E} x_{it}^{E} + \delta^{E} E_{it-1} + \gamma^{E} k_{it-1} + \eta_{i}^{E} \qquad (1b)$$

[4] With information on the history of poverty and childbearing events, we could (in theory) estimate hazard models in a simultaneous estimation framework. Clearly, in a panel of three waves the poverty history will necessarily be incomplete. Moreover, none of our data sets contain fertility histories, though they could be (incompletely) reconstructed from the household roster.

An obvious advantage of estimating the log consumption expenditure is that we use the whole distribution. The estimates of the log consumption expenditure are reported along side the poverty process in Tables 6, 7 and 8.

In order to ensure consistent and unbiased parameter estimates, η_i^p is assumed independent of the observed covariates. This assumption implies that there is no feedback from the dependent variable onto future values of the explanatory variables, including children and future child bearing events[5]. Several methods have been suggested to deal with these issues. Mundlak (1978) propose a parameterization of the random effect consisting of the mean values of the explanatory variables. Chamberlain (1984) suggests an approach whereby the random effect is specified as a linear regression of all explanatory variables. If there is sufficient within-household variation, separate estimates of the β vector can be obtained and used to identify the correlation between the household specific term and the covariates. Another issue concerns the time dimension of our sample. The observed fertility and poverty histories are certainly incomplete since our sample only includes three waves. As pointed out in Heckman (1981), with lagged response variable and unobserved heterogeneity, a small time dimension relative to the cross-sectional dimension produces inconsistent maximum likelihood estimates. This is commonly known as the initial condition problem and is certainly an issue that needs addressing in this application. Moreover, the random effect η_i^p is unlikely to be independent of the initial values of the poverty process p_{i0}. The initial conditions problem can be solved in different ways. One is to specify the initial conditions to be non-random constant, but implies that the initial conditions are assumed independent of unobserved and observed heterogeneity. The other is to let the initial conditions be random by using the joint distribution of all outcomes on the response conditional on unobserved and observed heterogeneity (Wooldridge, 2005). This approach implies computational challenges, but can be simplified for some important non-linear models. Wooldridge (2005) shows that for the probit, logit, tobit and the poisson, rather than specifying the distribution for the initial conditions separately, the distribution of heterogeneity, including unobserved, can be done by specifying an auxiliary regression for the random effect that includes the initial value of the response variable and strictly exogenous covariates. Whereas this approach offers computational convenience, it also omits interesting information about the initial conditions. Rather than simply specifying an auxiliary regression for the initial condition we estimate its distribution, together with the processes itself, integrating out over the random effect. Though the

[5] This is also known as the strict exogeneity assumption.

approach is computationally less convenient than the Wooldridge (2005), estimation can be done easily in software packages such as aML and MLwin.

In our application concern lies in whether fertility decisions are exogenous with respect to poverty and vice versa. If there is feedback from fertility onto future poverty status, then this violates the strict exogeneity assumption, implying that the random effect is not independent from the explanatory variable measuring fertility. The same will be the case of course if there is feedback from poverty onto future fertility outcomes. As a result we specify a model where poverty and fertility processes are estimated jointly. Whereas the specification of poverty is given according to equation (1), the specification of the fertility process is given the probit specification as follows:

$$\Pr(k_{it} = 1 \mid x) = \Phi\left(\beta^k x_{it}^k + \delta^k k_{it-1} + \gamma^k p_{it-1} + \eta_i^k\right) \tag{2}$$

where x_{it}^k is the set of exogenous covariates, which may or may not be the same as x_{it}^p in equation (1), k_{it-1} is the lagged birth event variable, p_{it-1} is the lagged poverty status and potentially endogenous with respect to childbearing, and η_i^k is the time-invariant household random effect related to childbearing. The initial condition for poverty status is also implemented by a probit model:

$$\Pr(p_{i0} = 1 \mid x_0) = \Phi\left(\beta^{p0} x_{i0}^{p0} + \gamma^{p0} K_{i0-1} + \eta_i^p\right) \tag{3}$$

Similarly, the initial condition for the log of consumption expenditure is given as:

$$\log\left(E_{i0}\right) = \beta^{E0} x_{i0}^{E0} + \gamma^{E0} k_{i0-1} + \eta_i^E \tag{3b}$$

Whereas a probit model can suitably be used for the poverty status in the initial time period, the same is not true for childbearing. Here the initial value will refer to the *number* of children in the first time period and as result we use the Poisson model. In general the Poisson regression model specifies that each outcome, K_{i0}, here the number of children in the initial period, is drawn from a Poisson distribution with parameter λ_i, that is related to the covariates. Using the log-linear model we specify the initial condition for fertility as:

$$\lambda_{i0}^K = \exp\left(\beta^{k0} x_{i0}^{k0} + \gamma^{k0} p_{i0} + \theta \eta_i^k\right) \tag{4}$$

Identification and estimation of equations (1) - (4) entail several important issues. First, equation (3) and (4) require exclusion restrictions over equations (1) and (2) respectively, which implies that for the poverty process some of the variables contained in the set x_{i0}^{p0} are excluded from x_{it}^{p}. Similarly has to be true for the fertility process. Second, note that the initial conditions for poverty, as specified in equation (3), and the poverty process itself, equation (1), contain the same random effect η_i^p. This is also the case for the initial condition for childbearing and the childbearing process, but since the parameters of the Probit enter in a different way than the parameters in the Poisson model, we allow for a scale parameter θ. The lagged variable of the number of children in the household is included in the poverty process, and lagged poverty status is included in the childbearing process, both of which likely to be endogenous, and therefore correlated with the random effects. In order to encompass the correlation, we estimate equations (1) – (4) in a joint Maximum Likelihood procedure, in which then random effects are specified with a joint normal distribution:

$$\begin{pmatrix} \eta_i^F \\ \eta_i^P \end{pmatrix} \sim N\left(\begin{pmatrix} 0 \\ 0 \end{pmatrix}, \begin{pmatrix} \sigma_k^2 & \rho_{pk} \\ \rho_{pk} & \sigma_p^2 \end{pmatrix}\right) \tag{5}$$

