A SIMULTANEOUS RANDOM EFFECT MODEL OF POVERTY AND CHILDBEARING: EVIDENCE FROM ETHIOPIA[1]

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Abstract

The incidence and severity of poverty in urban and rural Ethiopia are similar – both at very high levels. In contrast, urban and rural fertility rates differ dramatically. 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 processes and use a joint (simultaneous) estimation technique using FIML (Full Information Maximum Likelihood). In a panel probit context, we assumed non-zero correlation between the household specific random effects of our fertility and poverty equations. We have included fertility variables as endogenous regressors in the poverty equation and poverty indicator variable as an endogenous regressor in the fertility equation. Using a panel data for three (comparable) waves both for rural and urban Ethiopia, our analysis examines the inherent differences in the poverty and fertility relationship. Among others, child labour is a significant factor for high fertility in rural areas. Surprisingly, it is also a factor which is responsible for increasing the probability of poverty incidence at the household level. The possible implications of our results include the provision of improved family planning services, social support, labour market conditions and educational services both in rural and urban Ethiopia.

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"At an estimated population of 77 million people, Ethiopia is second only to Nigeria - currently sub-Saharan Africa's most populous nation. And Ethiopia's population is growing at a rapid pace, adding some two million people every year. Experts are warning the Horn of Africa nation may not be prepared to handle the consequences of such a population boom. By the year 2050, the Washington-based Population Reference Bureau says Ethiopia's population will grow by an astounding 120 percent. That means in 44 years, the population of Ethiopia is expected to be around 169 million people". March 8, 2006 (VOA News)

1. 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. 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 as a means of insurance or security in old age. Consequently perceived costs and benefits of children, and thus fertility behaviour, depend not only on economic forces and social organisations but also on cultural patterns. As such the poverty and fertility relationship is contingent upon social and institutional characteristics, including education, family planning and health services. However, these factors do not remain constant over time. Over the last two decades developing countries have shown rather different paths in terms of the fertility transition and economic progress. Some countries have witnessed sharp fertility decline and impressive economic growth, whereas others have remained static with high fertility levels, low economic growth and persistent poverty.

There is a rather substantial literature concerned with the interaction of poverty and fertility[1]. However, the great majority has relied either on cross sectional or aggregate level data. We revisit this issue by exploiting recent longitudinal micro level data. By emphasising the dynamic aspect of poverty and fertility, we produce new insights which cannot be derived from cross sectional data. In particular, we assess to what extent children are associated with poverty among households and the role of poverty on fertility behaviour by estimating both processes simultaneously using the aML (applied Maximum Likelihood) procedure. Given the richness of the micro level data we also assess the role of human capital and other important background variables. We perform the analysis for Ethiopia using panel data sets collected both from urban and rural area. Relative to other developing countries, Ethiopia is still facing high levels of fertility, low economic growth, and extreme poverty.

Of course the use of longitudinal data has also its drawbacks: available panel data for developing countries, which includes information both on fertility and consumption expenditure, are few and less comprehensive than panels available for developed countries. Nevertheless, the use of longitudinal data fills an important gap in this literature, and our study should be seen as a first step until more and longer panels for developing countries become available.

We find that in a cross sectional perspective there is always a positive association between poverty and number of children. However, our dynamic analysis shows that poor households do not necessarily have a higher rate of fertility, but households with many children (i.e. high fertility) tend to have a higher rate of entering poverty and lower rate of exiting poverty. The persistence of high levels of fertility and poverty in Ethiopia is driven by lack of economic growth and poor access to family planning, education and health provisions.

3. Previous Research

The existing literature, mainly based on either cross sectional or aggregate data, shows that the relationship between poverty and fertility is not unidirectional. Whereas many studies suggest a positive relationship between poverty and fertility, others find it to be negative, and yet others find it to have an inverse J-shaped

[1] Birdsall and Griffin (1988) and Birdsall et al (2001) provide excellent overviews of the issue of poverty and fertility.

relationship. The literature has tried to reconcile these discrepancies by differentiating countries by their level of economic development and demographic transition. Within the poorest countries, the relationship between poverty and fertility is often negative (Lipton 1998; Livi-Bacci and di Santis 1998). Studies from the 60s and the 70s pointed to such patterns in rural areas of Bangladesh, India, Indonesia, Pakistan and Sierra Leone. The most common relationship between poverty and fertility in contemporary less developed countries is, however, positive. For instance, countries with low fertility levels during the eighties and the nineties (TFR less than 3.5 – including Vietnam, Costa Rica, urban Paraguay, and urban South Africa) and with high fertility levels (TFR above 4.5, e.g. Guatemala, Cameroon, Bolivia, Calcutta in India, Belize), as well as medium level fertility (TFR between 3.5 and 4.5, e.g. Mexico, rural India, rural South Africa, Brazil, El Salvador, Ecuador, Paraguay), all show a positive relationship. Schoumaker (2004) using DHS surveys from sub-Saharan African countries supports a general positive relationship.

