A SOCIOECONOMIC ANALYSIS OF FERTILITY DETERMINANTS IN URBAN ETHIOPIA

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Socio-economic Determinants of Fertility in Urban Ethiopia

Abstract

Fertility, being a major study unit in population dynamics, should be analyzed from different perspectives as it plays a pivotal role in understanding the complex issues integral to population growth. The main objective of this study was, therefore, to understand what the micro level major socio – economic determinants of fertility are in the case of urban Ethiopia. Count data models were used to estimate fertility, given by the number of children ever born by a woman, using the Ethiopian Demographic and Health Survey (EDHS) data of 2005. The main findings of the study showed that education, age at first marriage, labor force participation and wealth status of women are negatively related to fertility while child mortality was not found to be a significant determinant of fertility. The findings of the study revealed that fertility decision is influenced by various socio-economic variables and, hence, achieving a low level of fertility rate requires an all rounded sustainable development process that could result in increased education, income and improved status of women in the society.

1. Introduction

Ethiopia is a country having one of the highest fertility rates in the world. According to the United Nations Population Fund (2007), the country is ranked among African countries that have high fertility rate and is not considered to be among the countries at or near the start of the transition to low level of fertility (Sibanda et al, 2003). The country's high population growth rate is also mainly sustained by this high fertility rate. Cognizant of this, the government of Ethiopia has been implementing a National Population Policy starting from 1993 the specific objectives of which includes reducing the total fertility rate (TRF) to approximately four by the year 2015.

The Ethiopian plan for Accelerated and Sustained Development to End Poverty also underlies that the high fertility rate is the major demographic factor behind the high population growth rate of the country and expresses a concern that the high fertility rate is not showing a sign of decline (MoFED, 2005). Since the introduction of the national population policy, the fertility rate of the country has not shown a significant decline and the target of achieving a lower level of TFR still looks out of reach. During the 1990 National Family and Fertility Study the total fertility rate was reported to be 6.4 births per woman, showing a drop of only 0.5 children on average by 2005 (CSA, 2005). However, as can be fairly expected, there is a stark difference in TFR of the urban and rural areas standing at 2.4 and 6 respectively (ibid).

The policies that are directed towards reducing the high TFR strongly focus on family planning initiatives which are mainly supply side solutions. However, the common belief that the widespread availability of contraceptives is the panacea to the problem of high fertility may not be always true. In addition to the supply side factors, demand side factors also play a significant role in influencing fertility decisions. For instance, in the case of Addis Ababa, the nation's capital, between 1990 and 2000 the TFR dropped from 3.3 to 1.9 which is even below the replacement rate. In contrast, the contraceptive prevalence rate was only 34 percent and this drop in the TFR occurred in the absence of any considerable family planning initiatives that could account to such a drastic decline (Simbada et al, 2003). This indicates that there are some underlying indirect socio economic factors that affect the fertility decisions of households. Hence, using the Ethiopian Demographic and Health Survey data, this study tries to look into these household level socio-economic determinants of fertility in urban areas.

The rest of this paper is organized in three sections. Section 2 presents review of literature. Section 3 presents the methodology, model specification and discussion of estimation results while section 4 presents the conclusion.

2. Review of Literature

The micro economic theory of fertility developed by Becker (1960) and Becker and Lewis (1973) has attracted much attention in different empirical studies. Different studies that have attempted to test the quantity-quality tradeoff have found a negative correlation between family size and child quality that supports the theory (Rosenzweig and Wolpin, 1980; Li et al, 2005). However, the relationship between household income and fertility decisions remains to be elusive in many empirical studies. In cases where the husband's income increases the positive relationship is likely to be prevailing as it results in an increased ability to support more children (Freedman and Thornton, 1982). On the other hand, an increase in the wife's earning from her participation in the labor force is shown to have a negative substitution effect by making childbearing a costly activity for the woman (McNown, 2003; Engelhardt et al, 2004).