In order to ensure identification, rather than including the contemporaneous poverty status, we use the lagged value (see Maddala 1983 for details on identification of simultaneous discrete choice models). By integrating out over the random error components, the observed outcomes are independent and can therefore be estimated by Full Information Maximum Likelihood (FIML). Integration of the error components is done by using quadrature approximation, and estimation is performed by the software package aML.

Though the specification encompasses endogeneity between poverty and fertility, it is assumed that the random effects are still independent of the remaining covariates. This can be dealt with by following Biewen (2004) who parameterize the random effect over the mean (over time) of the remaining covariates.

Results

Initial conditions

We start by presenting the estimates for the initial conditions (IC hereafter) for the rural and urban samples in Tables 5a and 5b, respectively. It is worth noting that the

estimates for the fertility IC remain rather stable with respect to the poverty measure used in the poverty process. In other words, estimation based on per capita poverty, poverty defined over the WHO equivalence scale, or even log of consumption expenditure, does not affect the IC fertility estimates much. As a result we report only one version of the IC fertility estimates (column (1)). In contrast, the parameter estimates of the poverty processes, are more sensitive to the equivalence scale, so here we present estimates based on per capita poverty (column (2)), poverty using the World Health Organisation (WHO) equivalence scale, and the log consumption expenditure – again using the WHO equivalence scale (column (4))[6].

The initial conditions require exclusion restrictions with respect to the dynamic poverty and fertility processes expressed by equations (3) and (4). We construct variables from the first wave that describes characteristics of the household which are of a semi-permanent nature. These include a deprivation index based on possessions of durables and physical characteristics of the dwelling (see Appendix I for a detailed description of the variables). For the urban sample (Table 5a) we include an indicator for home ownership, whether the income situation has improved (based on household head's subjective assessment) over the last five years, whether income levels are deemed sufficient to cover expenditure, and also a subjective poverty assessment, in which the household head is asked to express his view on the household's economic situation. For the rural sample (Table 5b) we control for land size and the amount of livestock, and whether the income situation worsened over the last five years. Unsurprisingly we find the deprivation index to be a strong predictor for poverty levels in both urban and rural areas. Conditional on deprivation (and other covariates) we find land size and livestock to have little impact on poverty levels in rural areas, but significant impact on fertility. Thus, the larger farm in terms of land size and livestock, the higher the demand for children. Having experienced a worsened income situation over the last five years, is associated with higher poverty, but no impact on fertility. For urban areas, unsurprisingly, we find home owners, those with increased income (over the last five years), and sufficient income levels to cover expenditure, to have lower poverty. The estimates also indicate that higher income households (in urban areas) have lower fertility, which reflect higher investment in child quality.

Moving onto the remaining IC parameters, it is interesting to see that once other factors are controlled for, children in *rural* households are not associated with higher poverty, which is in contrast to the pattern reported in Table 2. In urban areas (Table 5b), in contrast, children have a strong positive association with poverty, and there is a clear age gradient; the older the children, the higher the poverty rate. The effects of

[6] Appendix … provides details of the WHO equivalence scale.

children are reflected in the regression where log consumption expenditure is the dependent variable. Again, there is not significant effect of children in rural areas, but a significant negative effect in urban areas. Household composition also matters; more adults are associated with higher fertility, and also higher poverty, though there is a clear difference between rural and urban areas: a large number of women in rural households are linked with higher poverty, whereas in urban households large number of men is associated with higher poverty. Being married is naturally associated with higher fertility in both samples, but no significant effect on poverty or consumption expenditure. Extended households in urban areas, here measured by the number of generations living in the household, tend to be poorer. In rural areas, where extended families are more common, there is not strong association with poverty. In both cases, extended households, possibly reflecting more traditional family norms, have higher fertility.

The work ratios are calculated as the number of working household members over the total household members. Note however, that these are specific to adult men, adult women, and children. A high ratio of men working (in the household) is associated with lower fertility and poverty in urban areas and lower fertility in rural areas. A high female work ratio in rural areas is strongly associated with lower poverty, whereas there is little effect in urban areas. Child labour is also important, and for rural areas, we find that households where children are more likely to work also have higher fertility and higher poverty. Among urban households, the relationship is the opposite; households where children work have lower fertility and also lower poverty, though the latter is not precisely estimated.

The role of education is as expected and in general we find higher education to be associated with lower poverty and lower fertility. However, the parameters are not estimated precisely throughout. Especially in rural areas, we find evidence of non-linear effects, and in terms of the consumption expenditure, there is not much effect from higher education. This is in contrast to urban areas, where higher education is clearly associated with higher levels of expenditure.