There are, however, many cases where the positive relationship between poverty and fertility is rather weak. Examples include countries in demographic pre-transitional phases with very high TFR (e.g. Costa Rica, urban Sudan, Iran, Burkina Faso, Pakistan, urban India, rural Philippines) and also during the 90s in countries with relatively low fertility TFR (i.e. less than 3.5, such as in urban Morocco). In some cases, such as rural areas of India and Cameroon where fertility rates are very high, the relationship takes the inverse “J shape”, implying that both low and high-income households have lower rates of fertility, whereas medium level income households have higher fertility. It is argued that very low income households tend to be landless farmers, hence less reliant on children as cheap labour, whereas those with the highest income has lower fertility due to higher investment in child quality. The middle income families are landholding farms which depend on cheap labour, and therefore have a higher demand for child quantity, which explains the apparent inverse J-shaped relationship (see Schoumaker and Tabutin 1999 for further details).

Of course all of the studies referred to above are based on cross-sectional data, and as far as we are aware none have looked at the relationship in a dynamic perspective. However, with the emergence of longitudinal data, research on poverty dynamics for developing countries is now emerging, though emphasis on fertility is still limited. Examples of this literature include Jalan and Ravallion (2000) using a panel from rural China focussing on the issue of transient and chronic poverty;

Mcculloch and Baulch (2000) using a five-year panel of 686 households from rural Pakistan showing that large reductions in poverty can be achieved through policies aiming at smoothing household incomes – simply because a large part of poverty is indeed transitory; Dercon and Krishnan (2000) using three waves of the Ethiopian Rural Household Panel (ERHP) show that individual consumption levels vary widely by year and season, and indicate that a much larger proportion of households are vulnerable to poverty than what cross sectional poverty statistics may suggest[1]. Other examples of detailed analysis of poverty dynamics include Kedir and McKay (2004), using the Ethiopian Urban Household Panel (EUHP), Bigsten et al (2003) using both the ERHP and the EUHP, and Justino and Litchfield (2001) analysing poverty dynamics in Vietnam.

4. Theoretical Considerations and Country Description

A positive relationship between fertility and poverty is frequently explained in a micro-economic framework: children are considered as an essential part of the household's work force to generate household income, and 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. By acquiring children the share of household resources available for each member will decrease. Moreover, 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. Though childbearing may reduce a woman's working time or decrease her productivity in the short run, children may bring more resources as they grow older through work. As such the overall net effect of childbearing on poverty is not necessarily clear cut. 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 often 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).

[1] Baulch and Hoddinott (2000) summarises these findings by suggesting that the pool of poor households consist of both chronic poor and transitory poor, where the latter is surprisingly large, and this is the case independent of whether poverty is measured in relative or absolute terms.

These demand side arguments rely of course on the fact that couples are able to make choices about their fertility. The crucial component in this respect regards access and take-up of family planning. Poor availability of family planning means that women will not be able to plan their fertility career very well, implying a significant amount of unintended pregnancies (Easterlin and Crimmins 1985). There is a negative (though not always strong) relationship between availability of family planning and observed fertility levels (just as there is a negative relationship between economic growth and fertility). In other words, family planning is often more prevalent in countries that have experienced a great deal of economic progress, which is reflected by a higher contraceptive prevalence rate among households with higher human capital and wealth. In particular, women with higher earnings and high education are more likely to use modern contraceptives. The upshot of this is that identification of supply side effects from demand side effects are difficult to establish. For instance, family planning tends to be lacking in rural areas. This is where we also observe higher fertility rates. However, rural households may also have higher demand for children because of access to cheap labour and old age security[1].

It is useful to assess to what extent the simple theoretical predictions fit into the Ethiopian fertility-poverty situation. Table 1 gives summary data on the demographic and economic conditions prevailing in Ethiopia since 1980[2]. It is immediately clear that Ethiopia is a country where poverty is severe and 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 rural 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[3]. 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

[1] See Rosenzweig and Schultz (1985) for an approach where supply side effects are separated from demand side effects.
[2] All figures quoted in this section come from the *World Development Indicators* database (see http://www.worldbank.org/data/wdi2004/)
[3] The urban population in Ethiopia is about 15 percent of the total.

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, as depicted in Figure 1, remained high. Table 1 also shows other interesting factors that are correlated both with fertility levels and economic development. 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, especially in rural areas, are extremely low.