A wide range of empirical studies also show the existence a consistent relationship between women's education and low fertility (Jain, 1981; Chaundhury, 1984; Axinn, 1993; Bledsoe and Cohen; 1993). According to Jain (1981) education actually affects fertility through two mechanisms. One explanation for the negative effect of female education on fertility is through increasing the potential for educated women to participate in labor force of the modern sectors of the economy. This is expected to increase the opportunity cost of women to rear children and hence, reduce fertility. Second, education of women can also affect fertility through two important intermediate variables – breastfeeding and use of contraceptives by increasing the awareness of women on the benefits of breastfeeding and family planning in general. However, there could also be other indirect ways that education can affect fertility.
On the other hand, Jain (1981) further argues that a small amount of education in least literate societies might initially increase fertility at the early stage of development. This positive relation could arise from a possible income effect.

In the study of micro economic determinants of fertility, it is also argued that child mortality plays a significant role. According to Ben-Porath (1976), the effect of child mortality on fertility is considered to be broken into two components. It can first be assumed that the preferred family life cycle is not affected by child mortality and fertility is an attempt to attain the preferred family size. Second, the possible effect of mortality can be taken into account in the choice of family size. The desired number of children is defined as 'the desired number of surviving children by age of parents, with specification of relevant characteristics such as sex, education, labor force participation and earning' (Ben-Porath, 1976: S164). Hence, obviously, mortality raises the number of births necessary to arrive at the desired number of surviving children. Hoarding and replacement are the two types of reactions to child mortality where hoarding is the response of fertility to *expected* child mortality while replacement is the response to *experienced* child mortality.

An article by Benefot and Schultz (1996) in analyzing individual, household, and community characteristics that may affect fertility in contemporary Cote d'Ivoire and Ghana tries to look into the relationship between child mortality and fertility. Treating child mortality as exogenous, they found out that fertility responds directly to child mortality, but by a smaller proportion than estimated in studies of East Asia and Latin America.

Another determinant of fertility that is commonly employed in empirical studies is age-at-marriage. When women get married at a younger age the probability that they are likely to have more children is going to be high since the exposure to the risk of childbearing in their reproductive years is higher. Early marriage also makes it difficult for women to attain higher level of education. Field and Ambrus (2006), using a data from rural Bangladesh show that women attain less schooling as a result of marrying young. Hence, age-at-marriage may also affect fertility through the intermediate variable- education of women. This gives an indication that age-at-marriage may also affect fertility through education as an intermediate variable.

The household economic model also gives a strong emphasis on the opportunity cost of childbearing, which is female wages, as a determinant of fertility. Female wages are assumed to have counter-acting effect on fertility. On the one hand, the increase in income from the participation of the woman in the labor force affects fertility positively while on the other hand it has a negative substitution effect by making childbearing a costly activity for the woman. Engelhardt et al (2004) examine causality and parameter instability in the long run relationship between fertility and women's employment using a macro-level time-series data from developed countries. In this study they find that there in fact is causality between the two variables and their finding support the micro explanation that women's fertility and their labor force participation affect each other. However, earlier study by Smith-Lovin and Tickamyer (1982) estimated a non-recursive model with number of children ever born and number of years employed as the interdependent endogenous variables and find that the fertility of women has strong effect on their work behavior but there was no effect from work to fertility.

3. Data and Methodology

3.1. Data

The data set used in the study is the Demographic and Health Survey that is conducted by the Central Statistical Agency of Ethiopia in year 2005. The Ethiopian Demographic and Health Survey (EDHS) is a national representative survey of 14,070 women between the age of 15 and 49 and 6,033 men between age 15 and 59. The EDHS is the second comprehensive survey conducted in Ethiopia as part of the worldwide Demographic and Health Survey project (CSA, 2005). This cross sectional data is mainly intended to provide up-to-date and detailed information on fertility, family planning, mortality rates, maternal and child health, nutrition and knowledge of HIV/AIDS.

