Impact of fertility on objective and subjective poverty in Malawi

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Abstract

The paper uses data from the Second Malawi Integrated Household Survey (IHS2) to investigate the impact of fertility on poverty in rural Malawi. We use two measures of poverty; the objective and the subjective. After accounting for endogeneity of fertility by using son preference as an instrumental variable, we find that fertility increases the probability of being objectively poor. This effect is robust for all poverty lines used. It is also robust to accounting for economies of scale and household composition as well as assuming that poverty is continuous. We also find that when fertility is treated as an exogenous variable its impact is underestimated. When poverty is measured subjectively, the results are opposite to those of objective poverty. We find that fertility lowers the likelihood of feeling poor, and that fertility is exogenous with respect to subjective poverty.

1 Introduction

Research looking at the relationship between poverty and fertility at the micro level on the African continent remains scarce. Ironically, Africa has the highest rates of poverty and fertility. A lack of data has often been given as the reason for the paradoxical lack of studies on the continent. Empirically, there has not been any consensus as to the nature of the relationship between fertility and poverty. The mixed empirical results include; no relationship between fertility and poverty in Botswana (Chernichovsky 1984), a positive relationship in Sierra Leone and Ethiopia (Ketkar 1979), a negative relationship in Burkina Faso (Langani 1997) and in Southern Sudan (Cohen and House 1994). Further to that,

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Noumbissi and Sanderson (1998) find that in 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. The J shape is explained by the fact very low income households tend to be landless farmers; as a result they don't depend on children as cheap labor, whereas those with the highest income have lower fertility due to higher investment in child quality. The middle income families are landholding farms which depend on cheap labor, and therefore have a higher demand for child quantity.

The common thing about all the cited studies is that they treated fertility as an exogenous variable. By doing that, these studies ignored the fact that fertility can influence poverty, and at same time be affected by it. That is, causality can run in both directions. Technically, they did not take into account the simultaneity that exists between the two variables. Further to that, they also ignored the fact that there are unobserved factors which influence both variables; that is unobserved heterogeneity[1] was not accounted for. Another shortfall of these studies is that they only focussed on poverty defined in the objective monetary sense which is a narrower definition of household welfare. Subjective measures of welfare better capture the multidimensional nature of poverty. They are likely to include a household's feelings of relative deprivation, exclusion from services and institutions, as well as feelings of marginalization related to household or individual status (such as ethnicity, or marital status) (Devereux *et al.* 2006). It is therefore also interesting to see how fertility impacts on poverty when poverty is conceived multidimensionally.

Disregarding simultaneity and unobserved heterogeneity leads to biased and inconsistent estimates. It is therefore important for the reliability of results of any econometric analysis that they be accounted for. It is also worth noting that despite the poverty-fertility relationship being a demographic issue as well as an economic one; most of the studies on the continent have been done by demographers. These studies have mostly been descriptive in nature. And as discussed before the results have been divergent with some studies finding no relationship, while other studies find a negative or positive relationship. The only study we are aware of which accounts for the two effects was done in India by Gupta and Dubey (2006). With respect to Malawi, there have been a few studies which have looked at factors which influence objective poverty (Mukherjee and Benson 2003; Bokosi 2007) but none of these has looked at the impact of fertility on objective poverty let alone subjective poverty. The questions that this study therefore seeks to answer are twofold. Firstly, taking into account the simultaneity and unobserved effects, how does fertility impact on objective

[1] Manski (1993) calls this the correlated effect.

poverty in Malawi? Secondly, taking into account the simultaneity and unobserved effects, how does fertility impact on subjective poverty in Malawi? Answering these questions is significant in the sense that it will go a long way in contributing to the literature on poverty and fertility in Malawi as well as the African continent at large. Additionally, by using a methodology that captures the problems that the previous studies have ignored, we will be making a contribution with respect to how the two variables should be conceptualized and modeled. Further to that, by using subjective poverty, the study will shed some light on the impact of fertility on a broader definition of household welfare.

After accounting for endogeneity of fertility by using a natural experiment, son preference as our instrumental variable, the study finds a positive relationship between fertility and objective poverty. That is, having a large family increases the likelihood of being objectively poor. This effect is robust for all poverty lines used. It is also robust to accounting for economies of scale and household composition as well as assuming that poverty is continuous. We also find that when fertility is treated as an exogenous variable its impact is underestimated. When poverty is defined more broadly by using self rated assessments of welfare, the results are opposite to those of objective poverty. We find that fertility lowers the likelihood of feeling poor, that is having more than two children (a large family) lowers the probability of feeling poor. The study also finds that fertility is exogenous with respect to subjective poverty.

The rest of the paper is organized as follows. In Section 2 we present arguments for why causality between fertility and poverty is bidirectional. Section 3 focuses on the measurement of objective and subjective poverty, and fertility. Section 4 dwells on the specification of the empirical model, data, and descriptives. Econometric results are the focus of section 5. Our conclusions are presented in Section 6.

2 The poverty-fertility nexus

In this section, we give explanations which have been given in the literature which show that causality between fertility and poverty is bidirectional. The link between poverty and fertility may run from fertility to poverty. Poor households with big families have large dependency ratios, as a result investments in the human capital of children, which improve the future prospects of the children may be sacrificed to more immediate household needs such as food. This conflict is especially likely when the opportunity cost of certain investments in children (such as education) is high because of the associated loss of child labor in agriculture or home work (Birdsall and Griffin 1988).

Family size may have a negative impact on child development and human capital formation, and hence their future economic status. For instance, studies in both developed and developing countries find that children in big families tend to be shorter, less intelligent, and are even less likely to survive (e.g. Birdsall 1977; Bielicki 1986; Casterline *et al.*1987). Birdsall (1980) found that though total household spending on education tends to rise with family size, expenditures per child on education tend to be lower in large families for all income and education levels of the parents. Rosenzweig and Wolpin 1980, in a study of families with twins in India found that the additional unexpected child represented by twins reduced enrollment levels of all children in the household. Using Malaysian data, Rosenzweig and Schultz 1987 show that couples with a higher biological propensity to have births, also have lower schooling attainment for their children. A child's ability to learn is influenced by the amount and quality of attention received from parents and other adults in the first few years, and that is generally less in large families. Hence, children from large families are more likely not to be very educated and this makes them to be more prone to poverty (Birdsall and Griffin 1988). U.S. studies show that women with large families put in no more time on child care; educated women succeed in spending more time with each child principally by having fewer children (see Birdsall 1977).

On the other hand, the link between poverty and fertility may run from poverty to fertility. Parents whose children die may try to replace them, and since high mortality is generally high in poor households, parents may try to insure themselves against possible child loss by having more children than they would otherwise want. Olsen (1987 cited in Birdsall and Griffin 1988) found that parents in Colombia directly replaced at least 0.2 of children that had died, but further compensated by having on average about 0.14 extra children. Similar results were found for Malaysia (Olsen 1983 cited in Birdsall and Griffin 1988). Thus, hoarding by having extra children can be interpreted as an insurance strategy by parents in the presence of high infant mortality. As the risk of infant mortality diminishes, hoarding becomes unnecessary (Birdsall and Griffin 1988). Related to this, is that poor households may decide to have more children as a source of support in old age given the absence of life insurance markets and social security in many developing countries.

According to the quantity-quality theory of Becker and Lewis (1973), increases in income lead to an increase in demand for quality of children and a fall in the quantity of children. Thus, as households become wealthier, they will tend to have fewer children. Additionally, Willis (1973) argues that increases in women's wages (and therefore income) leads to fewer children, as this increases the opportunity cost of having more children.

3 Measurement of objective and subjective poverty and fertility

In this section, we discuss the measurement of both objective monetary poverty and subjective poverty as well as fertility. Objective poverty can be measured either by using household income or household consumption expenditure. Following Mukherjee and Benson (2003), we use a consumption expenditure based measure of poverty rather than income[2]. In the objective and monetary poverty analysis income or consumption is considered to be a measure of welfare. This approach reflects how most empirical work on poverty in Africa has been done. A household's subjective assessment of its well being is however much broader. Subjective well being (SWB) better captures the multidimensional nature of poverty. Subjective measures are likely to extend well beyond the narrow income or consumption needs, as they will include a household's feelings of relative deprivation, exclusion from services and institutions, as well as feelings of marginalization related to household or individual status (such as ethnicity, or marital status) (Devereux *et al.* 2006). Due to its broader scope, it is possible that some factors might affect the two poverty definitions differently. It is therefore imperative that we investigate how fertility impacts subjective poverty to complete the picture. There are three alternative "subjective" questions which are used to measure subjective wellbeing. Firstly, there is what is called the Income Evaluation Question (IEQ) introduced by Van Praag (1971). The IEQ asks what level of income is regarded as 'very bad', 'bad','not good', 'not bad', 'good', 'very good'. The IEQ for example goes like "Taking into account my (our) present living circumstances, I would regard a net weekly/monthly/yearly (encircle period) family income as: excellent, good,. . . ,.bad, very bad." Secondly, there is the Minimum Income Question (MIQ). Here people are asked what they consider as a minimum level of income to make ends meet. The MIQ is for example phrased like "We would like you to tell us the absolute minimum income of money for a household such as yours – in other words, a sum below which you couldn't make ends meet." The MIQ has been criticized for its focus on income, in that the concept of income may be poorly defined for respondents particularly but not only in developing countries (Ravallion and Lokshin 2002). Both the IEQ and MIQ

[2]We use consumption expenditure other than income for two reasons. First, particularly in an agricultural economy such as Malawi, income is often very lumpy. Farming households receive a large amount of cash income in May and June after the harvest, and receive very little the rest of the year. In contrast, households are constantly expending their income and consuming. Consumption expenditure is a smoother measure of welfare through time than is income. In other words, consumption can be viewed as realized welfare, whereas income is more a measure of potential welfare (Murkhejee and Benson 2003). Second, in Malawi much of household income is derived from self-employed business or subsistence-oriented agricultural production. Assigning income values to the proceeds of these enterprises is often problematic (Hentschel and Lanjouw 1996).

are based on income as a measure of welfare, and therefore they are not broad. A measure of subjective poverty which is much broader and open-minded is the Economic Ladder Question (ELQ). Here the respondents are asked a question framed as follows: "Please imagine a 6-step ladder where on the bottom, the first step, stand the poorest people, and on the highest step, the sixth, stand the rich. On which step are you today?" (Kalugina and Najman 2002). In the survey data we are using, this question was answered by the household head. Owing to its broadness relative to the IEQ and the MIQ, we employ the ELQ method to measuring subjective poverty[3]. In this study, we measure fertility as the number of children[4].

4 Methodology

4.1 Motivation of the methodology

In order to take into account the fact that fertility and poverty (objective and subjective) are potentially endogenous, we use instrumental variable (IV) estimation. We use a natural experiment as our instrument[5]. For the IV to be valid it must be correlated with fertility but should be uncorrelated with poverty. Our use of a natural experiment is inspired by a number of studies in the labour supply literature. Bronars and Grogger (1994) use the incidence of twins in the 1970 and 1980 U.S. Census Public Use Microdata Samples to estimate the effect of an unplanned second child on labor force participation for unwed mothers. Angrist and Evans (1998) study the labor supply of married women with at least two children, using both twins and the gender mix of the first two children as instruments. Since parents tend to prefer having a mix of genders among their children, gender mix operates as an instrument because couples with two children of the same sex are more likely to have a third child than couples with one boy and one girl. It has to be said that using twins reduces usable data dramatically, and using sibling sex mix as an instrument applies in the US and probably other western countries. In most developing countries, parents tend to prefer sons to daughters.

[3] The use of subjective wellbeing is advantageous in the sense that well being is self rated. These measures are however not completely perfect. For example, an individual's answers could be influenced by different factors, for instance, attitudes and anticipations. Individuals may estimate themselves by the means of comparison with socially accepted norms and rules, their group of reference etc (Kalugina and Najman 2002; Kingdon and Knight 2003).

[4] A Fertility measure normally used by demographers is the Total Fertility Rate (TFR) which is defined as the average number of children that would be born alive to a woman at the end of her reproductive period given the current specific fertility rate.

[5] A natural experiment is a naturally occurring random event or situation, which can be exploited as an instrumental variable. For a discussion on natural experiments in economics see Rosenzweig and Wolpin (2000).

Gupta and Dubey (2006) in a study of the impact of fertility on poverty in India (which is probably the first to use IV estimation) use having two girls first as an IV on households with more than two children. *A priori* parents are more likely to have another child if the first two are girls.

Just like Gupta and Dubey (2006) we use son preference as our IV. Sons are preferred in the developing world for a number of reasons. First, in many societies, old-age support is exclusively the task of male offspring by way of social practice and tradition. Even though female offspring may be just as able to offer support, there may be a stigma associated with receiving such support from daughters. Second, in societies where female employment is not in demand or undervalued, males may be potentially more productive future 'assets' (Gupta and Dubey 2006). Finally, sons may be preferred to daughters for the continuation of the family name.