Though these descriptive statistics suggest that as countries progress in their economic development, fertility rates also tends to decline, this is not generally the case. An important issue concerns urban/rural differentials. Periods of strong economic growth is often followed by a decline in the rural population due to migration. Ethiopia has experienced only a very modest growth in GDP and rural to urban migration has been less pronounced. There have been few economic reforms in the Ethiopian agricultural sector, and the current system is still characterised by state control, with very limited commercial/private land ownership. Moreover, land tenure arrangements are a highly contentious issue in the Ethiopian agricultural sector, and there is a high level of uncertainty associated with future land redistribution. Such uncertainties may cause disincentives for farmers' own investment in enhancing farm productivity. It is also possible to hypothesise that future if land distribution will depend directly on family size, and in so far this is a common consensus among agricultural households, this might increases the incentives for childbearing.

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)

Though there is little difference between poverty in rural and urban areas, there is a dramatic difference in fertility levels. The TFR in urban areas is around 3.4, whereas in Addis Ababa, by far the largest urban concentration in Ethiopia, the TFR 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).

Figure 1: Trends in total fertility rates (Source: UN estimates and projections)

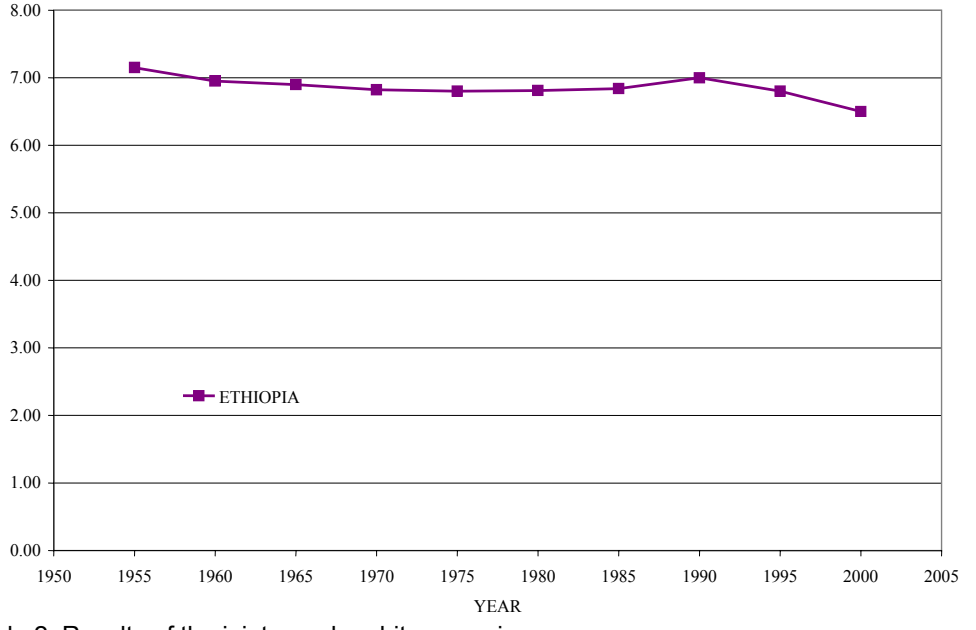

Table 2: Results of the joint panel probit regressions**:**

4. Econometric Framework

We estimate household fertility decisions and household welfare as random effect models. Given that household welfare and childbearing are potentially endogenous processes, we estimate the processes jointly allowing the random effects to be correlated. Formally the econometric specification is given as:

$$probit(F_{it}) = \beta x_{it}^{F} + \gamma P_{it-1} + \varepsilon_i^{F} + u_{it} \quad \textbf{(1)}$$

$$probit(P_{it}) = \beta x_{it}^{P} + \delta F_{it} + \varepsilon_i^{P} + v_{it} \quad \textbf{(2)}$$

where F_{it} is a binary indicator whether there is a new birth in the household between any two given waves and P_{it} is a binary indicator of the poverty status of the household, and the random household specific effects are specified with a joint normal distribution:

$$\begin{pmatrix} \varepsilon_i^{F} \\ \varepsilon_i^{P} \end{pmatrix} \sim N\left(\begin{pmatrix} 0 \\ 0 \end{pmatrix}, \begin{pmatrix} \sigma_F^2 & \rho_{PF} \\ \rho_{FP} & \sigma_P^2 \end{pmatrix} \right) \quad \textbf{(3)}$$

x_{it}^{F} and x_{it}^{P} are background variables, potentially time varying and may be specific to the process. The errors in equations (1) and (2) are iid. Also note that poverty status enters as an endogenous variable in the fertility process and the fertility outcome enters as an endogenous variable in the poverty process. However, 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.