Table 5a: Initial Conditions for rural sample

	FERTILITY (1) (who Eq.Sc.)		POVERTY (2) (Per capita)		POVERTY (3) (who Eq.Sc.)		CONS. EXP. (4) (who Eq.Sc.)	
Constant	0.3730		0.6505		-0.1653		3.7880	***
	(0.2601)		(0.7052)		(0.6822)		(0.8190)	
Level of deprivation	-0.1564		1.2467	***	1.5250	***	-1.0469	**
	(0.1353)		(0.3887)		(0.3839)		(0.4116)	
Land size	0.0136	***	-0.0041		-0.0025		0.0176	**
	(0.0032)		(0.0076)		(0.0075)		(0.0081)	
Amount of livestock	0.0034	***	-0.0056	*	-0.0048		0.0003	
	(0.0011)		(0.0032)		(0.0032)		(0.0033)	
Worsened income situation	0.0399		0.4880	***	0.5387	***	-0.2376	**
	(0.0344)		(0.0938)		(0.0916)		(0.1062)	
Children 0 to 4			-0.0067		-0.1093	*	0.0734	
			(0.0640)		(0.0622)		(0.0753)	
Children 5 to 9			0.0593		0.0481		-0.0789	
			(0.0510)		(0.0524)		(0.0632)	
Children 10 to 14			0.0039		0.0410		-0.0612	
			(0.0600)		(0.0587)		(0.0715)	
Age of HH head	-0.0035	***	0.0001		-0.0005		-0.0036	
	(0.0012)		(0.0032)		(0.0032)		(0.0035)	
Number of men in HH	0.1405	***	0.0091		0.0707		-0.0686	
	(0.0146)		(0.0513)		(0.0496)		(0.0566)	
Number of women in HH	0.1264	***	0.1572	***	0.1742	***	-0.0765	
	(0.0117)		(0.0483)		(0.0479)		(0.0608)	
Ration of working men	-0.1425	**	-0.1292		-0.0782		0.1272	
	(0.0566)		(0.1461)		(0.1445)		(0.1557)	
Ratio of working women	0.1187		-0.4835	**	-0.4898	**	0.1897	
	(0.0764)		(0.2007)		(0.1983)		(0.2322)	
Ratio of working children	0.3449	***	0.2100		0.2385	*	-0.1850	
	(0.0517)		(0.1414)		(0.1402)		(0.1575)	
HH head low education	-0.0620		-0.2952	**	-0.3111	**	0.1216	
	(0.0454)		(0.1260)		(0.1253)		(0.1512)	
HH head medium education	-0.1107	*	-0.3725	**	-0.0946		0.0340	
	(0.0570)		(0.1716)		(0.1664)		(0.1936)	
HH head high education	-0.2567	***	-0.7963	*	-0.5846		0.2585	
	(0.0944)		(0.4137)		(0.3884)		(0.4845)	
# of other HH members with high education			-0.0978	*	-0.1159	**	0.0893	
			(0.0563)		(0.0558)		(0.0795)	
# of other HH members with medium education			-0.1109		-0.1163		0.0038	
			(0.1024)		(0.0991)		(0.1140)	
HH head married	0.3973	***	0.0853		0.0268		0.0554	
	(0.0438)		(0.1272)		(0.1284)		(0.1348)	
Number of generations	0.1377	***	0.0257		0.0282		0.0182	
	(0.0310)		(0.0889)		(0.0890)		(0.0965)	

Table 5b: Initial Conditions urban sample

	FERTILITY (1) (WHO Eq.Sc.)		POVERTY (2) (Per capita)		POVERTY (3) (WHO Eq.Sc.)		CONS. EXP. (4) (WHO Eq.Sc.)	
Constant	0.4543	***	-1.8757	***	-1.8841	***	5.2228	***
	(0.1167)		(0.3902)		(0.3929)		(0.1716)	
Level of deprivation	0.1229	***	0.9289	***	1.0052	***	-0.4747	***
	(0.0458)		(0.1911)		(0.2023)		(0.0867)	
Home owner	0.0674	**	-0.3238	***	-0.3055	***	0.1986	***
	(0.0322)		(0.0924)		(0.0957)		(0.0422)	
Income increased	-0.1048	***	-0.5040	***	-0.6010	***	0.2377	***
	(0.0362)		(0.1050)		(0.1136)		(0.0510)	
Income sufficient to cover exp.	-0.0843	***	-0.3718	***	-0.3698	***	0.2017	***
	(0.0304)		(0.0882)		(0.0919)		(0.0402)	
Subjective poverty assessment			0.2681	***	0.2675	**	-0.1605	***
			(0.0986)		(0.1052)		(0.0488)	
Children 0 to 4			0.1828	**	0.0750		-0.0917	**
			(0.0926)		(0.0990)		(0.0418)	
Children 5 to 9			0.1536	**	0.1592	**	-0.1083	***
			(0.0670)		(0.0653)		(0.0313)	
Children 10 to 14			0.2406	***	0.2509	***	-0.1250	***
			(0.0538)		(0.0555)		(0.0256)	
Age of HH head	-0.0073	***	0.0085	**	0.0039		-0.0002	
	(0.0014)		(0.0042)		(0.0042)		(0.0019)	
Number of men in HH	0.1466	***	0.1117	*	0.1636	***	-0.0886	***
	(0.0108)		(0.0580)		(0.0596)		(0.0251)	
Number of women in HH	0.1589	***	0.0968		0.1065	*	-0.0404	
	(0.0115)		(0.0611)		(0.0634)		(0.0275)	
Ratio of working men	-0.0958	**	-0.2952	**	-0.2811	**	0.1981	***
	(0.0444)		(0.1294)		(0.1328)		(0.0581)	
Ratio of working women	-0.0802	*	0.0003		-0.0232		0.0653	
	(0.0485)		(0.1367)		(0.1411)		(0.0577)	
Ratio of working children	-0.7388	**	-2.2314		-1.6372		0.1477	
	(0.3002)		(1.3926)		(1.3232)		(0.3988)	
HH head low education	0.1271	***	-0.1436		-0.1622		0.1725	***
	(0.0479)		(0.1363)		(0.1355)		(0.0621)	
HH head medium education	-0.0182		-0.1237		-0.2492		0.1837	**
	(0.0544)		(0.1729)		(0.1738)		(0.0801)	
HH head high education	-0.1264	**	-0.5156	***	-0.5805	***	0.3681	***
	(0.0515)		(0.1727)		(0.1736)		(0.0769)	
# of other HH members with high education	0.3812	***	-0.0714		-0.0788		0.0279	
	(0.0366)		(0.0562)		(0.0580)		(0.0258)	
# of other HH members with medium education			0.0273		0.0524		-0.0156	
			(0.1005)		(0.0960)		(0.0447)	
HH head married			0.0004		-0.0558		0.0447	
			(0.1161)		(0.1171)		(0.0533)	
Number of generations in HH	0.1304	***	0.3735	***	0.2637	***	-0.1897	***
	(0.0314)		(0.0965)		(0.0980)		(0.0421)	