4.2 Model specification

Following the motivation given in the preceding section, we specify a recursive bivariate probit model which nets out simultaneity and unobserved heterogeneity effects and therefore enables us to isolate the causal effect of fertility on poverty (objective and subjective). We have two dependent variables; poverty status and fertility which are binary. Our unit of analysis is a household.

4.2.1 Objective poverty

As discussed earlier, in this study we measure objective poverty using consumption, and a household is defined as poor if its total real annualized per capita consumption expenditure (Y_i) falls below the poverty line. Letting Y^{PL} be a poverty line, then household i is poor ($T_i = 1$) if $Y_i \leq Y^{PL}$ and non poor ($T_i = 0$) if $Y_i > Y^{PL}$. Parameter estimates of a probit change with the poverty line. This means that the effects of different variables on poverty are strictly speaking specific to that poverty line. To find out whether or not the effect of fertility on poverty is robust to choice of poverty line we use three poverty lines, and look for the presence of sign reversals in the impact of fertility on the alternative poverty lines. When there are no sign reversals i.e. monotonicity holds, then the results can be considered first order dominant, implying that the direction of the impact of a fertility variable on the probability of being poor remains the same regardless of poverty line selected (Ravallion 1996).

We use three poverty lines; two as defined by the National Statistical Office of Malawi (NSO), and the third as defined by the World Bank. The two NSO poverty lines are; one for those considered ultra poor which is 10029 Malawi Kwacha per year, and another for the poor which is 16165 Malawi Kwacha per year. The World Bank poverty line is the US $1 per day (equivalent to an annualized figure of 11051 Malawi Kwacha after adjusting for purchasing power parity). The NSO poverty lines are based on the cost of basic needs approach. And they are adjusted for interspatial and intertemporal price differences. It is worth pointing out at this stage, that there is an unsettled debate in the poverty literature regarding whether poverty should be modeled as a continuous variable by using a levels regression or as a dummy by using probit or logit models. The first advantage of the levels regression is that it uses all the information on the distribution of consumption expenditure, whilst the binary model loses important information by collapsing consumption expenditure into two values. Secondly, the binary variable is derived from an observed continuous variable, and this runs counter to the fundamental assumption on which the probit or logit is based. Specifically, the binary indictor models assume that there is an unobserved latent response variable which generates an observed binary variable (Ravallion 1996). However, the levels regression has a major shortcoming in that it imposes constant parameters over the entire distribution and thus assumes that the impact of various factors on welfare is constant across the expenditure distribution. That is, it assumes that there is no difference between the rich and the poor in terms of their characteristics. In reality, the poor face different constraints such access to credit and services. As Grootaert (1997) argues, the poor's ability to cope with these constraints can be envisaged as a latent variable which is a function of household characteristics which generates binary welfare outcomes. In this study, we use both approaches to check the robustness of our results to the poverty definition.

Fertility (Z_i) is defined as equal to one if a household has more than two children and zero if it has two[6]. Our study is essentially about large families versus small families. It should also be pointed out that son preference would be more evident in the birth of the third child and not the second child since most families prefer having at least two children (Gupta and Dubey 2006). This implies that the son preference IV only works in the transition from the second to the third child. We later (see subsection 5.8) change this definition of fertility, as a way of checking the sensitivity of our results to the definition of family size. The poverty and fertility equations are jointly estimated in a recursive bivariate probit which is formally specified below.

[6]One can also quite plausibly assume that there is a latent variable which depends on personal and household characteristics which generates binary fertility outcomes i.e large family versus small family.

Consider the following levels regression;

$$Y_i = \beta' X_i + \delta Z_i + \varepsilon_i \tag{1}$$

then poverty status is defined as;

$$T_i = \begin{cases} 1 & if\ Y_i \leq Y^{PL} \text{ (poor)} \\ 0 & if\ Y_i > Y^{PL} \text{ (non poor)} \end{cases} \tag{2}$$

Consider the following levels regression for number of children (C_i);

$$C_i = \theta' X_i + \lambda M_i + \eta_i \tag{3}$$

then fertility is defined as;

$$Z_i = \begin{cases} 1 & \text{if } C_i > 2 \\ 0 & \text{if } C_i = 2 \end{cases} \tag{4}$$

The recursive bivariate probit is therefore defined as;

$$\Pr(T_i = 1, Z_i = 1 | X_i, Z_i, M_i) = \Phi_{i2}\left(Y^{PL} - (\beta' X_i + \delta Z_i), (\theta' X_i + \lambda M_i) - 2, \rho\right) \tag{5}$$

Where, $\Phi_{i2}(\cdots)$ is the bivariate normal cumulative density function, X_i is a vector of exogenous variables which influence both fertility and poverty, M_i is a zero-one dummy IV defined as equal to one if the first two children are girls and zero otherwise. β and θ are vectors of parameters to be estimated, and δ and λ are scalar parameters of the fertility dummy and the IV respectively. ε_i and η_i error terms with the following properties;

$$\rho = Cov(\varepsilon_i \eta_i) \tag{6}$$

$$E(\varepsilon_i | X_i, Z_i, M_i) = E(\eta_i | X_i, M_i) = 0 \tag{7}$$

$$Var(\varepsilon_i | X_i, Z_i, M_i) = Var(\eta_i | X_i, M_i) = 1 \tag{8}$$

The parameters β, θ, δ, λ, ρ are estimated by maximum likelihood (see Maddala 1983;

Greene 2003; and Monfardini and Radice 2008 for more details).

The log likelihood to be maximized is[7];

$$
\begin{aligned}
L(\beta,\theta,\delta,\lambda,\rho) &= \sum \left[d_{11} \ln P_i^{11} + d_{10} \ln P_i^{10} + d_{01} \ln P_i^{01} + d_{00} \ln P_i^{00} \right] \qquad (9)\\
\text{where} &: \\
d_{11} &= T_i Z_i, d_{10} = T_i(1-Z_i), d_{01} = Z_i(1-T_i), d_{00} = (1-Z_i)(1-T_i) \\
P_i^{11} &= \Pr(T_i = 1, Z_i = 1 | X_i, Z_i, M_i) = \Phi_{i2}(\beta' X_i + \delta, \theta' X_i + \lambda, \rho) \\
P_i^{10} &= \Pr(T_i = 1, Z_i = 0 | X_i, Z_i, M_i) = \Phi_{i2}(-\beta' X_i - \delta, \theta' X_i + \lambda, -\rho) \\
P_i^{01} &= \Pr(T_i = 0, Z_i = 1 | X_i, Z_i, M_i) = \Phi_{i2}(\beta' X_i + \delta, -\theta' X_i - \lambda, -\rho) \\
P_i^{00} &= \Pr(T_i = 0, Z_i = 0 | X_i, Z_i, M_i) = \Phi_{i2}(-\beta' X_i - \delta, -\theta' X_i - \lambda, \rho)
\end{aligned}
$$

Testing the null that $\rho = 0$ using a Wald test amounts to testing for the exogeneity of fertility. The specified recursive bivariate probit corrects for simultaneity (through the IV) and at the same time controls for unobserved heterogeneity (by allowing correlation between the errors which capture unobserved factors among other things). Our two equation system is identified by way of exclusion restriction i.e. the poverty equation does not have M_i the IV as a regressor[8].

The coefficients in any limited dependent variable model can be misleading. Since the model is a probability model, the absolute level of a coefficient can convey a wrong picture of the impact of a regressor on the dependent variable. To overcome this problem, we compute marginal effects on the conditional mean function given by;

[7] For ease of exposition and in keeping with Maddala (1983), Greene (2003), and Monfardini and Radice (2008), we express the log likelihood assuming that the poverty and fertility thresholds are at zero. This simplification does not affect our analysis.

[8] It should however be pointed out that theoretically it is possible to achieve identification by functional form only i.e. without exclusion restrictions. This type of identification depends entirely on the bivariate normality of the errors. The exclusion restrictions help in making results robust to distributional misspecification (Monfardini and Radice 2008). Further, in our case the instrument allows us to check the robustness of our probit results to assuming that poverty is continuous.

$$
\begin{aligned}
E\left[T_i|X_i, Z_i, M_i\right] &= \Pr\left[Z_i = 1\right] E\left[T_i|Z_i = 1, X_i, Z_i, M_i\right] \\
&\quad + \Pr\left[Z_i = 0\right] E\left[T_i|Z_i = 0, X_i, Z_i, M_i\right] \qquad (10) \\
&= \Pr(T_i = 1, Z_i = 1|X_i, Z_i, M_i) + \Pr(T_i = 1, Z_i = 0|X_i, Z_i, M_i) \\
&= \Phi_{i2}(\beta' X_i + \delta, \theta' X_i + \lambda, \rho) + \Phi_{i2}(-\beta' X_i - \delta, \theta' X_i + \lambda, -\rho) \\
&= P_i^{11} + P_i^{10}
\end{aligned}
$$

The marginal effects are just the derivatives of this conditional mean function[9]. For variables which appear in both the fertility and poverty equations, the total marginal effect of these variables is decomposed into the direct effect (derivative of the second part of equation 10) and the indirect effect (derivative of the first part of equation 10). This indirect effect works through fertility. For example, education may affect poverty directly, but may also affect poverty indirectly through its impact on fertility. For binary explanatory variables, we do not take derivatives of equation 10 rather the marginal effect is just the difference in the conditional mean function with the dummy set equal to one and zero (Greene 2003). The marginal effect of fertility on poverty is calculated as follows;

$$
\Pr(T_i = 1, |Z_i = 1|X_i, M_i) - \Pr(T_i = 1, |Z_i = 0|X_i, M_i) \qquad (11)
$$

The marginal effects in the fertility equation are just the derivatives of the marginal distribution quite like in a univariate probit.

4.2.2 Subjective poverty

As said earlier, this study uses the ELQ method to measure subjective poverty. Using this method, one can model subjective poverty using an ordered probit model (see for example Ravallion and Lokshin 2002), where the rungs of the ladder represent ordered outcomes. Following Devereux *et al.* (2006) and Kalugina and Najman (2002), we define a subjective poverty dummy as follows; households are subjectively poor if they fall on the bottom two rungs of the ladder and non-poor if they fall on rungs 3 to 6. So the impact of fertility on subjective poverty is modelled using the recursive bivariate probit presented in the preceding section for objective poverty.

In addition to the variables already discussed, for both objective and subjective poverty we

[9] If $\rho = 0$ then the two parts of equation 10 reduce to a product of marginals (Greene 2003).

include variables to capture household demographics, education, employment, agriculture, religion, and community level characteristics. We also control for regional effects by including regional dummies. The definition of the independent variables is presented in appendix Table A1.

4.3 Data and descriptives

The data for this analysis come from the Second Malawi Integrated Household Survey (IHS2). This is a nationally representative sample survey designed to provide information on the various aspects of household welfare in Malawi. The survey was conducted by the National Statistical Office from March 2004-April 2005. The survey collected information from a nationally representative sample of 11,280 households. In addition, information was also collected from a nationally representative sample of 564 communities. The households were sampled from these communities. The survey collects demographic information which *inter alia* includes; age, sex, together with the relationship of each household member to the household head. This information allows us to identify children and their birth orders, which we then use to generate the son preference IV. The survey also collects information on subjective assessment of well-being. Out of a total of 11280 households, we focus on 9827 rural households (87%) of the total, as it is the rural areas where son preference may be more evident. Because the survey does not track children across households; we impose the following restriction on the rural sample. The sample is limited to mothers aged 20-40, whose oldest child was less than 17 years of age at the time of the survey. Since we are focusing on households with at least two children, we would not expect many women younger than age 20 to have two children. Besides, it is to be expected that a child over age 17 has moved to a different household[10]. We therefore have about 3400 rural households constituting the restricted sample.

Table 1, presents objective poverty rates for the three poverty lines[11]. The results indicate that for all rural households, 56.4% are poor with a corresponding restricted sample head count rate of 52.5%. Additionally, 24.4% and 21.8% of all rural and restricted rural house-

[10] Similar restrictions are used by Angrist and Evans (1998), and Gupta and Dubey (2006). We later relax these age restrictions in subsection 5.7, to see if our results are not affected by the possiblity of sample selection.