Starting values

In the joint estimation of the above models, the need for a careful specification of starting values can hardly be overstated. If initial parameter values (i.e. starting values) are far removed from their optimal values, the search process may take a long time and in many cases optimisation fails altogether. Furthermore, theory suggests that the likelihood function need not be concave when equations are combined, so that poor starting values may lead to a local likelihood maximum. But our experience shows that the likelihood function either converges to the global

maximum or not. Therefore, we have made attempts to specify starting values as close to optimal values as possible, using all the information available to us in the data (Lillard and Panis, 2003)[1].

Identification and initial condition

In the standard static models of fertility, current period fertility is regressed on current period covariates. The labour supply literature has shown that this is wrong. Even in a perfect certainty framework, current period choices are a function of all current and future prices. This makes the identification issues much more difficult. We know that even in the standard static case, the problem of finding appropriate instruments is hard, now with lagged endogenous variables in the model the problem becomes nearly insurmountable (Schultz, 1997). One role for a dynamic econometric approach is to use econometric theory to suggest more structure for the problem.

As a means to overcome the endogeneity problem, we could (in theory) estimate hazard models in a simultaneous estimation framework. We have not used a hazard framework, even if it is flexible and deals explicitly with right censoring of the data due to incomplete spells of childbearing. This is due to the fact that the hazard approach often examines a sample conditional on the woman's being in the relevant birth interval, whereas, clearly, having previous birth (initial condition) is also endogenous to the same type of reproductive choice process, and raises issues of sample selection bias. Given that we do not have fertility histories and have only three waves, it is difficult to estimate such a model. One should note that without the presence of full fertility histories, any estimated model suffers from the initial conditions problem.

5. Data

Longitudinal surveys for less developed countries are still rare and certainly less extensive than typical panel studies from developed countries. A particular challenge in the study of fertility and poverty from a longitudinal perspective is that the surveys do need adequate information on both. Demographic and Health Surveys (DHS) normally contain extremely good information on fertility histories but little information

[1] When using poverty status we always use a probit. For son expenditure (result not provided yet) we use a linear random effect model. This can be estimated by OLS, but not aML since we need to let the random effects be correlated.

to assess poverty. For expenditure surveys, the problem is the opposite, in that demographic information is often limited. The surveys selected for our studies contain information on both aspects. We use both the Ethiopia Urban Household Survey and the Rural Household Survey. 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.

Poverty measurement

Since we are primarily interested in analysing fertility and household welfare for households with subsistence level of income, we compare poor households with non-poor households rather than treat expenditure as a continuous variable. Poverty status is specified as a discrete state, and is derived from the more general Foster-Greer-Thorbecke 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:

$$FGT_{\alpha} = \frac{E\left(\nu\delta_{\alpha}(y)\right)}{E\left(\nu\right)} \qquad \textbf{(4)}$$

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

$$\delta_{\alpha}(y) = \begin{cases} \left(1 - y/\tau\right)^{\alpha} & \text{if } y < \tau \\ 0 & \text{if } y \geq \tau \end{cases} \qquad \textbf{(5)}$$

and $\alpha \geq 0$ is the coefficient of poverty aversion. For simplicity we focus here on the headcount which is given by $\alpha = 0$.

The distribution of consumption expenditure within the household is unlikely to be uniform across household members, and children tend to consume less than adults. The standard solution is to impose an assumption on intra-household resources allocation, and adjustment is done by applying an equivalence scale that is consistent

with the assumption made – producing a measure of *expenditure per adult equivalent*. Unfortunately, there is limited consensus on the appropriate choice of equivalence scales, which are partly due to different patterns of household allocation between countries, regions and cultures. As a result official poverty statistics are frequently based on per capita household income or expenditure, which in effect means that in terms of household allocation, each household member is given *equal* weight. An implication of this approach is that households with a large number of *dependent* children are more likely to be recorded as being poor. In the present paper we maintain consistency with official poverty statistics, and define poverty over per capita consumption expenditure[1]. Clearly this assumption needs to be taken into account in interpreting the estimates.

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[2].

6. Results and Discussion[3]

We report our results separately for urban and rural areas. This is mainly due to the reason we have mentioned earlier. The extent of poverty (based on per capita expenditure) is similar in urban and rural Ethiopia but the pattern of urban fertility (esp. the number of children per household) is dramatically different from rural fertility (Kinfu, 2000). Therefore, we attempt to highlight the interesting results of each equation for each location accordingly.

[1] Equivalent scales can be estimated by using Engel coefficient as in Lanjouw and Ravallion (1995). Although estimating the effect of household size on Engel coefficient requires a range of assumptions on the consumption behaviour of household, the theoretical foundation is certainly an advantage. Another avenue we will soon follow in this paper is to examine how sensitive the results are to the choice of equivalent scale. The weight on a child's consumption relative to that on an adult and the scale of economy are two dimensions to be considered.