Random effects

The estimated standard deviations of the random effects and its correlations are presented in Tables 6a and 6b for the rural and urban samples, respectively. The estimated standard deviations of the random effects are highly significant for both processes, both in rural and urban samples. There is also a strong positive correlation between the poverty and fertility processes, though the correlations are weaker in the rural sample. The correlations between the poverty and fertility random effects also reflect the way poverty is defined, and in particular it depends on the equivalence scale used. Comparing columns (2) and (3) in Tables 6a and 6b demonstrates this point clearly. Column (2) shows the correlation when using per capita (or head count) poverty, whereas column (3) shows the correlation when imposing the WHO equivalence scale. Since it gives a smaller weight to younger children, the correlation naturally declines, and in general, the smaller weight assigned to children, the smaller the correlation between the two processes.

Table 6a: Random effects, rural sample

	Without IC (Per capita)		With IC (Per capita)		With IC (who Eq.Sc.)		With IC (Cons. Exp)	
	(1)		**(2)**		**(3)**		**(4)**	
S.D. of RE in fertility process	0.9857	***	1.0164	***	0.9986	***	1.0025	***
	(0.0888)		(0.0907)		(0.0896)		(0.0889)	
S.D. of RE in poverty process	0.3908	***	0.6360	***	0.6043	***	0.6213	***
	(0.1033)		(0.0656)		(0.0671)		(0.0683)	
Correlation of RE	0.0000		0.3326	***	0.2383	**	-0.0730	
			(0.0873)		(0.0935)		(0.1192)	
Theta (scale parameter)			0.2342	***	0.2349	***	0.2319	***
			(0.0337)		(0.0342)		(0.0339)	

Table 6b: Random effects, urban sample

	Without IC (Per capita)		With IC (Per capita)		With IC (who Eq.Sc.)		With IC (Cons. Exp)	
	(1)		(2)		(3)		(4)	
S.D. of RE in fertility process	3.1620	***	3.2886	***	3.3273	***	3.2590	***
	(0.4348)		(0.4547)		(0.4656)		(0.4287)	
S.D. of RE in poverty process	0.3991	***	0.6030	***	0.5964	***	0.5645	***
	(0.1141)		(0.0919)		(0.0905)		(0.0301)	
Correlation of RE	0.0000		0.4562	***	0.3977	***	-0.0517	
			(0.1126)		(0.1113)		(0.0587)	
Theta (scale parameter)			0.0566	***	0.0571	***	0.0545	***
			(0.0107)		(0.0108)		(0.0103)	

It is also worth noting the significance of the scale parameter θ. Specifications where the scale parameter is omitted (not shown here) produces very different correlations between the random effects (generally much stronger). Omitting the scale parameter also influence the parameter estimates of the covariates of interest.

Poverty and fertility processes – rural sample

We move next to analysing the fertility and poverty processes. Tables 7a and 7b provide estimates for the fertility and poverty processes, respectively, for rural households, tables 8a and 8b for the urban sample.

We start by considering the fertility process reported in Table 7a. The dependent variable is birth events occurring between waves and is estimated by probit according to equation (4). Of particular interest, is to assess the effect of lagged childbearing events (state dependence) and the lagged poverty status, the latter reflecting a possible feedback mechanism of poverty on future values of childbearing events. It is immediately clear that controlling for the initial conditions is important; the effect of previous children (i.e. state dependence) changes significantly once IC is estimated jointly with the process itself. In general we find presence of young children to have a strong effect on having another child, whereas the presence of older children has a negative effect. The effect of introducing the IC is not unexpected. Recall that the dependent variable of the IC is the number of children present in the household. Controlling for the IC should therefore weaken the effect of the children in the fertility process, as they themselves reflect the initial conditions. However, independent of the IC, lagged poverty status has no significant effect on childbearing events, suggesting that there is no causal feedback mechanism from poverty onto childbearing. Out of the other variables, we find child labour (here measured by the ratio of children working) to have a positive and significant effect on fertility. We also find household composition to matter, in particular, households with higher number of women present, have a lower likelihood of experiencing a childbearing event. This somewhat counterintuitive result is driven by the positive correlation between household composition and the number of generations living in the household, which has a positive effect on childbearing events. Other important variables include education, and in general we find those with higher education, net of other factors, to have a higher likelihood of experiencing a childbearing event.

Table 7b shows that there is positive state dependence in poverty, though the estimate is sensitive both to the IC and the equivalence scale. Without the IC, state dependence in poverty is over-estimated, whereas it is underestimated when using the head count poverty status. We also see some evidence of feedback from children onto poverty. Introduction of the IC has important effect on the estimates. For

instance, most of the children effects disappear, whereas the effect of having a child birth in the previous time period remains significant. Interestingly, the effect is negative which would suggest that there is some degree of planning of fertility decisions. In other words, child bearing might be more likely if the household experiences more favourable economic circumstances.