3.2 Estimation Method

Following other empirical studies on fertility, number of children born by a woman is used as the measure of fertility (Winklemann and Zimmermann (1994); ~~and~~ Schultz and Zeng (1995). In such economic contexts where the dependent variable of interest is a nonnegative integer or count, unlike the classical regression model, the response variable is discrete where the distribution places probability mass at nonnegative integer values only (Wooldridge, 2002). Given this discrete and non-negative nature of our dependent variable, the ordinary least squares (OLS) model is obviously inappropriate as the conditional mean it specifies, $x_i^{'}\beta$, may take negative values and a variance function that is homoskedastic. For count data, linear models have shortcomings very similar to those for binary responses or corner solution responses. This is because $y \geq 0$ and we know that $E(y/x)$ should be nonnegative for all *x*. If $\hat{\beta}$ is the OLS estimator, there usually will be values of *x* such that $x\hat{\beta} < 0$ - so that the predicted value of y is negative, which should not be the case when the dependent variable is of count nature. In count data settings the variables are often skewed to the right and the variance are intrinsically hetroskedastic as the variance increases with the mean. Hence, the appropriate model of estimation are count data models. Accordingly, the basic Poisson and negative binomial models for cross sectional data are employed in this study

The natural starting point of estimation of count data models is the Poisson model where the stochastic model is a Poisson point process for the occurrence of the event of interest. This implies a Poisson distribution for the number of occurrences of the event, with a probability function given as

$$pr[Y = y / \lambda] = \frac{e^{-\mu} \lambda^{y}}{y!}, \qquad y = 0, 1, 2.....N$$

Where λ is the intensity of rate parameter and the first two moments are defined as:

$$E[Y] = \lambda$$
$$V[Y] = \lambda$$

where $E[Y] and\ V[Y]$ are the mean and variance respectively. This equality of the mean and variance shows the equi-dispersion property of the Poisson distribution. The Poisson regression model is therefore derived from the Poisson distribution by using parameterizing the relation between the mean parameter and the regressors where the standard assumption is to use the exponential mean parameterization.

$$\lambda_i = \exp(x_i^{'}\beta) \quad , i = 1,.....N$$

$$V[y_i / x_i] = \exp(x_i^{'}\beta)$$

Since we assume equi-dispersion of the Poisson distribution in the Poisson regression, the Poisson regression is intrinsically hetroskedastic. Given the Poisson distribution of the mean and variance, the appropriate estimator for the Poisson model is maximum likelihood, where the log likelihood function is given by: $\ln\ L(\beta) = \sum_{i=1}^{N} \left\{ y_i x_i^{'} \beta - \exp(x_i^{'}\beta) - \ln y_i\,! \right\}$

The Poisson Maximum Likelihood Estimator denoted $\hat{\beta}$ is the solution to K non-linear equations with the first order condition for maximum likelihood given as:

$$\sum_{i=1}^{N} (y_i - \exp(x_i^{'}\beta)) x_i = 0$$

If x_i includes a constant term then the residuals $y_i - \exp(x_i^{'}\beta)$ sum to zero. The log likelihood function is globally concave; hence solving these equations by Gauss-Newton or Newton-Raphson iterative algorithm yields unique parameters estimates (Cameron and Trivedi, 2002).

However, the Poisson regression measure is usually too restrictive for count data. One apparent deficiency of the Poisson model is that for count data the variance usually exceeds the mean, a feature called over-dispersion while the Poisson model instead implies equality of the variance and the mean, a property called equi-dispersion. Whether the equi-dispersion assumption holds or not has important implications on how the statistical inference is carried out. While the Poisson variance assumption requires the mean to be equal to the variance a weaker assumption allows the variance-mean ratio to be any positive constant:

$$Var(y/x) = \sigma^2 E(y/x)$$

The case where $\sigma^2 > 1$ implies the variance is greater than the mean. Over-dispersion in such models has qualitatively similar consequences as the failure of the assumption of homoskedasticity in the linear regression model. According to Cameron and Trivedi (2005), large over-dispersion leads to grossly deflated standard errors and hence inflated t-statistics in the usual Maximum Likelihood output. A statistical test of over-dispersion is significantly relevant after running Poisson regression. Most count models with over-dispersion specify dispersion with the form:

$$V[y_i / x_i] = \lambda_i + \alpha g(\lambda_i)$$

Where α is an unknown parameter and $g(.)$ is a known function, most commonly $g(\lambda) = \lambda^2$ or $g(\lambda) = \lambda$. It is assumed that under the null hypothesis of $\alpha = 0$, the variance is given by $V[y_i / x_i] = \lambda_i$, generating the usual Poisson regression (ibid).