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

[3] We have estimated the two processes separately and considered flexible definitions of the dependent variables (e.g. counts for childbearing using count data models and continuous total household expenditure variable using panel and quantile regression models without the random effects). Results can be obtained from authors upon request.

Fertility Equation

According to the results presented in Table 2 below, lagged poverty status (which we alternatively termed as past welfare status) has a negative (positive) but statistically insignificant effect on current fertility in rural (urban) areas. Therefore, fertility might have been driven by factors other than poverty status of households such as culture, child labour and level of education and we explore all possible factors in the paragraphs below.

The number of children between the age of 2 and 4 has interesting and significant impact on rural and urban fertility. In rural areas the presence of these children is positively linked to the probability of child birth. However, in urban areas, this variable is negative and significant. In terms of the number of children between the age of 5 and 9, the impact is positive and significant both on urban and rural fertility. This pattern might be a reflection of the ability or preference of urban households to child spacing as opposed to rural households.

Unsurprisingly, having older household heads is negatively and significantly related to fertility in both areas. But the negative and significant link between fertility and number of adults in the household is somewhat counter intuitive.

Even if the average household sizes are close to each other in rural and urban areas, there are underlying major differences in terms of household composition as well as economic activities of household members. The mean number of children (i.e. those who are below the age of 15) in rural (urban) areas is 2.7 (1.8). The maximum number of those children working is 6 in rural areas as opposed to 1 in urban areas. The child labour issue is very important as it is evident from our model results. According to our results, there is a significant link between child labour and fertility in rural Ethiopia. This confirms to the theoretical predictions that have been advanced by Hazan and Berdugo (2002). The authors argue that child labour can explain high fertility rates in developing countries.

In our estimations, we can consider the education of the head (which is often a male member of the household in both locations) as wage proxies. Relative to heads without education, our results show that when the head has completed primary or secondary schooling (which enhances labour market opportunities), this has a

significant and positive impact on fertility. As an empirical observation, most cross-sectional studies of fertility have found fertility to be inversely related to women's wages or to the most common proxy for wages, education. The male wage is often associated with higher fertility in traditional agricultural societies, but is also found to be associated in some instances with lower fertility in industrially advanced, high-income societies (Shultz, 1997).

Here we are comparing the rural sub-sample results with the urban ones. As expected, marital status has a significant and positive impact on fertility. This is also true for the number of generations within the household. Except for one (i.e. the household head being an Oromo in the rural case and an Amhara in the urban case), none of culture variables (either ethnicity or religion) do not have significant impact on fertility. Rural households with Oromo heads tend to have higher fertility while Amhara heads in urban areas tend to have the opposite. Location wise, leaving in the west part of the country is linked to lower fertility.

Overall, the discussion so far seems to reinforce the child labour argument as a major cause of high fertility expansion especially in rural Ethiopia.

FERTILITY equation

	RURAL	URBAN
Fcons	-0.7024 *	-3.4972 **
	(0.4182)	(1.4463)
Flpov	-0.0046	0.0105
	(0.0056)	(0.0087)
Fkids24	0.2011 ***	-0.8069 ***
	(0.0515)	(0.2956)
Fkids59	0.2049 ***	0.4468 ***
	(0.0505)	(0.1279)
Fkid1014	0.0060	0.3667 **
	(0.0562)	(0.1757)
Fhhhage	-0.0432 ***	-0.0952 ***
	(0.0039)	(0.0203)
Fnmen	-0.0832 *	-0.0814
	(0.0477)	(0.1448)
Fnwomen	-0.2009 ***	-0.2653 **
	(0.0556)	(0.1241)
Fmwork	-0.1495	1.0509 **
	(0.1734)	(0.4552)
Fwwork	0.0654	0.2628
	(0.1910)	(0.3712)
Fcwork	0.3799 ***	2.1347
	(0.1434)	(3.2794)
Fhhhed2	0.2313 *	0.3109
	(0.1297)	(0.6643)
Fhhhed3	0.3571 **	0.1971
	(0.1441)	(0.6900)
Fhhhed4	0.1866	0.1052
	(0.1512)	(0.6548)
Fhhhmar	1.4530 ***	2.5940 ***
	(0.1719)	(0.6942)
Fngen	0.4145 ***	0.5826
	(0.1007)	(0.4147)
Fhhhfarm	0.0203	(0.1580)
Fhhhamh	-0.1669	-0.9320 *
	(0.2323)	(0.5238)
Fhhhoro	0.5973 **	0.4420
	(0.2674)	(0.5260)
Fhhhtigr	0.1793	0.6193
	(0.3278)	(0.6011)
Fhhhgura	-0.2079	0.5747
	(0.2394)	(0.5903)
Fmusl	0.2396	0.5447
	(0.8543)	(0.4051)
Fcentral	-0.0689	-0.4873
	(0.3698)	(0.3893)
Fsouth	-0.1716	-0.1525
	(0.3507)	(0.5105)
Fwest	-0.6110 *	-1.1019 *
	(0.3161)	(0.5916)