[11] The poverty indices are based on the Foster, Greer and Thorbecke (FGT) measure given by $P_\alpha(c_i, z) = \frac{1}{n}\sum_{i=1}^{q}\left(\frac{g_i}{z}\right)^\alpha$. Where c_i is consumption of household i , z is the poverty line, and $g_i = c_i - z$ is a consumption shortfall. q is the number of poor households, α is a measure of poverty aversion. For $\alpha = 0$ we have the headcount, for $\alpha = 1$ we have the poverty gap, for $\alpha = 2$ we have the poverty severity index.

holds respectively are ultra poor. This means that about one in five of the rural population (restricted and unrestricted) live in dire poverty such that they cannot even afford to meet the minimum standard daily recommended food requirement. In terms of the World Bank poverty line of US$1 a day, 30.6% and 27.7% of all Malawians residing in rural areas and those in the restricted rural sample respectively live on less than a dollar a day. Using the three poverty lines, we also find that the poverty gap measures are similar for the two samples. For instance, using the poor poverty line we find that the poor for all rural households (restricted rural households) have a poverty gap of 19.3% (17.7%) suggesting that they on average subsist on 19.3% (17.7%) less than K16165. What is therefore emerging from the results is that even though the poverty rates for all rural households are consistently higher than those for the restricted sample, the difference is not very big. This would imply that the restricted sample that we are using for this study is a reasonable representation of all rural households. In Table 2, we present results of the relationship between poverty headcounts and fertility measured as number of children. We find that for all poverty lines the poverty headcount rate is increasing with the number of children. For example, using the poor poverty line we find that for the unrestricted (restricted) 47.3% (46.2%) of households with less than three children are poor; this is in contrast to a headcount rate of 71.6% (74.5%) for those households with more than six children. This suggests that poverty and fertility might be positively related. This pattern holds for both samples; we should also note that the head counts are not very different for the two samples implying that our restricted sample represents quite well the rural population.

We now turn to the descriptive analysis of subjective poverty. We find that 84.8% of all rural households consider themselves to be subjectively poor with a corresponding figure of 83.5% for the restricted sample. These rates are very high as compared to the objective rates given in Table 1. In Table 3, we check the relationship between subjective poverty headcounts and the number of children. The results show an opposite relationship to that found under the objective poverty analysis (Table 2). Where as before we found that the more the number of children the higher the poverty rate; the results here show that the more the number of children a household has the lower the subjective poverty. This suggests that there might be a negative relationship between subjective poverty and fertility.

Table 4 summarizes results of the relationship between objective poverty and subjective poverty[12]. The results suggest that the objectively and subjectively poor are not the same people. This is evidenced by the fact that the off-diagonals (unshaded cells) are nonzero.

[12]Since the results for the restricted and whole samples are similar, we only report results for all rural households

This indicates that the matching of households between the two definitions of poverty is weak. For example, using the poor poverty line, we find that of 1359 households who are subjectively non-poor only 987 households are non-poor in the objective sense[13]. The Cramer's V statistics test the null hypothesis of no association between the two measures. A Cramer's V statistic of close to 1 (0) indicates strong (weak) association. The values are between 0 and 1, implying that there is a relationship between the two and this is confirmed by the likelihood test (probabilities of the chi-square are zero.) It is however worth emphasizing that the relationship is not very strong.

In Table 5, we report results of the descriptive analysis of the explanatory variables used in the study. The average number of children is 2.9. About three quarters of households have more than two children. Households which have two girls first make about 19% of our sample. This would suggest weak evidence of non random sex targeting since you expect the proportion of households with two girls first to be 25%. Education levels are low as is indicated by very low averages of numbers of people both male and female with some education be it primary or secondary. The averages are less than one suggesting very low numbers of people with education. In terms of education of parents, we note that fathers have more education than mothers as we move up the education ladder. For instance,13.6% of fathers have secondary as their highest education level as compared to just about 5% for mothers. The labour force participation for fathers is higher than that of mothers with 23% of fathers working for a wage compared to 4% for mothers.

The average for number of enterprises is very low indicating that very few households engage in non-agricultural income generating activities. About a quarter of our sampled households grow tobacco which is a cash crop. The results indicate that close to two thirds of households have no clinics in their communities; in addition 2% of the households live in trading centres suggesting that most households are not close to markets. In Table 5, we also show descriptive statistics for all rural households[14]. This is done in order to check the representativeness of the variables used in our regression analyses. The results indicate that the restricted sample is generally not very different from the sample of all rural households; suggesting that it is a realistic representation of rural households. For example, the average number of children for the two or more children sample is slightly higher than that of all households, 2.9 against 2.4 for all households. In terms of employment, we also note that the sample of two or more children households has somewhat higher labor force participation rates for both fathers and mothers. Looking at all rural households their educational measures are to some extent

[13] A similar mismatch is found by Ravallion and Lokshin (2002) for Russia.

[14] These are households with at least one child.

lower. The same pattern emerges for religion and community characteristics.

5 Econometric results

In this section, we present econometric results of the impact of fertility on objective and subjective poverty. We start with the presentation and discussion of results for objective poverty, and this is followed later by results for subjective poverty.

5.1 Impact of exogenous fertility on objective poverty

In this section results (Table 6) of naïve univariate probit regressions which assume that fertility is exogenous for the three poverty lines are presented and discussed. These results serve as our base for comparison with the scenario where we assume that fertility is endogenous. For all the three poverty regressions, the chi-square statistics show all variables included in the models are jointly significant.

Similar to the findings of Gupta and Dubey (2006), the univariate probit results suggest a positive and statistically significant effect of fertility on poverty. This implies that exogenous fertility increases the likelihood of being poor. The size of the effect ranges from 11% to 23%, and these values are economically substantial. This relationship is monotonic, as it holds for all the three poverty lines, suggesting that our results are robust to choice of a poverty line and that the first order dominance assumption is not violated. We also observe that the impact of exogenous fertility on poverty increases as the poverty line increases i.e. moving from ultra poor to poor. This might indicate that children become more expensive as your income increases as households opt for good quality children. As expected, the dependency ratio is significantly and positively related to poverty across the three poverty lines. An increase in the dependency ratio *ceteris paribus* increases the probability of falling into poverty by 4%, 5.7% and 11% for ultra poor, World Bank, and poor poverty lines respectively. These effects are quite large economically. Having secondary education for mothers and fathers significantly affects poverty. The relationship as expected is negative. Holding other things constant, when a father (mother) has secondary education it lowers the likelihood of being poor by 5% (7%), 8.8% (6.6%), and 18.9% (18.4%) for ultra poor, World Bank, and poor poverty lines respectively. All the other education variables have the expected negative sign but their impact is statistically insignificant. It should however be pointed out that the magnitudes of the education variables are economically quite significant.

With respect to employment, we find that for fathers being employed for a wage lowers the likelihood of being poor with economically significant effects ranging from 4% to 6%. However, for mothers being employed for a wage is not statistically significant, probably reflecting the very low labour force participation rates for mothers (see Table 5). In terms of the magnitude of the effect, we note that they are quite large with values quite similar to those for fathers. The more non agricultural income generating enterprises a household has, the lower the chance of being poor. For instance, using the poor poverty line we note that *ceteris paribus* having more enterprises increases the probability of being non poor by about 10%. The effect is increasing on successive poverty lines suggesting that the effect is more pronounced as the level of consumption increases. Accessing loans has the expected negative and significant effect on poverty.

Growing tobacco which is a cash crop has the expected negative relationship with poverty. The impact is both statistically and economically significant, with the magnitude ranging from 1% to 9.6%. We notice however that for the lowest poverty line (ultra poor), growing tobacco is not statistically significant suggesting that tobacco growing has no statistically significant effect on poverty at the lower end of the income distribution even though the effect seems to be economically large (about 1%). The statistical insignificance perhaps reflects the fact that due to its high cost nature very few ultra poor households can grow tobacco. Unsurprisingly, land which is a productive resource, statistically significantly increases the chance of being non poor. And the magnitude of the effects suggests that it is economically significant. Although the importance of livestock as a means of livelihood is falling in Malawi, the results suggest that holding other things constant, owning livestock increases the probability of being non poor by 3%, 4% and 6% for the ultra poor, World Bank, and poor poverty lines respectively. Having a clinic in a community lowers the probability of being poor by 3%, 5%, and 7% in the ultra poor, World Bank, and poor poverty lines respectively. These effects are substantial from an economic as well as a statistical viewpoint. As might be expected, the presence of a clinic would imply easily accessible medical attention which would among other things improve the productivity of people in the area.

Our discussion above has been based on the assumption that fertility is exogenous, but as discussed before fertility might be endogenous. In the next section, we address this issue of endogeneity of fertility.

5.2 Controlling for endogenous fertility

As discussed before, to account for endogeneity we need an instrumental variable. In our case we are using son preference as our IV. Before we go ahead to use the IV we first check two things. Firstly, we test using a hazard model whether indeed son preference exists in rural Malawi. Secondly, we then check the validity of son preference as an IV. We address each one of these issues in the next subsections.

5.2.1 Evidence of son preference in rural Malawi

Since the focus of this study is not on measuring son preference, we will not be too detailed about the methodology (for details see Haughton and Haughton 1998). In order to test for evidence of son preference, we need to first define what we mean by son preference. There are basically two concepts of son preference. The first is called lexicographic preferences; also referred to as the threshold, fixed minima, or target view of son preference, this approach assumes that the i^{th} household desires S_i sons, regardless of the number of daughters which it will need to have to achieve this goal. In practice, the target is likely to vary over households, and it may vary within a household over time, either way it is an unobservable quantity. The second concept of son preference is what is called sequential preference. This obtains when for any given number of sons and daughters, parents prefer an additional son to an additional daughter.

To measure lexicographic preferences you need families which have stopped child-bearing i.e. complete families (Haughton and Haughton 1998). To measure sequential preference you can use incomplete families. Since in the IHS2 data there is no distinction between complete and incomplete families, we use the concept of sequential preference to measure son preference. Sequential preference can be measured by using a hazard model. The hazard model estimates the risk (hazard) of having another child at any point in time. For an accelerated failure time (AFT) model, if the hazard is higher for families with a son (or sons), the implication is that son preference is present. The dependent variable is the length of the interval (in months) between one birth and the next, a by-product of recording the birth dates of the children born in the household. Specifically, we focus on two intervals namely the transition from the second to the third child, and the transition from the third to the fourth child. In addition to the covariates included in the other regressions, we use the variable *boyz* which is the number of existing boys.

If son preference is present, we would expect the coefficient of the variable *boyz* to be positive, implying that the higher the number of boys, the longer the duration between births. It is

supposed that households that do not have as many sons as they wish, will hurry to have another before it is too late. Underlying this idea is the notion that households may have sequential son preference. Results in Table 7 are based on the accelerated failure time Weibull hazard model. For the two transitions, the coefficient of the variable *boyz* is positive and significant suggesting the presence of son preference in rural Malawi[15]. Among other variables, we controlled for the employment of the father, and for the interval 2 to 3 we find that fathers' employment increases the duration of the birth interval though this effect is insignificant on the next birth interval. Having found that son preference is present in rural Malawi the next thing to be done is to check if it is a valid instrument.

5.2.2 Son preference as an instrumental variable

For a variable to be a good IV, it firstly must be uncorrelated with the error term in our case it must not be correlated with poverty. Secondly, it must be correlated with the endogenous variable. The consistency of our results may be affected by the possibility that the IV may be correlated with the error term, that is it may be endogenous. There are two possible scenarios in which this can happen[16]. Firstly, there is a possibility of using ultrasound services to know in advance the sex of a child which the rich can access, which can then be used to do prenatal sex screening. This would make our IV correlated with economic status (poverty). It however has to be said that while this is possible in rich countries where medical services are very advanced, this cannot be the case in rural Malawi where medical facilities are quite basic. Besides, abortion including sex selective abortion is illegal in Malawi[17]. The second issue which can lead to endogeneity is what Rosenzweig and Wolpin (2000) call the hand-me-down effect. They argue that the cost of children depends on sex composition and show that there is strong evidence for a hand-me-down effect. This is an economies of scale effect where if you have children of the same sex you spend less because there are some things like clothing which can be used by the child coming after. Now if households with children of the same sex spend significantly less money than do households with children of different sexes, this difference in consumption may affect the poverty situation of the household. In this case

[15] To complement these results, we tested (using a t-test) whether or not there is a difference in the average number of children between households with two girls first and those with two boys first. We find that households with two girls first have a significantly higher number of children with a mean difference (standard error) of 0.3036 (0.054).

[16] There is a possibility that poor households may prefer sons to work in the fields, this would also mean that the instrument would be correlated with poverty. We control for this by including a variable which captures whether or not children work outside the home.

[17] There is a possibility of using more traditional sex-targeting mechanisms such as female infanticide and extreme neglect of female children leading to their eventual death (Sen 1984). However, there is no reported evidence of this in Malawi.

therefore the IV is endogenous. In Table 8, we report results of two sample t-tests of mean differences to check for evidence of the hand-me-down effect. If the hand-me-down effect is present, we would expect there to be a statistically significant difference in expenditure on clothing and education by sex of the child. That is, if the hand-me-down effect is present, the expenditure on the two items should be significantly lower for the case where two girls or two boys are first than the case where there is a mix of a boy and a girl. However, we do not find a statistically significant difference in expenditure on the two items between households with two girls first or two boys first and those with a girl and a boy. The implication of this finding is that son preference is not endogenous through the hand-me-down effect. We then need to check the second condition that son preference and fertility are correlated.