It is clear however, after controlling for state dependence and unobserved heterogeneity, only a limited of covariates have powerful explanatory power on poverty. Household composition is again important, larger households measured by the number of men and women, and also the number of generations living in the households, have higher poverty risk. The mechanisms underlying the significant effects are less clear. The use of equivalence scales is behind part of the story, but not all. Larger households may be a reflection of economic hardship. If it is the case that individuals choose to share the dwelling as a means to cope economically, then this would explain the positive relationship to poverty. To some extent this would also explain the negative effect with respect to fertility, since couples might try to reduce their fertility during extreme economic hardship. Certainly, in an environment where family values are important and where there are no social support schemes run by the state, living arrangement in extended families are common. As a coping mechanism relatives and friends who face economic hardships rely on each other for support, one solution being shared accommodation. The fact that extended families (again measured by the number of generations living in the households) are positively associated with poverty is therefore not unexpected. Interestingly, these households also face higher fertility levels (i.e. Table 7).

Child labour also play an important role, as we find a strong and significant effect of child labour on poverty. As we have already seen from Table 7, households with high levels of child labour also increases fertility. The effect of child labour in rural areas is particularly interesting. It is positive, and become stronger once we control for the IC. The estimates suggest that higher child labour produces higher poverty, and is interesting given that child labour is also associated with higher fertility

Table 7a: RANDOM EFFECT MODELS OF CHILDBEARING, RURAL SAMPLE

	Without IC		With IC Per capita Pov.		With IC WHO Eq.Sc.		With IC WHO Eq.Sc.	
Constant	-0.6760		-0.6518		-0.7279	*	-0.6674	
	(0.4177)		(0.4300)		(0.4232)		(0.4346)	
Lagged poverty status	-0.0039		-0.0049		-0.0051			
	(0.0057)		(0.0053)		(0.0053)			
Lagged log consumption exp.							0.0020	
							(0.0265)	
Children 2 to 4	0.1990	***	0.1251	**	0.1409	***	0.1422	***
	(0.0513)		(0.0521)		(0.0517)		(0.0516)	
Children 5 to 9	0.2064	***	0.0172		0.0230		0.0309	
	(0.0505)		(0.0523)		(0.0513)		(0.0512)	
Children 10 to 14	0.0035		-0.1822	***	-0.1921	***	-0.1969	***
	(0.0567)		(0.0578)		(0.0572)		(0.0566)	
Age of HH head	-0.0432	***	-0.0465	***	-0.0453	***	-0.0456	***
	(0.0039)		(0.0039)		(0.0038)		(0.0038)	
Number of men in HH	-0.0826	*	-0.0751		-0.0789	*	-0.0751	
	(0.0479)		(0.0466)		(0.0461)		(0.0462)	
Number of women in HH	-0.2028	***	-0.1825	***	-0.1703	***	-0.1733	***
	(0.0557)		(0.0564)		(0.0558)		(0.0550)	
Ratio of working men	-0.1582		-0.1234		-0.0699		-0.0998	
	(0.1736)		(0.1706)		(0.1656)		(0.1658)	
Ratio of working women	0.0715		0.0816		0.0714		0.0734	
	(0.1905)		(0.1930)		(0.1903)		(0.1892)	
Ratio of working children	0.3787	***	0.5005	***	0.4586	***	0.4663	***
	(0.1439)		(0.1459)		(0.1418)		(0.1423)	
HH head low education	0.2300	*	0.2108		0.2183	*	0.2106	*
	(0.1299)		(0.1303)		(0.1268)		(0.1277)	
HH head medium education	0.3554	**	0.3448	**	0.3555	**	0.3464	**
	(0.1471)		(0.1428)		(0.1386)		(0.1401)	
HH head high education	0.1893		0.1944		0.1829		0.1796	
	(0.1515)		(0.1485)		(0.1409)		(0.1411)	
HH head married	1.4523	***	1.5590	***	1.5440	***	1.5659	***
	(0.1722)		(0.1729)		(0.1686)		(0.1682)	
Number of generations	0.4118	***	0.4744	***	0.4883	***	0.4847	***
	(0.1019)		(0.1014)		(0.1006)		(0.1010)	
Farm household	0.0256		0.0455		-0.0012		-0.0144	
	(0.1578)		(0.1541)		(0.1521)		(0.1509)	
Fhhhamh	-0.1799		-0.1779		-0.2184		-0.2797	
	(0.2381)		(0.2381)		(0.2298)		(0.2304)	