POVERTY Equation

	RURAL	URBAN
Ccons	0.9590 ***	-0.5539
	(0.2864)	(0.3517)
Ckids02	0.1654 **	0.4225 ***
	(0.0746)	(0.1535)
Ckids24	0.1185 ***	0.1253
	(0.0399)	(0.1084)
Ckids59	0.1213 ***	0.2078 ***
	(0.0315)	(0.0570)
Ckid1014	0.0563	0.3309 ***
	(0.0351)	(0.0483)
Chhhage	-0.0001	0.0102 ***
	(0.0020)	(0.0039)
Cnmen	0.0372	0.1159 **
	(0.0310)	(0.0530)
Cnwomen	0.1227 ***	0.1121 **
	(0.0301)	(0.0520)
Cmwork	-0.0032	-0.5709 ***
	(0.0926)	(0.1102)
Cwwork	-0.0083	-0.1729
	(0.1045)	(0.1215)
Ccwork	0.2137 ***	-1.3684 **
	(0.0766)	(0.6769)
Chhhed2	-0.1612 **	-0.4590 ***
	(0.0791)	(0.1396)
Chhhed3	-0.1132	-0.4409 ***
	(0.0982)	(0.1683)
Chhhed4	-0.1700	-1.0730 ***
	(0.1096)	(0.1653)
Cnhighed	-0.1227 ***	-0.1487 ***
	(0.0342)	(0.0501)
Cnmeded	-0.0734	-0.0033
	(0.0648)	(0.0902)
Chhhmar	-0.0369	-0.1876 *
	(0.0849)	(0.1111)
Cngen	0.1016 *	0.2825 ***
	(0.0535)	(0.0778)
Chhhfarm	-0.1940 **	(0.0824)
Chhhamha	-0.5301 ***	-0.3125 *
	(0.1413)	(0.1823)
Chhhorom	0.1833	-0.1329
	(0.1559)	(0.1942)
Chhhtigr	-0.5985 **	-0.5093 **
	(0.2497)	(0.2121)
Chhhgura	0.7156 ***	0.0250
	(0.1429)	(0.2124)
Cmusl	-0.3146	-0.3953 ***
	(0.5134)	(0.1400)
Ccentral	-1.2830 ***	0.2189 *
	(0.2660)	(0.1130)
Csouth	-1.2985 ***	0.2743
	(0.2584)	(0.2266)
Cwest	-1.6649 ***	0.1152
	(0.2518)	(0.1921)

RANDOM EFFECTS

SigEpsF	0.9870 ***	3.1846 ***
	(0.0894)	(0.4335)
SigEpsC	0.6072 ***	1.2065 ***
	(0.0448)	(0.0642)
corr	0.1163	-0.0307
	(0.0962)	(0.0934)
ln-L	-3779.65	-2504.21

NOTE: Asymptotic standard errors in parentheses;
Significance: '*'=10%; '**'=5%; '***'=1%.
Endnotes

Poverty equation

Unlike the results in the fertility equation, the impact of demographic composition on household poverty status is significant and positive. The number of young children below the age of 10 has a positive impact on the household poverty in rural areas. Except for the age group 2 to 4, the same significant pattern has also been observed for urban Ethiopia if there are children below the age of 15. Poverty is significantly and positively associated with old age of household heads, number of adult women and men in urban areas. The number of adult women increases the probability of being poor in rural areas.

There are interesting results with respect of activity status of different household members. The ratio of working men as well as children is negatively associated with poverty incidence in urban Ethiopia. However, the ratio of working children does contribute to the probability of being poor in rural areas.

Education has the expected role of reducing poverty incidence. In urban areas, completing primary, secondary and higher education are all related to reduction in poverty incidence. Completion of higher education has the most pronounced impact on reducing poverty prevalence. In rural Ethiopia, education has a negative impact on the probability of being poor but the only significant coefficient is the one that relates to the completion of compulsory schooling (i.e. primary education). Marital status in the form of marriage seems to be a cushion against experiencing poverty only in urban areas and the estimated coefficient is significant at 10 percent level.

The larger the number of generations, the higher the probability of experiencing poverty. In an environment where family values are important and where there are no any social support schemes run by the state living arrangement in extended families are common. Ethiopian households are not the exception here. As a coping mechanism, individuals (i.e. family members who are related to each other) with economic hardships rely on each other for support and live in extended family arrangements which increases the number of generations within a given household. The average number of generations in our data is above 2 for both locations.