We check for the relationship between fertility and our IV by estimating a reduced form univariate probit model of fertility. The results are presented in Table 9. Column 1 leaves out religion, column 2 leaves out region but includes religion, and column 3 has all covariates. Most of the variables have the expected signs. A father's education is a strong predictor of fertility though the education of mother does not have a significant effect on fertility. This probably reflects the fact in rural households a father has a final say on everything including for example contraceptives. And the more educated a father is, the more likely is the family going to adopt family planning. We find that if children work at home it leads to more fertility as more hands are needed for domestic work. Of particular interest is the relationship between the IV and fertility. Having two girls first significantly increases the probability of having more than two children. The relationship holds for all the three specifications presented in Table 9. This suggests that fertility and the IV are correlated[18]. It is worth noting that whether or not we control for religion and region, the effect of having two girls first on the probability of having more than two children is not affected by religion or regional effects.

So far we have found that son preference exists in rural Malawi, and that son preference is a good IV in the sense that it is uncorrelated with poverty and it is correlated with fertility. We now test whether fertility is endogenous. We present two complementary tests of the endogeneity of fertility. Since the confidence intervals do not contain a zero, the cross equation error correlation (rho) results in Table 10 suggest that the null hypothesis of exogenous fertility is rejected at the 5% significance level for all poverty lines. This conclusion is further confirmed by the Wald test results presented in Table 11. As said before failing to account for endogeneity of fertility would lead to biased and inconsistent results. We therefore present results of a recursive bivariate probit which jointly estimates fertility and

[18]This can in a sense be viewed as direct evidence of son preference.

objective poverty.

5.3 Impact of endogenous fertility on objective poverty

In Tables 12-14, we report the marginal effects of the recursive bivariate probit of the impact of fertility on poverty for the three poverty thresholds. For all the three poverty lines, the chi-square statistics suggest that the variables are jointly significant. The maximum likelihood results indicate that fertility and poverty are positively related. The effect is statistically significant. This implies that fertility increases the probability of being poor. The impacts are economically significant with values ranging from 0.139 to 0.304. This relationship is monotonic, as it holds for the three poverty thresholds, suggesting that just like in the base scenario where we assumed fertility to be exogenous, our results are robust to choice of a poverty line. This means that the first order dominance assumption is not violated. Just like the naïve results of exogenous fertility, the impact of endogenous fertility across the poverty lines increases as the poverty line increases i.e. moving from ultra poor to poor. We note however that the total effect of fertility on poverty is larger than the one we got when we assumed that fertility is exogenous. This implies that assuming that fertility is exogenous underestimates its impact on poverty. For all poverty lines, the underestimation is about 1.3 times. It should be pointed out that the statistically significant effect of endogenous fertility is not in conformity with a finding by Gupta and Dubey (2006) for India. They find that the impact of fertility on poverty is statistically insignificant after controlling for endogeneity.

As expected, the dependency ratio is significantly and positively related to poverty across the three poverty lines. The total effect is almost equal to that from the base regressions. The recursive bivariate probit results show that having secondary education for mothers and fathers are statistically significant predictors of poverty. The relationship as expected is negative. In terms of the size of the impact, we note that in the case of the ultra poor model, for a father (mother) having secondary education *ceteris paribus* lowers the probability of being poor by 5.7% (6.6%), with the effect of a mother's education being slightly higher. As was the case with the univariate probit, most of the education variables have the expected negative sign but they are not statistically significant though they appear economically large. With respect to employment, we find that for a father all things being equal, being employed for a wage lowers the likelihood of being poor. The effect is almost the same as that for the base regressions for all poverty thresholds. However, as before wage employment for mothers has no statistically significant effect. The effect seems to be economically significant though, with the magnitudes of the effects similar to those for fathers. Similar to the results from

the simple probits, we find that for the lowest poverty line (ultra poor), growing tobacco has no statistically significant effect though with a marginal effect of about 1% it would suggest that the effect is economically sizeable. Land and livestock increase the probability of being non poor. Having a clinic in a community lowers the probability of being poor by 7% in the poor poverty line model, and this effect is substantial from an economic as well as a statistical perspective.

Two things are coming out of our comparison between the base scenario regressions which assumed that fertility is exogenous and the recursive bivariate probit results. Firstly, all the variables which were significant in the simple probit regressions are also significant after accounting for endogeneity. Secondly, the total effects for the joint estimation of fertility and poverty are generally larger than those for the univariate probit regressions.

So far our analysis has been based on real per capita annualized consumption expenditure. This analysis does not take into account household composition and economies of scales. In the next section, we investigate whether or not the impact of fertility on objective poverty that we have found is robust to accounting for household composition and economies of scale.

5.4 Household composition and economies of scale

The use of per capita consumption expenditure is common in poverty studies; however this procedure has two problems. First, different individuals have different needs. For example, a young child typically requires less food than an adult. Second, there are economies of scale in consumption for such items as housing, kitchen utensils, and utilities such as electricity. It costs less to house two people than to house two individuals separately. Larger households can do bulk buying which can attract discounts. Some studies have shown that the impact of household size on poverty disappears once these two problems are addressed (e.g. Lanjouw and Ravallion 1995; White and Masset 2003). The solution to these problems is to use adult equivalent scales[19]. An adult equivalent scale measures the number of adult males (typically) to which that household is deemed to be equivalent[20]. In this study, we use the arbitrary method to measure equivalence scales; in the literature there are different methods for measuring equivalence scale, none of them commands universal assent (see Deaton and Zaidi 2002). The number of adult equivalents (AE) is defined as follows:

[19]The implication of using per capita consumption for poverty analysis is that households with children are judged poorer on a per capita basis than they would be if their welfare level was measured on an adult equivalent basis. Besides, using the per capita measures overestimates the impact of number of children on poverty.

[20]In keeping with other studies (e.g Lanjouw and Ravallion 1995; White and Masset 2003), in this study we do not make a gender distinction.

$$AE = (A + \pi K)^{\kappa} \tag{12}$$

where A is the number of adults in the household, and K is the of number of children, parameter π is the cost of a child relative to that of an adult, and lies between 0 and 1. The parameter κ which also lies between 0 and 1, controls the extent of economies of scale; since the elasticity of adult equivalents with respect to "effective" size, $A + \pi K$ is κ, $(1 - \kappa)$ is a measure of economies of scale. When both π and κ are unity (the most extreme case with no discount for children or for size) the number of adult equivalents is simply household size, and deflation by household size is equivalent to deflating to a per capita basis. If κ is zero, then economies of scale are so extreme that welfare is the same for different households with the same total consumption expenditure regardless of household size. The choice of the values of the parameters π and κ is arbitrary, we use the following values $\pi = 0.65$ and $\kappa = 0.9$. For the cost of children parameter, our value is based on the one used for Zambia by the World Bank (2005). Being neighbors, we would expect the Zambian figures to be similar to Malawi's. With respect to the economies of scale parameter, our choice is motivated by the fact that in most developing countries food is major component of consumption. And food is largely a private good and therefore there are no economies of scale with food. This implies that a high value of κ should be used. The annualized real consumption expenditure for each household is divided by the adult equivalent (AE) to have consumption per adult equivalent. With this adjustment a household is considered poor if its annualized real consumption per adult equivalent is below the three poverty lines discussed before.

The previous regressions were re-estimated in order to check the robustness of our findings to accounting for household composition and economies of scale. We present results (Table 15) for both univariate probit which assumes exogenous fertility as well as the recursive bivariate probit. We have replicated the previous per capita results for comparison. For the univariate probit regression, the results indicate that the variables are jointly significant. The simple probit results indicate that when we account for economies of scale and household composition, fertility significantly increases the likelihood of being poor across the poverty lines. This effect is monotonic as before implying our results are robust to choice of poverty line, and that the first order dominance assumption is not violated. As was the case with the per capita poverty regressions, we find that for the adjusted regressions the impact of fertility across the poverty lines increases as the poverty line increases i.e. moving from ultra poor to poor. However, as expected adult equivalent scale adjustment reduces the impact of fertility on poverty. The reductions are economically substantial. For the ultra poor poverty line, the reduction is about 83.4%, for the World Bank U$S1 line the reduction is 77.6%,

and finally for the poor poverty line the reduction is 37.8%. This implies that the higher the consumption the lower the reduction in the impact of fertility after adult equivalent adjustments.

For the bivariate probit regressions a similar pattern emerges[21]. After accounting for the endogeneity of fertility as well as economies of scale and household composition, fertility significantly increases the likelihood of being poor across the poverty lines. Besides, the impact is not as economically significant as that for per capita models, as it ranges from 0.012 to 0.177, compared against a range of 0.139 to 0.304 for the unadjusted models. Our results are robust to choice of poverty line and the impact of fertility across the poverty lines increases as the poverty line increases i.e. moving from ultra poor to poor. Compared with the results from the simple probit models which account for economies of scale and household composition, we note that the impact of fertility on poverty is underestimated in the simple probit models. However, compared with the per capita bivariate probit results, the results show that the impact is reduced. For the ultra poor model the reduction is 91.4%, for the World Bank U$S1 line the reduction is 77.8%, and finally for the poor poverty line the reduction is 35%. These are economically significant reductions. We also notice that these reductions are not very different from those found for univariate probit models. These findings suggest that it is quite possible that the impact of fertility would be economically insignificant with some values of the equivalent scale parameters[22].

The conclusion from these results is that accounting for economies of scale and household composition reduces the impact of fertility on poverty, and that these reductions are economically large. However, the impact of fertility is still statistically significant regardless of whether or not fertility is exogenous or endogenous. This far we have looked at the impact of fertility on poverty with poverty defined as a dummy. In the next section, we investigate the robustness of our results to treating objective poverty as a continuous variable.

5.5 Impact of fertility on continuous objective poverty

With poverty treated as continuous, we estimated a Two Stage least Squares (2SLS) regression of the impact of fertility on poverty measured as the log of real annualized per capita

[21] For the bivariate probit regression with adult equivalent adjustment we also find that fertility is endogenous, with the following Wald statistics (p values) for the three poverty lines; Ultrapoor 8.1933 (0.0042), World Bank 4.2567 (0.0391), Poor 4.392 (0.0361).

[22] Another way of accounting for economies of scale is to directly include household size and the square of household size in the poverty equation, however this approach ignores the interactions that may exist between economies of scale and other variables included in the model.

and adult equivalent adjusted consumption expenditures[23]. For the 2SLS regression all right hand variables for the two regressions remain the same as in the bivariate probit[24]. In this framework, we also estimated a naïve regression which assumes that fertility is exogenous. This is done by using Ordinary least Squares (OLS). All right hand variables are the same as those for the univariate probit regressions. The results are presented in Table 16. The results indicate that for the OLS regression, fertility is negatively related to both per capita and adult equivalent adjusted consumption. This implies that having more than two children lowers consumption and hence increases poverty. This is similar to the finding earlier where poverty is defined as a dummy. The impact of fertility on poverty is lower when we account for economies of scale and household composition. Again this is similar to our earlier findings. The regression based Hausman test for endogeneity (see Woodridge 2002 for details) shows that fertility is endogenous. This implies that our OLS results may be biased and inconsistent.

The 2SLS results, which account for this endogeneity show that as is the case with the OLS results, fertility is significantly negatively related to both per capita and adult equivalent adjusted consumption. However, the impact of fertility on consumption is higher when we account for endogeneity of fertility. For example, the OLS results of the per capita regression underestimate the effect of fertility by about 2.3 times. The finding that accounting for endogeneity raises the impact of fertility on poverty is similar to the one before where poverty is defined as a dummy. Additionally, the impact of endogenous fertility is reduced when we account for economies of scale and household composition. The reduction after accounting for endogeneity of fertility (2SLS) is about 20%. We also note that this reduction though economically large is smaller than the reductions found for poverty defined as a dummy.

To conclude, these results suggest that our earlier findings are robust to a different conceptualization of objective poverty. Specifically, with objective poverty defined as a continuous variable; fertility increases the likelihood of being poor, that this effect is underestimated when the joint determination of the two is not accounted for, and that accounting for household composition and economies of scale diminishes the effect. Our analysis so far has looked at poverty in the objective and monetary sense which is a narrower definition of poverty. In the next section, we present econometric results of the impact of fertility on subjective poverty which is based on self reported well being.

[23]The F-statistic of the first stage regression on the excluded instrument (girlIV) is 247.18 with a p-value of 0.000. The partial R^2 of the excluded instrument is 0.0376. Together these statistics suggests our IV is not weak.

[24]The coefficient for the instrument is .172 with a p-value of 0.000 suggesting that if the first two children are girls significantly increases the number of children.

5.6 Impact of fertility on subjective poverty

As before, we test for evidence of endogeneity between fertility and subjective poverty[25]. We find no evidence that fertility is endogenous with respect to subjective poverty. This is in stark contrast to the objective poverty analysis where we find that fertility is endogenous. We therefore present results in Table 17 of a univariate probit regression since fertility is exogenous.