Table 7b: RANDOM EFFECT MODELS OF POVERTY, RURAL SAMPLE

3	(1) Without IC		(2) With IC Per capita Pov.		(3) With IC WHO Eq.Sc.		(4) With IC WHO Eq.Sc.	
Constant	0.4884		0.6477	*	0.4675		3.3786	***
	(0.3212)		(0.3713)		(0.4125)		(0.5415)	
Lagged poverty status	0.2049	***	0.0076		0.1396	*		
	(0.0566)		(0.0809)		(0.0764)			
Lagged log consumption exp.							-0.0284	
							(0.0265)	
Children 0 to 1	-0.1787	***	-0.0701		-0.1422	**	0.0022	
	(0.0541)		(0.0673)		(0.0644)		(0.0852)	
Children 2 to 4	-0.0948	**	-0.0231		-0.0430		0.0499	
	(0.0483)		(0.0542)		(0.0545)		(0.0862)	
Children 5 to 9	0.0750	**	0.0924	**	0.0511		-0.0300	
	(0.0366)		(0.0419)		(0.0414)		(0.0707)	
Children 10 to 14	0.0879	**	0.0395		0.0670		-0.0643	
	(0.0400)		(0.0474)		(0.0454)		(0.0691)	
Age of HH head	-0.0038	*	-0.0026		-0.0008		-0.0002	
	(0.0021)		(0.0024)		(0.0024)		(0.0032)	
Number of men in HH	0.0341		0.0292		0.0927	**	-0.0433	
	(0.0352)		(0.0395)		(0.0390)		(0.0640)	
Number of women in HH	0.0845	**	0.0876	**	0.0872	**	-0.0603	
	(0.0346)		(0.0392)		(0.0376)		(0.0571)	
Ratio of men working	-0.0151		0.0089		0.0262		0.1362	
	(0.1030)		(0.1173)		(0.1111)		(0.1787)	
Ratio of women working	0.1456		0.1746		0.0868		-0.1570	
	(0.1151)		(0.1293)		(0.1303)		(0.1595)	
Ratio of children working	0.1765	**	0.3127	***	0.3422	***	-0.2494	**
	(0.0868)		(0.0955)		(0.0953)		(0.1267)	
HH head low education	0.0062		-0.0351		-0.0044		0.0278	
	(0.0873)		(0.1020)		(0.1039)		(0.1467)	
HH head medium education	0.1658		0.1154		0.0914		-0.1545	
	(0.1080)		(0.1237)		(0.1264)		(0.1638)	
HH head high education	0.0919		0.0209		0.0972		0.0011	
	(0.1179)		(0.1340)		(0.1275)		(0.1885)	
# of other members with	-0.1505	***	-0.1435	***	-0.1534	***	0.0983	
high education	(0.0392)		(0.0434)		(0.0429)		(0.0699)	
# of other members with	-0.0965		-0.0845		-0.1168		0.1349	
medium level education	(0.0676)		(0.0777)		(0.0766)		(0.1294)	
HH head married	0.1734	*	0.1657	*	0.0409		-0.0373	
	(0.0892)		(0.1001)		(0.0961)		(0.1128)	
Number of generations	0.2624	***	0.2780	***	0.1870	***	0.0096	
	(0.0598)		(0.0672)		(0.0640)		(0.0937)	
Farm household	-0.2217	**	-0.2597	**	-0.2178	**	0.1564	
	(0.0908)		(0.1062)		(0.1041)		(0.1671)	

Poverty and fertility processes – urban sample

Starting with the fertility process, we see again that lagged poverty status has no impact on fertility outcomes. The role of past childbearing events is however, very different to those of the rural sample. Whereas, in the rural case, the presence of young children encouraged further childbearing, the opposite pattern is the case in urban Ethiopia. Of course, this is a reflection of the very different fertility patterns in urban and rural Ethiopia. As was the case in the rural sample, controlling for the initial conditions have the expected effect of reducing the impact of past childbearing events. Other than past fertility events, age of the household head, and marital status, not many covariates appear important in explaining urban fertility. The most important is the male work ratio, which reflects an income effect.

There is considerably more action in the poverty process. Compared to the rural sample we find considerably stronger state dependence in poverty. The negative effect of childbearing might at first seem non-intuitive given descriptive statistics presented previously, which showed a positive relationship between poverty and the number of children. The explanation lies in the inclusion of the lagged dependent variable (i.e. state dependence). Since children are positively related to poverty, inclusion of the lagged poverty status brings about the negative coefficient associated with young children. However, older children (aged 10 to 14) bring about a positive effect on poverty. The effects of lagged poverty and children persist in the urban sample once controlling for the IC. The effects are, however, significantly weaker. Thus we observe a high level of poverty persistence in urban areas, and once controlling for this persistence, child bearing events do not bring about a higher level of poverty.

Several other factors explain poverty in urban Ethiopia. As with the rural sample, the number of adults and generations in the household is always associated with higher poverty. Thus pooling of resources and accommodation is an important coping mechanism also in urban areas. Employment is clearly important in alleviating poverty, as reflected in the negative coefficient on the make work ratio. The coefficients on the children and female work ratios are also negative, but never significant.

In contrast to rural Ethiopia, education has a much stronger impact on poverty alleviation. In urban areas, completing primary, secondary and higher education, all reduces the poverty incidence, and with completion of higher education has the most pronounced impact.