If the household head is a farmer, this is negatively and significantly linked with probability of being poor for rural households. Households with Amhara and Tigre heads experience lower poverty incidence in both areas. In rural Ethiopia, households with Gurage heads experience higher probability of being poor. Households with Muslim heads are less likely to be poor in the cities. All location variables are associated to lower poverty incidence probability in rural areas but being located in the capital city increases the probability of being poor.

Finally, our household specific random effects both in the fertility and poverty equations are much higher in urban than rural areas and statistically significant in both locations. However, they are not strongly correlated to each other.

10. Concluding Remarks

The relationship between fertility and poverty is complex. In many low-income countries, TFRs have declined by 50% or more since 1960. The paucity of economic studies of the fertility transition may reflect not only shortage of data but also other factors. The decline might be due to the changing economic constraints facing families or due to the provision of subsidised modern birth control through organised family planning programmes. Relative to other regions, TFR in Africa is higher. The contributing factors mentioned in the literature include the persisting high levels of child mortality, low levels of maternal education, co-residence of the extended family, fostering of children and limited responsibility of fathers for the costs of child rearing. The shortage of reliable household survey data containing a combination of economic and demographic variables has prevented researchers from contributing much to the debates of this nature about the causes of high fertility (Shultz, 1997).

Using a panel data set from three 'comparable' waves from rural and urban Ethiopia, we estimated fertility and poverty equations jointly using a FIML framework. This study is unique in such a way that it attempts to link poverty and fertility (in a joint estimation context) at the household level using panel data from a poor country. One of the significant findings of our study is the significance of child labour as the most important factor explaining high fertility. However, child labour does increase households' probability of being poor for rural households but decreases the same probability for urban households. Children might simply be producing services that Ethiopian parents value but these services do not have any significant role in reducing households' economic hardships. This suggests the need to abolish child labour so that Ethiopian children are afforded the chance to allocate their time for productive uses such as attending schools. This is useful not to perpetuate intergenerational poverty traps in the economy and to enhance children's chance of being non-poor adults in the future.

Traditional coping mechanisms such as living in extended families increase the probability of being poor. Our analysis 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.

Recent work elsewhere indicates that different sources of family income have different effects on the number of children. This is obtained just by focusing on a single fertility equation using a household demand framework (Shultz, 2005). 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 initial conditions and estimation of 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.

References

Admassie, A., (2002), Explaining the High Incidence of Child Labour in Sub-Saharan Africa, *African Development Review*, **14**(2), 251 – 275.

Baulch, B. and Hoddinott, J. (Eds.) (2000) Economic mobility and poverty dynamics in developing countries, *Journal of Development Studies*, Vol 36(6).

Becker, G. and Lewis H.G., (1973), On the Interaction between the Quantity and Quality of Children, *Journal of Political Economy*, **81**(2), Part 2, S279-S288.

Betti, G. (2003), *Poverty and Inequality Mapping in Albania: Final Report*, Washington, DC and Tirana, World Bank and INSTAT (mimeo).

Bigsten, A., Kebede, B. and Shimeles, A., (2003), Growth and Poverty Reduction in Ethiopia: Evidence from household Panel Surveys, *World Development*, **31**(1), 87 – 106.

Birdsall, N.M. and Griffin, C.C. (1988), Fertility and Poverty in Developing Countries, *Journal of Policy Modeling*, **10**(1), 29-55.

Birdsall, N., Kelley, A.C. and Sinding, S.W., (2001), *Population Matters: Demographic Change, Economic Growth, and Poverty in the Developing World*, Oxford University Press, Oxford,

Carletto, G., Devis, B., Stampini, M., Trento S. and Zezza, A., (2004), Internal Mobility and International Migration in Albania, ESA Working Paper No. 03-13, Agriculture and Development Economics Division, FAO

Dercon, S. (2004), Growth and Shocks: evidence from Rural Ethiopia, *Journal of Development Economics*, **74**(2), 309-29.

Dercon, S. and Krishnan, P., (2000), Vulnerability, Seasonality and Poverty in Ethiopia, *Journal of Development Studies*, **36**(6).

Easterlin, R.A., and Crimmins, E.M., (1985). *The Fertility Revolution*, University of Chicago Press.

Eastwood, R. And M. Lipton (1998) Impact of Changes in Human Fertility on Poverty, *mimeo*, Department of Economics, University of Sussex.

Foster, J., Greer, J. and Thorbecke, E., (1984), A Class of Decomposable Poverty Measures, *Econometrica*, **52**(3), 761-766.