Fertility is found to significantly lower the likelihood that a household will be subjectively poor. We find that fertility lowers the probability of being poor by about 3%. This result is however different from the objective poverty analysis where we find consistently that fertility increases the probability of being poor. This perhaps reflects rural Malawi's social cultural context where those households with more children are treated with respect and those with few or without children are looked at with some contempt. That is, having more children elevates your status in society and these intangible benefits feed into peoples' sense of wellbeing. Another possible explanation is that there is discounting taking place in the sense that households with more children expect to have a higher future discounted income and therefore feel less poor[26]. The results also suggest that the higher the dependency ratio, the lower the subjective poverty, again we found an opposite effect for monetary poverty. In terms of the magnitudes, we note that the probability of feeling poor is lowered by 2.5%. The fact that having more dependents makes households feel less poor can also be explained by the cultural context that the more people depend on you the higher will be your social status. And this intangible benefit is reflected in lower subjective poverty.

Interestingly, for all the other variables the results are similar in terms of the signs and statistical significance to those for monetary poverty. For example; education of the father, number of enterprises, loans, growing tobacco, land, and ownership of livestock lower the likelihood of being subjectively poor. We included a dummy variable marital status to capture some of the characteristics of the household head. We have three classes; monogamous (mono), polygamous (poly) and the base category is those who are not married i.e. widowed, divorced, or separated[27]. The results indicate that being married lowers the probability of feeling poor. We further note that the decrease in the likelihood of feeling poor is higher for polygamous households than it is for monogamous households. Specifically, relative to being widowed, divorced, or separated, being polygamous lowers the probability of being

[25] We estimated a recursive bivariate probit of subjective poverty and fertility, the Chi-square value (P-value) of the Wald test for exogeneity of fertility is 0.17 (0.6766).

[26] We would like to thank Erik Thorbecke for pointing out this possible explanation.

[27] In our sample 64% are monogamous, 9.6% are polygamous, and 26.4% are either widowed or divorced or separated.

subjectively poor by 7.6% as against 5.9% for monogamous households. The same cultural explanation can be given here where being married raises your status, and having more wives further increases the respect that people may give you. The level of per capita annualized real consumption is also included to capture household income status. We find that household economic status lowers the probability of feeling poor by about 10%.

5.7 Sample selection bias

As discussed earlier, our results are based on a restricted sample of women aged between 20 and 40, and the oldest child is under 17. This is motivated by the fact we need to have households which still have at least the first two children at home. However, this restriction may lead to a selected sample i.e. a non-random sample. Sample selection may bias our results. Sample selection may arise from; a) the possibility that older children may still be at home, b) the fact that women in developing countries tend to marry at a very young age, and c) the possibility that some women may start bearing children much later in life. To check the extent to which the restriction affects our results, we re-estimated the previous regressions with the mother's age relaxed to between 17 and 50, and the oldest child to under 20. With this relaxation, the sample size increases to 4572 rural households.

The results are similar to those found before, thus giving us confidence that our conclusions are invariant to the age restrictions. For example (compare with Table 15), when objective poverty is defined as a dummy and we control for household composition and economies of scale, the marginal effects (standard errors) of fertility for the recursive bivariate probit are 0.014 (0.003), 0.035 (0.006) and 0.148 (0.021) for ultra poor, World Bank U$S1 and poor poverty lines respectively. The same picture emerges when objective poverty is defined as a continuous variable (compare with Table 16), with 2SLS coefficients (standard errors) of fertility being -0.426(0.126) and -0.325 (0.116) for per capita and adult equivalent adjusted consumption respectively[28]. Similarly, the relaxation does not change our conclusions regarding the impact of fertility on subjective poverty. The marginal effect and standard error of fertility on subjective poverty (compare with Table 17) are -0.022 and 0.002 respectively.

5.8 Two child versus one child families

In keeping with the literature (e.g. Angrist and Evans 1998; Gupta and Dubey 2006), our analysis has been based on the restriction of our sample to families with at least two children.

[28] The results are also similar for exogenous fertility on objective poverty.

We have argued that son preference which we use as our IV, would be more evident in the birth of the third child and not the second child, since most families prefer having at least two children. With this restriction, the corresponding son preference IV (two girls first) only works in causing exogenous variation in the transition from the second to the third child. However, with this restriction, the higher-order birth IV may be correlated with poverty. It may potentially be correlated with poverty in the sense that poorly nourished women may have difficulty conceiving three times. This possible correlation may make the IV invalid, and thus making our results inconsistent. To check if our results are affected by this potential problem, we re-estimated the previous regressions using a sample of families with at least one child. For these new regressions, fertility (Z_i) is re-defined as equal to one if a household has more than one child and zero if it has one[29]. The corresponding IV (M_i), is re-defined as a dummy equal to one if the first child is a girl, and zero if the first child is a boy[30]. With this relaxation, the sample size increases to 6595 rural households.

The pattern of results is generally similar to those found before albeit with higher marginal effects[31]. For example (compare with Table 15), when objective poverty is defined as a dummy and we control for household composition and economies of scale, the marginal effects (standard errors) of fertility for the recursive bivariate probit are 0.032 (0.002), 0.044 (0.003) and 0.203 (0.001) for ultra poor, World Bank U$S1 and poor poverty lines respectively. A similar conclusion is arrived at when objective poverty is defined as a continuous variable (compare with Table 16), with 2SLS coefficients (standard errors) of fertility being -0.612(0.014) and -0.511 (0.033) for per capita and adult equivalent adjusted consumption respectively. Interestingly, with the relaxation we find that the marginal effect of fertility on subjective poverty is lower. The marginal effect and standard error of fertility on subjective poverty (compare with Table 17) are -0.014 and 0.004 respectively. This suggests that while having a child makes a household feel less poor, higher-order births have an even bigger effect on subjective poverty. Since the general findings are not different from those found using a sample of families with at least two children, this reassures us that our conclusions are robust to the definition of family size.

[29] See equation 4, for comparison.

[30] See equation 3, for comparison.

[31] The mother's age was restricted to between 15 and 40, and the oldest child to under 17. It should be pointed out that alternative restrictions did not affect our conclusions.

6 Conclusions

In the paper, we sought to find the impact of fertility on poverty while recognizing the fact that the two variables are jointly determined. The study uses data from the Second Malawi Integrated Household Survey (IHS2). By using a natural experiment, son preference as our instrumental variable, we are able to use exogenous variation in number of children to uncover the causal effect of fertility on poverty of rural households in Malawi. First, we have looked at poverty defined in the monetary sense. A menu of three poverty lines has been used to check the sensitivity of our results to the choice of a poverty line. Results from the naïve probit models show that fertility increases the likelihood of being poor. Since fertility is found to be endogenous, we estimated a recursive bivariate probit where son preference is used as an IV. For the bivariate probit models, it has been found that fertility increases the likelihood of being poor as well. However, this effect is larger for endogenous fertility, implying that when fertility is treated as exogenous its effect on poverty is underestimated. For both the base scenario of exogenous fertility and that of endogenous fertility, its impact has been found to be robust to choice of poverty line. The positive impact of fertility on objective poverty has also been shown to hold when household composition and economies are accounted for, though the effect tends to be reduced. It has also been demostrated that when objective poverty is conceptualized as a continuos variable this does not change our finding that fertility increases poverty and that its effect is higher when fertility is endogenous.

Second, we have looked at poverty defined more broadly by using self rated assessments of welfare. It has been shown that subjective poverty and objective poverty are related albeit weakly. Interestingly, fertility has been found to be exogenous with respect to subjective poverty, probably suggesting that the endogeneity of fertility is a monetary phenomenon. In terms of its impact on subjective poverty, it has been found to have the opposite effect to that found under objective poverty. That is having more than two children lowers the probability of feeling poor, probably reflecting the fact that having more children elevates your status in society and these intangible benefits feed into peoples' sense of wellbeing. This contradiction in the impact of fertility on the narrower objective poverty and the broader subjective poverty might be a possible explanation for why families in rural Malawi have many children (in spite of this making them poor in the objective monetary sense) as it makes them feel less poor.

Though the study is able to estimate a causal relationship between fertility and poverty, it is worth pointing out that the study is static in nature and therefore cannot capture dynamic aspects of the relationship between poverty and fertility.

References

Angrist, J. D. and Evans, W.N., (1998), "Children and Their Parents' Labor Supply: Evidence from Exogenous Variation in Family Size," *American Economic Review* Vol. 88, pp. 450-477.

Becker, G. and Lewis H.G., (1973), "On the Interaction between the Quantity and Quality of Children," *Journal of Political Economy*, Vol. 81, pp. 279-288.

Bielicki, T. (1986), "Physical Growth as a Measure of Economic Well-being of Populations: The Twentieth Century ," *In Human Growth: A Comprehensive Treatise*, 2nd ed. (F. Falkner and J. Tanner, Ms.). New York: Plenum, Vol. 3

Birdsall, N. (1977), "Analytical Approaches to the Relationship of Population Growth and Development," *Population and Development Review,* Vol. 3, pp. 63- 102.

Birdsall, N. and C. Griffin, (1988), "Fertility and poverty in developing countries, " *Journal of Policy Modeling*, Vol. 10, pp. 29-55.

Birdsall, N., (1980), "Population and Poverty in the Developing World," World Bank Staff Working Paper, 404, Washington D.C.: The World Bank.

Bokosi F.K (2006), "Household Poverty Dynamics in Malawi: A bivariate probit analysis," *Journal of applied sciences*, Vol. 7, pp. 258-262.

Bronars, S.G., and Grogger, J., (1994), "The Economic Consequences of Unwed Motherhood: Using Twins as a Natural Experiment," *American Economic Review,* Vol. 84, pp. 1141–1156.

Casterline, J., Cooksey, E., and Ismail, A. (1987), "Household Income and Survival in Egypt," Population, Health, and Nutritional Technical Note 87- 12, The World Bank, Washington,D.C.

Chernichovsky, D., 1984, "Socioeconomic correlates of fertility behavior in rural Botswana," *Genus*, Vol. 40 , pp. 129-146.

Chun H and Oh J. (2002), "An instrumental variable estimate of the effect of fertility on the labour force participation of married women," *Applied Economics Letters,* Vol. 9, pp. 631-634

Cohen, B. and W. House, (1994), "Demographic behavior and poverty: micro-level evidence from southern Sudan," *World Development*, Vol. 22, pp. 1031-1044.

Deaton A and Zaidi S (2002), "Guidelines for Constructing Consumption Aggregates For Welfare Analysis,". Living Standards Measurement Study Working Paper No 135, Washington, D.C: The World Bank.

Devereux S, Baulch B, Phiri A, Sabates-Wheeler R (2006), "Vulnerability to Chronic Poverty and Malnutrition in Malawi: A report for DFID Malawi," [online] available at www.aec.msu.edu/fs2/mgt/caadp/malawi_pva_draft_052606_final_draft.pdf

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

Godlonton S and Keswell M (2005), "The impact of health on poverty: evidence from the south African: integrated family survey,"*South African Journal of Economics,* Vol 73, pp. 133-148.

Greene, W.H. (2003), *Econometric Analysis*, Upper Saddle River, NJ: Prentice Hall

Grootaert, C. (1997), "The Determinants of Poverty in Cote d'lvoire in the 1980s," *Journal of African Economies*, Vol. 6, pp. 169-196.

Gupta N .D and Dubey A (2005), "Fertility and the Household's Economic Status: A Natural Experiment using Indian Micro Data," *Journal of Development Studies*, Vol. 42, pp. 110-138.

Haughton J. and Haughton D. (1998), "Are simple tests of son preference useful? An evaluation using data from Vietnam," *Journal of population economics,* Vol. 11, pp. 495-516

Hentschel, J., and Lanjouw, P., (1996), "Constructing an indicator of consumption for the analysis of poverty:Principles and illustrations with reference to Ecuador," Living standards measurement study working paper no. 124. The World Bank, Washington, DC.

Kalugina E. Najman B. (2002), "Labour and Poverty in Russia Self-Rated Perceptions and Monetary Evaluations," [online] available on http:// ecsocman.edu.ru/images/pubs/2004/02/10/0000148505/07_01_03.pdf

Ketkar, S. L., (1979),"Determinants of Fertility in a Developing Society: The Case of Sierra Leone," *Population Studies*, Vol. 33, pp. 479-488.

Kingdon G.G and Knight J. (2003), "Well-being poverty versus income poverty and capabilities poverty ?" CSAE working paper series no. 16

Langani, Y.,(1997),"Groupes sociaux et fécondité au Burkina Faso. Une étude à partir de l'EDS de 1993," Mémoire de DEA. Institut de démographie. Louvain-la-Neuve, Université catholique de Louvain.

Lanjouw, P. F. and Ravallion, M. (1995), "Poverty and household size," *Economic Journal*, Vol. 105, pp. 1415-1434.

Lokshin M., Umapathi N., Paternostro S. (2004),"Robustness of Subjective Welfare Analysis in a Poor Developing Country," World Bank Policy Research Working Paper No.3191

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

Manski, C. (1993), "Identification of Endogenous Social Effects: The Reflection Problem," *Review of Economic Studies*, Vol. 60, pp. 531-542.