Table 8a: RANDOM EFFECT MODELS OF CHILDBEARING, URBAN SAMPLE

	Without IC		With IC Per capita Pov.		With IC WHO Eq.Sc.		With IC WHO Eq.Sc.	
Constant	-3.5650	**	-2.8931	**	-2.7876	**	-2.7731	**
	(1.4032)		(1.2606)		(1.2840)		(1.2379)	
Lagged poverty status	0.0100		0.0079		0.0090			
	(0.0087)		(0.0110)		(0.0110)			
Lagged log consumption exp.							0.0091	
							(0.0106)	
Children 2 to 4	-0.7997	***	-1.1301	***	-1.1666	***	-1.1457	***
	(0.2991)		(0.2925)		(0.2940)		(0.2922)	
Children 5 to 9	0.4518	***	0.1333		0.1210		0.1364	
	(0.1284)		(0.1456)		(0.1459)		(0.1472)	
Children 10 to 14	0.3665	**	-0.1082		-0.1074		-0.1013	
	(0.1760)		(0.1920)		(0.1925)		(0.1899)	
Age of HH head	-0.0912	***	-0.0895	***	-0.0962	***	-0.0922	***
	(0.0193)		(0.0212)		(0.0227)		(0.0224)	
Number of men in HH	-0.0823		-0.2401		-0.2441		-0.2345	
	(0.1448)		(0.1554)		(0.1578)		(0.1547)	
Number of women in HH	-0.2717	**	-0.1606		-0.1602		-0.1641	
	(0.1237)		(0.1280)		(0.1285)		(0.1283)	
Ratio of men working	1.0520	**	1.4155	***	1.4130	***	1.3297	***
	(0.4541)		(0.4486)		(0.4532)		(0.4385)	
Ratio of women working	0.2538		0.3244		0.3629		0.3578	
	(0.3695)		(0.4030)		(0.4124)		(0.3996)	
Ratio of children working	2.0269		3.3737		3.4526		3.4147	
	(3.2258)		(2.2817)		(2.3134)		(2.1769)	
HH head low education	0.2693		0.6530		0.6795		0.6103	
	(0.6635)		(0.6082)		(0.6117)		(0.6106)	
HH head medium education	0.1952		0.2308		0.1714		0.1913	
	(0.6803)		(0.5505)		(0.5529)		(0.5481)	
HH head high education	0.1201		-0.0772		-0.1524		-0.1750	
	(0.6428)		(0.5203)		(0.5198)		(0.5098)	
HH head married	2.5616	***	2.4028	***	2.4923	***	2.4319	***
	(0.6754)		(0.5946)		(0.6096)		(0.5789)	
Number of generations	0.5626		0.4821		0.5336		0.5050	
	(0.4100)		(0.3595)		(0.3664)		(0.3820)	

Table 8b: RANDOM EFFECT MODELS OF POVERTY, URBAN SAMPLE

	Without IC (Per capita)		With IC (Per capita)		With IC (WHO Eq.Sc.)		With IC (Cons. Exp)	
Constant	-0.1399		-0.0546		-0.2896		4.3249	***
	(0.2669)		(0.2979)		(0.2975)		(0.3636)	
Lagged poverty status	0.9568	***	0.7313	***	0.7341	***		
	(0.0578)		(0.0969)		(0.0909)			
Lagged log consumption exp.							-0.0168	
							(0.0131)	
Children 0 to 2	-0.6789	***	-0.5764	***	-0.5718	***	0.1101	
	(0.0902)		(0.1112)		(0.1009)		(0.1713)	
Children 3 to 4	-0.3118	***	-0.1951	**	-0.2005	**	0.0299	
	(0.0846)		(0.0980)		(0.0957)		(0.1690)	
Children 5 to 9	0.0222		0.0292		0.0265		-0.1042	
	(0.0489)		(0.0556)		(0.0545)		(0.0839)	
Children 10 to 14	0.2591	***	0.2371	***	0.2098	***	-0.1481	*
	(0.0476)		(0.0539)		(0.0520)		(0.0829)	
Age of HH head	-0.0017		-0.0002		0.0012		-0.0054	*
	(0.0030)		(0.0033)		(0.0033)		(0.0029)	
Number of men in HH	0.1214	***	0.1209	**	0.1913	***	-0.1758	***
	(0.0463)		(0.0519)		(0.0528)		(0.0601)	
Number of women in HH	0.1199	***	0.1262	**	0.1132	**	-0.1135	*
	(0.0454)		(0.0500)		(0.0502)		(0.0687)	
Ratio of working men	-0.2500	***	-0.2956	***	-0.3084	***	0.3096	**
	(0.0953)		(0.1058)		(0.1054)		(0.1408)	
Ratio of working women	-0.0747		-0.0994		-0.0768		0.2693	
	(0.1023)		(0.1132)		(0.1163)		(0.1728)	
Ratio of working children	-0.5508		-0.6946		-0.6999		0.2999	
	(0.5991)		(0.6967)		(0.6627)		(0.7842)	
HH head low education	-0.3131	***	-0.3552	***	-0.3628	***	0.3796	**
	(0.1065)		(0.1195)		(0.1188)		(0.1541)	
HH medium education	-0.2004		-0.2619	*	-0.2677	*	0.1900	
	(0.1293)		(0.1429)		(0.1448)		(0.1533)	
HH high education	-0.5282	***	-0.6771	***	-0.5769	***	0.4981	***
	(0.1259)		(0.1436)		(0.1450)		(0.1797)	
Ratio of other HH members with high education	-0.1616	***	-0.1639	***	-0.1911	***	0.1811	***
	(0.0436)		(0.0482)		(0.0488)		(0.0619)	
Ratio of other HH members with medium education	-0.0528		-0.0800		-0.1248		-0.0065	
	(0.0701)		(0.0791)		(0.0807)		(0.1186)	
HH head married	-0.0245		-0.0372		-0.0880		0.3312	***
	(0.0851)		(0.0949)		(0.0961)		(0.1240)	
Number of generations	0.1149	*	0.1423	*	0.1236	*	0.0048	
	(0.0667)		(0.0729)		(0.0737)		(0.0931)	

Concluding Discussion

The relationship between fertility and poverty is complex. Whereas many low-income countries has experienced substantial decline in TFR, sub-Saharan fertility levels have remained high, together with consistently high poverty levels. The contributing factors are of course many, including poor employment prospects, primitive production technology in rural areas, lack of family planning, low education and poor education infra structure, and last but not least, strong social norms associated with women's role in society. Whereas much has been said about the associations between poverty and fertility, existing data sources have prevented analysis of a more causal nature. Using longitudinal data set from three comparable waves from rural and urban Ethiopia together with random effect models, our paper goes little further in terms of establishing causal mechanisms.