Glewwe, P., Gragnolati, M. and H. Zaman, H., (2001), Who gained from Vietnam's boom in the 1990s? An analysis of poverty and inequality trends, World Bank working paper.

Hazan, M. and B. Berdugo (2002) Child Labour , Fertility and Economic Growth, *Economic Journal*, Vol. 112, No. 482, P. 810-828.

Hotz, V.J., Klerman, J. and Willis, R. (1997), The Economics of Fertility in Developed Countries, in *Handbook of Population and Family Economics*, M. Rosenzweig and O. Stark, (eds.), Elsevier Science, 275-348.

INSTAT, 2002. The Population of Albania, (2001), Tirana, INSTAT.

Jalan, J. and Ravallion, M. (2000), Is transient poverty different? Evidence for rural China, *Journal of Development Studies*, Vol.: **36**(6)

Justino, P. and Litchfield, J., (2001), Welfare in Vietnam during the 1990s: Poverty, Inequality and Poverty Dynamics, PRUS Working paper No. 8.

Kedir, A. and McKay, A. (2004), Chronic Poverty in Urban Ethiopia: Panel Data Evidence, mimeo, University of Leicester, UK.

Kinfu, Y., (2000), Below-Replacement Fertility in Tropical Africa? Some Evidence from Addis Ababa, *Journal of Population Research*, 17(1): 63-82.

Lanjouw, P. and Ravallion, M. (1995), Poverty and Household Size, *The Economic Journal*, **105**(433): 1415 – 1434.

Lillard L. and Panis, C. (2003) AML Multilevel Multiprocess Statistical Software, Release 2.0, Los Econware: Angeles.

Lindstrom, D. and Berhanu, B., (1999), The impact of war, famine, and economic decline on marital fertility in Ethiopia, Demography, **36**(2), 247 – 261.

Lipton, M., 1998, *Successes in Anti Poverty*, International Labor Organization, Geneva.

Livi-Bacci, M. and de Santis, G., (1998), Population and Poverty in the Developing World, Clarendon Press, Oxford.

Maddala, G.(1983) Limited Dependent and Qualitative Variables in Econometrics; Cambridge University Press: Cambridge.

Mcculloch, N. and Baulch, B., (2000), Stimulating the impact of policy upon chronic and transitory poverty in rural Pakistan, *Journal of Development Studies*, **36**(6)

Moav, O., (2005), Cheap Children and the Persistence of Poverty, *The Economic Journal*, **115**, 88-110.

Ravallion M., (1996), Issues in measuring and modelling poverty, *The Economic Journal,* **106**, n.438, 1328-1343.

Ravallion, M. and Bidani, B., (1994), How Robust Is a Poverty Profile?, *World Bank Economic Review*, Oxford University Press, **8**(1), 75-102.

Rosenzweig M.R. and Schultz P.T., (1985), The demand for and supply of births: Fertility and its lifecycle consequences, *American Economic Review*, **75**(2):992 – 1015.

Schoumaker, B. and Tabutin, D., (1999), Relationship between poverty and fertility in Southern countries: Knowledge, methodology and cases, Working Paper no 2, Department of Science of Population and Development, Université Catholique de Louvain.

Schoumaker, B., (2004), Poverty and Fertility in Sub-Saharan Africa: Evidence from 25 Countries, paper presented at the Population Association of America Meeting, Boston.

Shultz, T. P. (2005) Fertility and Income, Centre Discussion paper No. 925, Economic Growth Centre, Yale University.

_____ (1997) Demand for children in low income countries, *Handbook of Population and Family Economics*, Volume 1A, M. Rosenzweig and Stark (eds.), Elsevier, North-Holland: Amsterdam, 349-430.

_____ (1981) Economics of Population (Addison-Wesley, Reading, MA).

Sibanda, A., Woubalem, Z., Hogan, D.P. and Lindstrom, D.P., (2003), The proximate determinants of the decline to below-replacement fertility in Addis Ababa, Ethiopia, *Studies in Family Planning*, **34**(1):1 – 7.

Strauss, J., Beegle, K., Dwiyanto, A., Herawati, Y., Pattinasarany, D., Satriawan, E., Sikoki, B., and Witoelar, F., (2004), Indonesian Living Standards Before and After the Financial Crisis: Evidence from the Indonesia Family Life Survey, RAND Corporation, Santa Monica, U.S.A.

UNDP, (2003), Human Development Report 2003 Millennium Development Goals: A compact among nations to end human poverty, Oxford University Press.

Willis, R.J., (1973), A New Approach to the Economic Theory of Fertility Behavior, *Journal of Political Economy*, **81**(2), part 2, S14-S64.

World Bank, (2003). Albania: Poverty Assessment, Report No. 26213-AL, Washington, DC