Monfardini C and Radice R (2008), "Testing exogeneity in the bivariate probit model: a Monte Carlo study, " *Oxford Bulletin of Economics and Statistics*, Vol. 70, pp. 271-282.

Mukherjee S and Benson T. (2003), "The Determinants of Poverty in Malawi," *World Development,* Vol. 31, pp. 339-358.

National Statistical Office (1998),"Malawi population and housing census: Report of final census results," Zomba, Malawi: National statistical office, December

National Statistical Office (NSO) (2005), "Integrated household survey" [online] available at http://www.nso.malawi.net/data_on_line/economics/ihs/IHS2/overviewIHS2.html

Noumbissi, A. and J.-P. Sanderson, (1998), "Pauvreté et comportements démographiques au Cameroun," in F. Gendreau (ed.), Crises, pauvreté et changements démographiquesdans les pays du Sud. Paris: Estem, pp. 149-163.

Olsen, R.J. (1983), "Mortality Rates, Mortality Events, and Number of Births," *American Economic Review* Vol. 73, pp. 29-32.

Olsen, R.J. (1987), "Cross-Sectional Methods for Estimating the Replacement of Infant Deaths," *Research in Population Economics* (T.P. Schultz, Ed.). Greenwich, Connecticut: JAI, Vol. 6.

Pradhan M. and Ravallion M. (2000),"Measuring poverty using qualitative perceptions of welfare," *Review of Economics and Statistics*, Vol. 82, pp. 462-472.

Ravallion, M. (1996), "Issues in Measuring and Modeling Poverty," *Economic Journal,* Vol. 106, pp. 1328-1343.

Ravallion M., and Lokshin M.(2002), "Self-Rated Economic Welfare in Russia," *European Economic Review,* Vol. 46, pp.1453-1473.

Rosenzweig, M.R., and Schultz, T.P. (1987), "Fertility and Investments in Human Capital:Estimates of the Consequences of lmperfect Fertility Control in Malaysia," Yale University Economic Growth Center Discussion Paper No. 534, New Haven,Connecticut.

Rosenzweig, M.R., and Wolpin, K.I. (1980), "Testing the Quantity-Quality Fertility Model: The Use of Twins as a Natural Experiment," *Econometrica,* Vol. 48, pp. 227-240.

Rosenzweig M. and Wolpin K. (2000), "Natural "Natural Experiments," *Journal of Economic Literature,* Vol. 38, pp 827-874.

Sen, A. (1984), *Resources, Values and Development,* Cambridge, M.A.: Harvard University Press.

United Nations Development Fund (UNDP) (2006), "Human development report,"[online] http://hdr.undp.org/hdr2006/statistics/countries/country_fact_sheets/cty_fs_MWI.html

Van Praag, B.M.S., (1971), "The welfare function of income in Belgium: An empirical investigation," *European Economic Review*, Vol. 2, pp. 337-369.

White, H. and Masset, E. (2003), "Constructing the poverty profile: An illustration of the importance of allowing for household size and composition in the case of Vietnam," *Development and Cultural Change*, Vol. 34, pp. 105-126.

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

Wooldridge, Jeffrey M. (2002), *Econometric Analysis of Cross Section and Panel Data*, Cambridge, Mass: MIT Press.

World Bank (2005), "Zambia: Poverty and Vulnerability Assessment," Report No 32573-ZM [online] available at http://www.sarpn.org.za/documents/d0001457/index.php

Table 1: Poverty lines and associated poverty rates

Poverty line name	Poverty index	Poverty line per year	Poverty measure	
			Restricted	All
Ultra poor	Headcount		21.8%	24.4%
	Poverty gap	MK10029	5.1%	5.8%
	Poverty severity		1.7%	2.0%
Poor	Headcount		52.5%	56.4%
	Poverty gap	MK16165	17.7%	19.3%
	Poverty severity		7.8%	8.7%
World Bank (US$1)	Headcount		27.7%	30.6%
	Poverty gap	MK11051	6.9%	7.9%
	Poverty severity		2.5%	2.9%

Notes: The ultra poor poverty line is a food poverty line. The poverty lines are expressed in Malawi Kwacha (MK).

Table 2: Poverty headcount and fertility

Poverty line name	Number of Children	Poverty Headcount	
		Restricted	All
Ultrapoor	Less than three	15.9%	17.5%
	Between three and six	33.1%	33.9%
	Greater than six	45.3%	42.8%
Poor	Less than three	46.2%	47.3%
	Between three and six	69.1%	69.8%
	Greater than six	74.5%	71.6%
World Bank (US$1)	Less than three	21%	22.8%
	Between three and six	40.8%	41.2%
	Greater than six	52.3%	48.8%

Notes: The ultra poor poverty line is a food poverty line.

Table 3: Subjective poverty and number of children

	Subjectively poor headcount	
Number of children	**Restricted**	**All**
Less than three	83.5%	85.38%
Between three and six	84.6%	85.12%
Greater than six	76%	76.51%

Table 4: Objective poverty and subjective poverty

Absolute poverty line		Subjective poverty: Non poor	Poor	Total
Ultrapoor	Non-Poor	**1,261**	6,759	8,020
	Poor	98	**1,709**	1,807
	Total	1,359	8,468	9,827
	Cramér's V = 0.1156	Chisquare= 157.9	Prob> Chisquare = 0.000	
Poor	Non-Poor	**987**	4,195	5,182
	Poor	372	**4,273**	4,645
	Total	1,359	8,468	9,827
	Cramér's V = 0.1596	Chisquare= 260	Prob> Chisquare = 0.000	
World Bank	Non-poor	**1,224**	6,283	7,507
	Poor	135	**2,185**	2,320
	Total	1,359	8,468	9,827
	Cramér's V = 0.1290	Chisquare= 191.5	Prob> Chisquare = 0.000	

Table 5: Sample statistics

	Restricted		All households	
Variable	**Mean**	**Standard Deviation**	**Mean**	**Standard Deviation**
Demographics				
childno	2.910627	.0365515	2.423051	.0286636
twok	.7608118	.0082506	.6108187	.0066297
agemoth	29.10582	.1096724	37.50181	.240289
depratio	1.361335	.0169433	1.187387	.0141034
girlIV	.188402	.0071974	.1373361	.00457
agemobirth	19.40541	3.838322	19.85218	3.949439
Education				
prifem	.0983405	.0067846	.1014171	.0059358
primal	.1592433	.0108257	.1680409	.0084645
JCEfem	.0558154	.0046985	.0536465	.0037974
JCEmale	.1136867	.0065776	.1101352	.0050674
MSCEmal	.0438612	.0042456	.0372241	.0031862
fathnon	.751661	.0023005	.807705	.0034122
mothnon	.891231	.0017032	.927293	.0062371
fathpri	.1127936	.0063001	.0954657	.0041973
motpri	.0589645	.0041884	.0425612	.0027699
fasec	.1355454	.0073334	.096829	.0050333
motsec	.0498045	.0044107	.0300455	.0025036
Employment				
wagefath	.2328373	.010074	.1859403	.0076554
wagemot	.0414332	.0042292	.0309512	.003083
chworkhom	.504807	.010293	.5184155	.0073577
workout	.0446999	.0041152	.0746205	.0039465
noenterp	.4597906	.016602	.4164337	.0131016
Agriculture				
loan	1050.168	98.66299	1635.488	582.397
tob	.2657778	.0119243	.2382278	.0097572
landpc	0.58458	2.652096	0.64926	1.424733
lnlivestpc	6.184791	.02887696	6.380213	.0250001
Religion				
muslim	.125529	.0077292	.1220689	.0066006
catholic	.257815	.0109174	.2680185	.0093857
protestant	.6340125	.0120363	.6403704	.0100509
Community				
clinic	.2998732	.0222924	.2924817	.021051
trading	.0224902	.0064503	.024335	.0067625
Region				
north	.1271692	.0045091	.1283621	.0034756
centre	.4070733	.0083056	.4092272	.0059133
Sample size	3402		6595	

Notes: Restricted rural households are those which; have a mother aged between 20 and 40, the oldest child under 17, and have at least two biological children. All households are rural households with at least one child.

Table 6: Marginal effects of the impact of exogenous fertility on poverty

Variable	Ultrapoor	Worldbank	Poor
Demographics			
twok	0.109***	0.134***	0.225***
	(0.013)	(0.016)	(0.027)
agemoth	0.004***	0.004**	0.006***
	(0.001)	(0.001)	(0.002)
depratio	0.040***	0.057***	0.109***
	(0.007)	(0.009)	(0.016)
agemobirth	−0.010***	−0.010***	−0.017***
	(0.002)	(0.002)	(0.003)
Education			
prifem	−0.028	−0.042	−0.123***
	(0.026)	(0.033)	(0.046)
primal	−0.013	−0.013	−0.013
	(0.019)	(0.023)	(0.038)
JCEfem	−0.017	−0.023	0.043
	(0.034)	(0.039)	(0.060)
JCEmale	0.041	0.033	0.055
	(0.026)	(0.033)	(0.051)
MSCEmal	−0.047	−0.049	−0.117
	(0.045)	(0.051)	(0.075)
fathpri	−0.006	−0.008	−0.056
	(0.025)	(0.031)	(0.047)
motpri	−0.010	0.017	0.084
	(0.035)	(0.048)	(0.065)
fasec	−0.053**	−0.088***	−0.189***
	(0.024)	(0.028)	(0.053)
motsec	−0.070***	−0.066*	−0.184***
	(0.025)	(0.038)	(0.062)
Employment			
wagefath	−0.038***	−0.038**	−0.060**
	(0.013)	(0.016)	(0.024)
wagemot	−0.034	−0.039	−0.012
	(0.025)	(0.031)	(0.047)
chworkhom	0.008	0.026	0.020
	(0.014)	(0.017)	(0.025)
workout	0.020	0.046	0.071
	(0.028)	(0.036)	(0.051)
noenterp	−0.020*	−0.033**	−0.095***
	(0.011)	(0.013)	(0.019)
Agriculture			
loan	−0.031**	−0.041*	−0.049**
	(0.002)	(0.021)	(0.024)
tob	−0.012	−0.036**	−0.096***
	(0.014)	(0.016)	(0.023)
landpc	−0.021***	−0.028***	−0.034**
	(0.004)	(0.003)	(0.017)
lnlivestpc	−0.032***	−0.040***	−0.062***
	(0.004)	(0.005)	(0.007)
Religion			
muslim	0.031	0.023	0.035
	(0.026)	(0.030)	(0.042)
catholic	0.029	0.032	0.018
	(0.019)	(0.024)	(0.033)
protestant	0.036**	0.021	0.001
	(0.017)	(0.022)	(0.032)

Table 6: continued

Variable	Ultrapoor	Worldbank	Poor
Community			
clinic	−0.033***	−0.048***	−0.071***
	(0.012)	(0.014)	(0.021)
trading	−0.028	−0.042	−0.093
	(0.032)	(0.038)	(0.062)
Region			
north	0.016	0.010	0.045
	(0.017)	(0.020)	(0.031)
centre	−0.105***	−0.144***	−0.190***
	(0.012)	(0.015)	(0.022)
Loglikelihood	−1274.66	−1470.5	−1904.2
Chisquare	511.47	624.9	892.5
Prob > Chisquare	0.00	0.00	0.00
Sample size	3402	3402	3402
M^{c}Fadden R^2	0.167	0.175	0.19

Notes: The significance asterisks are defined as follows: * p<0.10, ** p<0.05, *** p<0.01. The dependent variable is a poverty indicator based on annualized per capita real consumption expenditure. The coefficients are marginal effects evaluated as partial changes at the mean value of the continuous covariates. For dummy covariates, the partial changes are measured as a discrete change in the poverty indicator as the dummy covariate changes from 0 to 1. Numbers in parentheses are standard errors.

Table 7: Accelerated failure time Weibull model

Variable	Mean	Hazard ratio	Transition 2 to 3	Hazard ratio	Transition 3 to 4
boyz	1.94	1.12	0.114***	1.11	0.113***
			(0.018)		(0.023)
wagefath	.2328	2.71	0.100**	0.92	−0.073
			(0.046)		(0.062)
chworkhom	.5048	0.90	−0.103**	0.74	−0.299***
			(0.048)		(0.081)
workout	.0446	0.77	−0.259***	1.16	0.156*
			(0.074)		(0.081)
F-statistic			4.79		5.50
Prob > F-statistic			0.00		0.00
Sample size			2720		1651

Notes: The significance asterisks are defined as follows: * p<0.10, ** p<0.05, *** p<0.01. The dependent variables are birth intervals moving from 2 to 3 children, and moving from 3 to 4 children. In addition to the new variable boyz, the models also include all the other covariates included in the previous models. The hazard ratio is an exponentiated coefficient. Numbers in parentheses are standard errors.