An important finding of our paper is the issue of state dependence in poverty. This is particularly strong in urban Ethiopia, and suggests that experiencing poverty tend to bring about further poverty in the future. There is also evidence of some state dependence in rural poverty, but there the estimates are somewhat sensitive to the equivalence scale. There is also state dependency in childbearing, in that past fertility events tend to influence further childbearing. However, state dependence in children has opposite signs in the rural and urban samples. Whereas recent childbearing events in urban areas tend to discourage further childbearing, it encourages more children in rural areas. However, we find very little evidence of any causal feedback mechanism from poverty onto fertility, independent of the sample used. Moreover, the feedback from childbearing onto poverty is also quite weak once state dependence is controlled for.

One of the most important findings of our study is the significance of child labour as a mechanism influencing both fertility and poverty. Whereas we do not find any significant effects in urban areas, possibly due to small sample size, we do find that child labour increases both fertility and poverty in rural areas. These differences have important policy implications, and suggest the need to abolish child labour, especially in rural areas, so that Ethiopian children are granted the chance to allocate their time for productive uses such as attending schools. The issue of child labour is likely to be an important contributor in perpetuating intergenerational poverty traps. Reducing child labour enhances children's chance of becoming non-poor adults in the future. Our results support therefore the policy recommendations in SPRPR, which highlights the importance of increasing enrolment rates in rural Ethiopia. Of course, rural Ethiopia are still facing endemic school drop out rates, and poor education infra

structure. Much more is needed. (elaborate on the issues lied out in SDRPR concerning education).

We also find that household composition matters. In particular we find that the more adults present in the household, the higher is poverty. This is consistent with our regressions using log of consumption expenditure. We also find that extended household where there are more than two generations living in the household (e.g. presence of grand parents) are not always more likely to be poor, but also have higher fertility. On one hand large families might simply reflect traditional coping mechanisms where friends and relatives pool resources to deal with economic hardship. However, our measure of extended family relations might also reflect more traditional attitudes and social norms, in which men are perceived successful if they have many children, and women are expected to specialise in household production and rearing of children. In so far this is the case, presence of social norms is potentially important in explaining both higher fertility and higher poverty.

Our analysis also shows that education have strong explanatory power in rural Ethiopia, both for fertility and poverty. As expected, higher levels of education either of the household head or other household members, reduced poverty incidence. The role of education is not equally strong in rural areas. This is perhaps not unexpected. First, the distribution of education in rural areas is highly skewed in that very few have any formal education. Illiteracy rates are still extremely high in rural areas. Another issue is related to the fact that rural Ethiopia is dominated by primitive agriculture, in which the return to schooling might not be particularly high. Consequently, our study suggest that there is a great need to increase enrolment rates partly to offset the high incidence of child labour, but also that investment in higher education might not yet be the most sensible policy. In other words, in terms of policy implication, it is important that the government ensure that not only more children attend school, but also that they reduce the drop out rate. Our analysis also shows that both improved labour market and educational opportunities and improvements in family planning – preferably both – should have a substantial impact on reducing poverty in Ethiopia. Problem is that we don't really show directly that lack of family planning is important – i.e. there are no variables measuring the level of family planning.

For the urban sample, a similar analysis can be conducted due to the presence of income data which can be complied from different disaggregated components (such as business income, wage income, pension income, remittance income, and income from female/children economic activity). As an extension, we would also like to conceptualise our joint estimation in a structured theoretical framework. From an econometric point of view, there are outstanding empirical issues such as sensitivity analysis of our results with respect to the equivalence scale. As a result we need to

estimate equivalence scales fitting Engel curves using data from the surveys themselves. To demonstrate the robustness of our analysis, we will also use several measures of household wellbeing by using different adult equivalence scales. Hence we explore the data further more carefully to discuss the implications of our study in much more detail.

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Appendix I:

World Health Organization equivalence scales

```
gen eq1 = 0.33 if age<=1
replace eq1 = 0.46 if age>1&age<=2
replace eq1 = 0.54 if age>2&age<=3

replace eq1 = 0.62 if age>3&age<=5

replace eq1 = 0.74 if age>5&age<=7&sex==1
replace eq1 = 0.70 if age>5&age<=7&sex==2

replace eq1 = 0.84 if age>7&age<=10&sex==1
replace eq1 = 0.72 if age>7&age<=10&sex==2

replace eq1 = 0.88 if age>10&age<=12&sex==1
replace eq1 = 0.78 if age>10&age<=12&sex==2

replace eq1 = 0.96 if age>12&age<=14&sex==1
replace eq1 = 0.84 if age>12&age<=14&sex==2

replace eq1 = 1.06 if age>14&age<=16&sex==1
replace eq1 = 0.86 if age>14&age<=16&sex==2

replace eq1 = 1.14 if age>16&age<=18&sex==1
replace eq1 = 0.86 if age>16&age<=18&sex==2

replace eq1 = 1.04 if age>18&age<=30&sex==1
replace eq1 = 0.80 if age>18&age<=30&sex==2

replace eq1 = 1.00 if age>30&age<=60&sex==1
replace eq1 = 0.82 if age>30&age<=60&sex==2

replace eq1 = 0.84 if age>60&sex==1
replace eq1 = 0.74 if age>60&sex==2
```

Endnotes

[1]All figures quoted in this section come from the *World Development Indicators* database (see http://www.worldbank.org/data/wdi2004/)

[2] The urban population in Ethiopia is about 15 percent of the total.

[3] The poverty line for Ethiopia controls for regional prices, including controls for urban and rural areas.