Table 8: Son preference and the hand-me-down effect

Variable	Sample mean (μ)	Mean difference ($\mu - \mu_{mix}$)
Two girls first		
Education	1458.875	322.929
	(264.87)	(197.309)
		[0.1017]
Clothing	4431.883	324.835
	(7022.024)	(199.979)
		[0.1043]
Two boys first		
Education	1199.512	63.566
	(70.881)	(100.73)
		[0.5280]
Clothing	4173.29	66.249
	(91.23)	(118.75)
		[0.5769]

Notes: Mean differences are defined as the sample means of rural households which have two girls first (two boys first) (μ) minus the sample of rural households which have a mix in the first two children i.e. boy and a girl (μ_{mix}). The means are weighted. Numbers in parentheses are standard errors. Numbers in square brackets are p-values. The significance asterisks are defined as follows: * p<0.10, ** p<0.05, *** p<0.01.

Table 9: Marginal effects of reduced form univariate probit regressions of fertility

Variable	(1)	(2)	(3)
Demographics			
agemoth	0.001*	0.001*	0.001*
	(0.001)	(0.001)	(0.001)
depratio	0.148***	0.149***	0.148***
	(0.023)	(0.023)	(0.023)
girlIV	0.102***	0.103***	0.102***
	(0.020)	(0.020)	(0.020)
agemobirth	−0.019***	−0.019***	−0.019***
	(0.004)	(0.004)	(0.004)
foster	0.003	0.003	0.003
	(0.003)	(0.003)	(0.003)
Education			
prifem	−0.003	−0.004	−0.003
	(0.019)	(0.019)	(0.018)
primal	0.027	0.025	0.025
	(0.016)	(0.017)	(0.016)
JCEfem	0.020	0.023	0.019
	(0.025)	(0.024)	(0.024)
JCEmale	0.074***	0.074***	0.073***
	(0.020)	(0.020)	(0.020)
MSCEmal	0.084***	0.085***	0.083***
	(0.028)	(0.028)	(0.028)
fathpri	−0.029	−0.029	−0.024
	(0.027)	(0.027)	(0.026)
motpri	−0.005	−0.007	−0.007
	(0.025)	(0.025)	(0.026)
fasec	−0.152***	−0.151***	−0.146***
	(0.052)	(0.052)	(0.051)
motsec	−0.044	−0.052	−0.046
	(0.043)	(0.044)	(0.043)
Employment			
wagefath	0.007	0.006	0.007
	(0.008)	(0.008)	(0.008)
wagemot	0.017	0.018	0.017
	(0.011)	(0.011)	(0.011)
chworkhom	0.103***	0.103***	0.104***
	(0.026)	(0.025)	(0.026)
workout	0.026	0.028*	0.027*
	(0.016)	(0.016)	(0.016)
noenterp	−0.001	−0.001	−0.001
	(0.006)	(0.006)	(0.006)
Agriculture			
loan	0.003	0.005	0.002
	(0.006)	(0.004)	(0.002)
tob	0.011	0.016**	0.010
	(0.007)	(0.008)	(0.007)
landpc	−0.002	−0.001	−0.003
	(0.003)	(0.002)	(0.003)
lnlivestpc	−0.005*	−0.004	−0.005
	(0.003)	(0.003)	(0.003)

Table 9: continued

Variable	(1)	(2)	(3)
Religion			
muslim		0.011	0.016
		(0.011)	(0.011)
catholic		0.001	−0.001
		(0.010)	(0.010)
protestant		0.016	0.015
		(0.011)	(0.011)
Community			
clinic	0.007	0.008	0.007
	(0.007)	(0.007)	(0.007)
trading	−0.001	−0.001	−0.001
	(0.022)	(0.022)	(0.021)
Region			
north	−0.004		−0.002
	(0.012)		(0.012)
centre	0.020**		0.022**
	(0.008)		(0.009)
Loglikelihood	−867.28	−870.62	−864.89
Chisquare	2006.61	2001.93	2013.39
Prob > Chisquare	0.00	0.00	0.00
Sample size	3402	3402	3402
M°Fadden R^2	0.536	0.535	0.538

Notes: The significance asterisks are defined as follows: * p<0.10, ** p<0.05, *** p<0.01. The dependent variable is a dummy for more than two children. The coefficients are marginal effects evaluated as partial changes at the mean value of the continuous covariates. For dummy covariates, the partial changes are measured as a discrete change in the poverty indicator as the dummy covariate changes from 0 to 1. Numbers in parentheses are standard errors.

Table 10: Cross equation error correlation

Name of poverty line	Rho	95% Confidence Interval	
Ultra poor	-.2431234	-.3882092	-.0862774
Poor	-.1865539	-.3436128	-.0193431
World Bank (US$1)	-.177207	-.326869	-.0188744

Table 11: Wald test for exogeneity of fertility

Name of poverty line	Chi square	Prob. > Chi square
Ultra poor	9.05406	0.0026
Poor	4.76884	0.0290
World Bank (US$1)	4.79995	0.0285

Table 12: Impact of endogenous fertility on poverty (ultra poor)

	Poverty Equation			Fertility Equation
Variable	**Direct effect**	**Indirect effect**	**Total effect**	**Total effect**
Demographics				
twok	0.139***		0.139***	
	(0.014)		(0.014)	
girlIV		0.011**	0.011**	0.105***
		(0.005)	0.005)	(0.020)
agemoth	0.003***	0.001	0.004***	0.001
	(0.001)	(0.001)	(0.001)	(0.001)
depratio	0.057***	−0.028***	0.043***	0.151***
	(0.008)	(0.006)	(0.007)	(0.023)
agemobirth	−0.011***	0.003***	−0.009***	−0.020***
	(0.002)	(0.001)	(0.002)	(0.005)
Education				
prifem	−0.027	−0.002	−0.028	−0.002
	(0.023)	(0.004)	(0.024)	(0.017)
primal	−0.010	−0.007*	−0.013	0.028*
	(0.015)	(0.004)	(0.016)	(0.016)
JCEfem	−0.014	−0.006	−0.017	0.020
	(0.031)	(0.006)	(0.033)	(0.024)
JCEmale	0.047**	−0.012**	0.042*	0.074***
	(0.024)	(0.005)	(0.025)	(0.021)
MSCEmal	−0.032	−0.022***	−0.043	0.085***
	(0.042)	(0.008)	(0.044)	(0.029)
fathpri	−0.009	0.005	−0.006	−0.030
	(0.020)	(0.006)	(0.022)	(0.028)
motpri	−0.007	0.001	−0.007	−0.007
	(0.029)	(0.006)	(0.031)	(0.025)
fasec	−0.063***	0.014	−0.057**	−0.146***
	(0.020)	(0.009)	(0.023)	(0.054)
motsec	−0.065***	−0.001	−0.066***	−0.048
	(0.022)	(0.006)	(0.024)	(0.043)
Employment				
wagefath	−0.035***	−0.005**	−0.037***	0.007
	(0.012)	(0.002)	(0.013)	(0.008)
wagemot	−0.031	−0.006**	−0.034	0.019*
	(0.022)	(0.003)	(0.023)	(0.011)
chworkhom	0.018	−0.021***	0.007	0.108***
	(0.014)	(0.006)	(0.014)	(0.025)
workout	0.027	−0.006	0.024	0.030*
	(0.026)	(0.004)	(0.027)	(0.016)
noenterp	−0.019*	−0.002	−0.020*	−0.001
	(0.011)	(0.001)	(0.011)	(0.006)
Agriculture				
loan	−0.021***	−0.032***	−0.053***	0.001
	(0.001)	(0.002)	(0.002)	(0.001)
tob	−0.010	−0.003	−0.012	0.010
	(0.014)	(0.002)	(0.015)	(0.007)
landpc	−0.011***	−0.003	−0.012**	−0.001
	(0.001)	(0.003)	(0.002)	(0.001)
lnlivestpc	−0.030***	−0.002**	−0.031***	−0.005
	(0.004)	(0.001)	(0.005)	(0.003)

Table 12: Continued

Variable	Poverty Equation: Direct effect	Poverty Equation: Indirect effect	Fertility Equation: Total effect	Fertility Equation: Total effect
Religion				
muslim	0.031	−0.002	0.031	0.017
	(0.028)	(0.003)	(0.029)	(0.012)
catholic	0.025	0.002	0.027	0.000
	(0.019)	(0.003)	(0.020)	(0.011)
protestant	0.035**	−0.000	0.035**	0.016
	(0.015)	(0.003)	(0.016)	(0.012)
Community				
clinic	−0.029**	−0.004*	−0.031**	0.006
	(0.014)	(0.002)	(0.014)	(0.007)
trading	−0.027	−0.002	−0.029	−0.000
	(0.032)	(0.004)	(0.033)	(0.019)
Region				
north	0.012	0.001	0.013	−0.001
	(0.022)	(0.004)	(0.023)	(0.013)
centre	−0.093***	−0.013***	−0.100***	0.023**
	(0.015)	(0.004)	(0.015)	(0.009)
Chisquare	725.23			
Prob > Chisquare	0.00			
Sample size	3402			

Notes: The significance asterisks are defined as follows: * p<0.10, ** p<0.05, *** p<0.01. The coefficients are marginal effects. For variables which appear in both the poverty and fertility equations, the marginal effects are decomposed into two effects. The direct effect produced by its presence in the poverty equation, and an indirect effect which works through the fertility equation. The sum of the two makes the total effect. The total effect may not exactly equal the sum of the two effects due to rounding. Numbers in parentheses are standard errors. The poverty equation is based on annualized per capita real consumption expenditure.

Table 13: Impact of endogenous fertility on poverty (World Bank)

	Poverty Equation			Fertility Equation
Variable	**Direct effect**	**Indirect effect**	**Total effect**	**Total effect**
Demographics				
twok	0.167***		0.167***	
	(0.020)		(0.020)	
girlIV		0.010*	0.010*	0.106***
		(0.005)	(0.005)	(0.020)
agemoth	0.003**	−0.002	0.003**	0.001
	(0.001)	(0.002)	(0.001)	(0.001)
depratio	0.080***	−0.033***	0.059***	0.150***
	(0.010)	(0.007)	(0.010)	(0.023)
agemobirth	−0.013***	0.004***	−0.010***	−0.020***
	(0.002)	(0.001)	(0.002)	(0.005)
Education				
prifem	−0.040	−0.002	−0.042	−0.003
	(0.034)	(0.005)	(0.035)	(0.017)
primal	−0.008	−0.008*	−0.013	0.027
	(0.017)	(0.004)	(0.018)	(0.016)
JCEfem	−0.018	−0.007	−0.023	0.020
	(0.036)	(0.007)	(0.038)	(.024)
JCEmale	0.043	−0.016***	0.033	0.075***
	(0.031)	(0.006)	(0.032)	(0.021)
MSCEmal	−0.030	−0.024***	−0.046	0.086***
	(0.049)	(0.009)	(0.051)	(0.029)
fathpri	−0.012	0.006	−0.008	−0.028
	(0.025)	(0.007)	(0.027)	(0.028)
motpri	0.017	0.003	0.019	−0.007
	(0.046)	(0.007)	(0.048)	(0.024)
fasec	−0.099***	0.015	−0.091***	−0.147***
	(0.024)	(0.010)	(0.028)	(0.054)
motsec	−0.064*	0.003	−0.062*	−0.046
	(0.035)	(0.009)	(0.038)	(0.043)
Employment				
wagefath	−0.035**	−0.004*	−0.038**	0.007
	(0.016)	(0.002)	(0.016)	(0.008)
wagemot	−0.036	−0.006**	−0.040	0.018
	(0.027)	(0.003)	(0.028)	(0.011)
chworkhom	0.039**	−0.024***	0.024	0.108***
	(0.017)	(0.006)	(0.017)	(0.025)
workout	0.053	−0.006	0.050	0.029*
	(0.034)	(0.005)	(0.035)	(0.016)
noenterp	−0.031**	−0.002	−0.033**	−0.001
	(0.013)	(0.002)	(0.013)	(0.006)
Agriculture				
loan	−0.026***	−0.022**	−0.046**	0.002
	(0.002)	(0.005)	(0.001)	(0.002)
tob	−0.032*	−0.005**	−0.035*	0.010
	(0.017)	(0.002)	(0.018)	(0.007)
landpc	−0.002*	−0.002	−0.004	−0.002
	(0.001)	(0.002)	(0.003)	(0.002)
lnlivestpc	−0.038***	−0.001*	−0.039***	−0.005*
	(0.005)	(0.001)	(0.006)	(0.003)

Table 13: Continued

Variable	Poverty Equation: Direct effect	Poverty Equation: Indirect effect	Poverty Equation: Total effect	Fertility Equation: Total effect
Religion				
muslim	0.025	−0.003	0.023	0.017
	(0.033)	(0.004)	(0.034)	(0.012)
catholic	0.029	0.002	0.030	−0.000
	(0.023)	(0.003)	(0.024)	(0.011)
protestant	0.022	−0.002	0.021	0.015
	(0.021)	(0.003)	(0.022)	(0.012)
Community				
clinic	−0.043**	−0.005*	−0.046**	0.007
	(0.018)	(0.002)	(0.019)	(0.007)
trading	−0.040	−0.003	−0.042	−0.001
	(0.037)	(0.005)	(0.038)	(0.020
Region				
north	0.007	0.001	0.008	−0.001
	(0.027)	(0.004)	(0.029)	(0.013)
centre	−0.130***	−0.015***	−0.141***	0.024**
	(0.019)	(0.005)	(0.019)	(0.009)
Chisquare	828.37			
Prob > Chisquare	0.00			
Sample size	3402			

Notes: The significance asterisks are defined as follows: * p<0.10, ** p<0.05, *** p<0.01. The coefficients are marginal effects. For variables which appear in both the poverty and fertility equations, the marginal effects are decomposed into two effects. The direct effect produced by its presence in the poverty equation, and an indirect effect which works through the fertility equation. The sum of the two makes the total effect. The total effect may not exactly equal the sum of the two effects due to rounding. Numbers in parentheses are standard errors. The poverty equation is based on annualized per capita real consumption expenditure.

Table 14: Impact of endogenous fertility on poverty (poor)

	Poverty Equation			Fertility Equation
Variable	**Direct effect**	**Indirect effect**	**Total effect**	**Total effect**
Demographics				
twok	0.304***		0.304***	
	(0.040)		(0.040)	
girlIV		0.015**	0.015**	0.106***
		(0.008)	(0.008)	(0.020)
agemoth	0.006***	−0.003	0.006***	0.001
	(0.002)	(0.002)	(0.002)	(0.001)
depratio	0.169***	−0.081***	0.109***	0.148***
	(0.020)	(0.016)	(0.017)	(0.023)
agemobirth	−0.024***	0.010***	−0.016***	−0.019***
	(0.004)	(0.003)	(0.003)	(0.005)
Education				
prifem	−0.119***	−0.005	−0.124***	−0.002
	(0.042)	(0.010)	(0.044)	(0.017)
primal	−0.001	−0.017	−0.014	0.028
	(0.038)	(0.011)	(0.041)	(0.017)
JCEfem	0.048	−0.011	0.041	0.022
	(0.055)	(0.014)	(0.059)	(0.024)
JCEmale	0.084*	−0.041***	0.054	0.075***
	(0.047)	(0.014)	(0.050)	(0.021)
MSCEmal	−0.074	−0.055***	−0.118	0.086***
	(0.070)	(0.019)	(0.074)	(0.029)
fathpri	−0.064	0.013	−0.055	−0.029
	(0.043)	(0.016)	(0.046)	(0.028)
motpri	0.079	0.009	0.088	−0.008
	(0.061)	(0.016)	(0.064)	(0.025)
fasec	−0.228***	0.049*	−0.195***	−0.148***
	(0.043)	(0.025)	(0.050)	(0.054)
motsec	−0.185***	0.009	−0.181***	−0.047
	(0.057)	(0.018)	(0.063)	(0.042)
Employment				
wagefath	−0.055**	−0.007	−0.061**	0.007
	(0.024)	(0.004)	(0.025)	(0.007)
wagemot	−0.008	−0.010	−0.016	0.016
	(0.046)	(0.007)	(0.047)	(0.011)
chworkhom	0.062**	−0.060***	0.016	0.107***
	(0.028)	(0.015)	(0.027)	(0.025)
workout	0.088*	−0.015	0.077	0.029*
	(0.049)	(0.011)	(0.050)	(0.016)
noenterp	−0.091***	−0.004	−0.095***	−0.001
	(0.020)	(0.004)	(0.020)	(0.006)
Agriculture				
loan	−0.028***	−0.001	−0.029***	0.003
	(0.002)	(0.004)	(0.005)	(0.007)
tob	−0.087***	−0.010**	−0.096***	0.011
	(0.028)	(0.005)	(0.029)	(0.007)
landpc	−0.002*	0.002	−0.004	−0.001
	(0.001)	(0.002)	(0.004)	(0.002)
lnlivestpc	−0.060***	−0.004	−0.061***	−0.005*
	(0.007)	(0.002)	(0.007)	(0.003)

Table 14: Continued

Variable	Poverty Equation: Direct effect	Poverty Equation: Indirect effect	Fertility Equation: Total effect	Fertility Equation: Total effect
Religion				
muslim	0.039	−0.008	0.033	0.016
	(0.044)	(0.007)	(0.044)	(0.012)
catholic	0.015	0.001	0.016	−0.001
	(0.033)	(0.006)	(0.035)	(0.011)
protestant	0.006	−0.008	−0.001	0.014
	(0.031)	(0.007)	(0.033)	(0.012)
Community				
clinic	−0.064**	−0.007	−0.070**	0.007
	(0.027)	(0.004)	(0.028)	(0.007)
trading	−0.089	−0.005	−0.094	0.001
	(0.085)	(0.010)	(0.088)	(0.019)
Region				
north	0.040	0.002	0.042	−0.000
	(0.045)	(0.008)	(0.046)	(0.013)
centre	−0.171***	−0.022***	−0.190***	0.024**
	(0.029)	(0.007)	(0.029)	(0.009)
Chisquare	1076.35			
Prob > Chisquare	0.00			
Sample size	3402			

Notes: The significance asterisks are defined as follows: * p<0.10, ** p<0.05, *** p<0.01. The coefficients are marginal effects. For variables which appear in both the poverty and fertility equations, the marginal effects are decomposed into two effects. The direct effect produced by its presence in the poverty equation, and an indirect effect which works through the fertility equation. The sum of the two makes the total effect. The total effect may not exactly equal the sum of the two effects due to rounding. Numbers in parentheses are standard errors. The poverty equation is based on annualized per capita real consumption expenditure.

Table 15: Accounting for household composition and economies of scale (marginal effects)

	Ultrapoor		Worldbank		Poor	
Variable	**per capita**	**AES**	**per capita**	**AES**	**per capita**	**AES**
UNIVARIATE PROBIT						
twok	0.109***	0.018***	0.134***	0.030***	0.225***	0.147***
	(0.013)	(0.004)	(0.016)	(0.005)	(0.027)	(0.015)
All covariates	Yes	Yes	Yes	Yes	Yes	Yes
Chisquare	511.47	208.69	624.9	263.63	892.5	542.73
Prob > Chisquare	0.00	0.00	0.00	0.00	0.00	0.00
Sample size	3402	3402	3402	3402	3402	0.00
M^cFadden R^2	0.167	0.18	0.175	0.176	0.19	0.153
BIVARIATE PROBIT						
Twok	0.139***	0.026***	0.167***	0.037***	0.304***	0.177***
	(0.014)	(0.002)	(0.020)	(0.006)	(0.040)	(0.020)
Instrument	*girlIV*	*girlIV*	*girlIV*	*girlIV*	*girlIV*	*girlIV*
All covariates	Yes	Yes	Yes	Yes	Yes	Yes
Chisquare	725.23	4792.6	828.37	665.49	1076.35	779.68
Prob > Chisquare	0.00	0.00	0.00	0.00	0.00	0.00
Sample size	3402	3402	3402	3402	3402	3402

Notes: The significance asterisks are defined as follows: * p<0.10, ** p<0.05, *** p<0.01. Numbers in parentheses are standard errors. The per capita poverty equations are based on annualized per capita real consumption expenditure, and AES poverty equations are based on annualized real consumption expenditure per adult equivalent scale and economies of scale. For the poverty equations in the bivariate probit we report the total marginal effects only. For brevity total marginal effects of the fertility equation for the bivariate probit are not reported. The per capita results are replicated from earlier regressions for comparison.

Table 16: OLS and 2SLS results of continuous fertility and poverty

Variable	OLS per capita	OLS AES	2SLS per capita	2SLS AES
Twok	−0.298***	−0.172***	−0.568***	−0.456***
	(0.026)	(0.026)	(0.124)	(0.122)
Instrument	–	–	*girlIV*	*girlIV*
All covariates	Yes	Yes	Yes	Yes
Hausman test	–	–	0.281**	0.295**
			(0.125)	(0.123)
Mean of dep variable	9.627	9.99	9.627	9.99
	(.578)	(.547)	(.578)	(.547)
F-stat	59.75	43.45	53.86	40.18
Prob> F-stat	0.00	0.00	0.00	0.00
Sample size	3402	3402	3402	3402

Notes: The significance asterisks are defined as follows: * p<0.10, ** p<0.05, *** p<0.01. Numbers in parentheses are standard errors. The dependent variables for the per capita models are log of the annualized per capita real consumption expenditure. The dependent variables for the AES regressions are the log of the annualized real consumption expenditure per adult equivalent and economies of scale. The Hausman test is a regression based test of endogeneity of fertility.

Table 17: Impact of fertility on subjective poverty

Variable	
Demographics	
twok	−0.025**
	(0.012)
depratio	−0.016***
	(0.005)
mono	−0.059***
	(0.011)
poly	−0.076***
	(0.022)
Education	
prifem	−0.046***
	(0.014)
primal	−0.008
	(0.013)
JCEfem	−0.055***
	(0.019)
JCEmale	−0.012
	(0.014)
MSCEmal	−0.034
	(0.022)
fathpri	−0.041*
	(0.022)
motpri	0.038**
	(0.018)
fasec	−0.134***
	(0.029)
motsec	−0.012
	(0.029)
Employment	
wagefath	−0.010
	(0.012)
wagemot	−0.040
	(0.027)
chworkhom	−0.048***
	(0.011)
workout	0.042***
	(0.015)
noenterp	−0.008
	(0.005)
Agriculture	
loan	−0.002*
	(0.001)
tob	−0.040***
	(0.011)
landpc	−0.032***
	(0.003)
lnlivestpc	−0.024***
	(0.003)
Consumption	
lnrexpapc	−0.099***
	(0.009)

Table 17: Continued

Variable	
Religion	
muslim	−0.087***
	(0.023)
catholic	−0.003
	(0.012)
Protestant	0.001
	(0.012)
Community	
clinic	−0.011
	(0.010)
trading	0.045**
	(0.018)
Region	
north	−0.101***
	(0.017)
centre	−0.039***
	(0.011)
Chisquare	857.003
Prob > Chisquare	0.000
Sample size	3402
McFadden R^2	0.159

Notes: The significance asterisks are defined as follows: * p<0.10, ** p<0.05, *** p<0.01. The dependent variable is a subjective poverty indicator based on the Economic Ladder Question (ELQ. The coefficients are marginal effects evaluated as partial changes at the mean value of the continuous covariates. For dummy covariates, the partial changes are measured as a discrete change in the poverty indicator as the dummy covariate changes from 0 to 1. Numbers in parentheses are standard errors.

7 Appendix

Table A1: Definition of variables

Variable	Definition
Demographics	
childno	Number of children
twok	=1 if household has more than 2 children, 0 if it has 2 children
agemoth	Current age of mother
depratio[c]	Dependency ratio
girlIV	=1 if household has 2 girls first,0 otherwise. Our instrument
agemobirth	Age of the mother at first birth
Education	
prifem	Number of females with primary education in household
primal	Number of males with primary education in household
JCEfem	Number of females with junior secondary education in household
JCEmale	Number of males with junior secondary education in household
MSCEmal	Number of males with senior secondary education in household
fathnon[a]	=1 if fathers highest educational level is none, 0 otherwise
motnon[a]	=1 if mothers highest educational level is none,0 otherwise
fathpri	=1 if fathers highest educational level is primary,0 otherwise
motpri	=1 if mothers highest educational level is primary,0 otherwise
fasec	=1 if fathers highest educational level is secondary,0 otherwise
motsec	=1 if fathers highest educational level is secondary,0 otherwise
Employment	
wagefath	=1 if fathers works for a wage,0 otherwise
wagemot	=1 if mothers works for a wage,0 otherwise
chworkhom	=1 if children work at home,0 otherwise
workout	=1 if children work outside the home,0 otherwise
noenterp	Number of non-agricultural income generating enterprises
Agriculture	
loan	Amount of loan received in Malawi Kwacha
tob	=1 if household grows tobacco,0 otherwise. An indicator of cash crop production
landpc	land per capita measured in square meters
lnlivestpc[b]	log of the per capita value of livestock owned
Religion	
muslim	=1 if muslim,0 otherwise
catholic	=1 if catholic,0 otherwise
protestant	=1 if protestant,0 otherwise
other[a]	=1 if other religions,0 otherwise
Community	
clinic	=1 if community has a clinic,0 otherwise
trading	=1 if community is in a trading centre,0 otherwise
Region	
north	=1 if region is north,0 otherwise
centre	=1 if region is centre,0 otherwise
south[a]	=1 if region is south,0 otherwise

Notes: [a] denotes reference category. [b] The value of livestock is a total values of the following animals; cattle, goats, sheep, pigs, chicken and other poultry. [c] The dependency ratio is measured as the sum of the number of people in a household aged below 15 and above 65 divided by the number of people in a household aged between 15 and 65. The number of females with MSCE (senior secondary) in our sample is zero we therefore don't use it.