One cause of over-dispersion in count data may be unobserved heterogeneity. In this case, counts are considered as being generated by a Poisson process but the rate parameter of the process cannot be correctly specified. The rate parameter itself is a random variable. In such cases where there is an over-dispersion a better suited analysis is the full maximum likelihood having a particular parameterization of the negative binomial distribution taking the density function of the form:-

$$pr(Y = y/\lambda,\alpha) = \frac{\Gamma(\alpha^{-1}+y)}{\Gamma(\alpha^{-1})y!}\left(\frac{\alpha^{-1}}{\alpha^{-1}+\lambda}\right)^{\alpha^{-1}}\left(\frac{\lambda}{\lambda+\alpha^{-1}}\right)^{y}$$

Where λ is the mean or the expected value of the distribution and α is the over-dispersion parameter. The likelihood function for the negative binomial model is, therefore, defined as:

$$L(\beta/y,\mathrm{X}) = \prod_{i=1}^{N}\mathrm{pr}(y_i/\mathrm{x}_i) = \exp\prod_{i=1}^{N}\frac{\Gamma(y+\alpha^{-1})}{y!\Gamma(\alpha^{-1})}\left[\frac{\alpha^{-1}}{\alpha^{-1}+\lambda_i}\right]^{\alpha^{-1}}\left[\frac{\lambda_i}{\alpha^{-1}+\lambda_i}\right]^{y_i}$$

$$\text{where } \lambda_{\mathrm{i}} = E[y_i/\mathrm{x}_{\mathrm{i}}] = \exp(\mathrm{x}_{\mathrm{i}}\beta)$$

4. Model Specification and Discussion of Results

The major variables included in the model that are expected to have an effect on the fertility decision of women are education, age, and marital status of the woman; the number of children that were born alive to the woman but died before the age of five; the participation of the woman in income generating activity; the age of the woman when she was first married and a variable to indicate the woman's living status. Since the DHS data set does not incorporate income or consumption data, a wealth index is constructed for the sample in the urban areas. In constructing the wealth index each asset was given a weight that was generated through principal component analysis and each household was then assigned a score for each asset. A single asset index was developed for the whole sample and the sample was accordingly divided into five quintiles from the lowest to the highest scores. The bottom two quintiles were grouped as 'poor', the third quintile as 'middle' and the two higher quintiles as 'rich'.

Table 1. Description of variables and summary statistics

Variable	Definition	Mean	Std dev
Dependent variables			
Children ever born		3.174	2.274
Explanatory variables			
Age	Age in years	33.019	8.430
Age2	Age in years squared		
Marital status (1=married; 0=otherwise)		0.698	0.459
Religion			
Christian	1=Christian; 0=otherwise	0.765	0.424
Muslim	1=Muslim; 0=otherwise	0.233	0.423
Other	1=other; 0=otherwise	0.002	0.048

Education level			
Illiterate	1= illiterate, 0= otherwise	0.335	0.472
Primary education	1= primary education ; 0=otherwise	0.228	0.420
Secondary education	1= secondary education ; 0=otherwise	0.371	0.483
Higher education	1= higher education ; 0=otherwise	0.066	0.248
Wealth status			
Poor	1= poor; 0= otherwise	0.433	0.496
middle	1= middle; 0=otherwise	0.168	0.374
Rich	1= rich; 0=otherwise	0.399	0.490
Child mortality	the number of children that were born alive but died before the age of 5	0.639	1.130
Age at first marriage	Age of the woman at her first marriage	17.340	4.336
Income generation status of woman	1=if the woman was engaged in any income generating activity in the past 12 months; 0=otherwise	0.489	0.500
Region dummies			
Addis Ababa	1=Addis Ababa; 0 = otherwise	0.340	0.474
Tigray	1=Tigray; 0 = otherwise	0.048	0.214
Afar	1=Afar; 0 = otherwise	0.033	0.178
Amhara	1=Amhara; 0 = otherwise	0.057	0.232
Oromiya	1=Oromiya; 0 = otherwise	0.074	0.262
Somali	1=Somali; 0 = otherwise	0.040	0.197
Ben-gumuz	1=Ben-gumuz; 0 = otherwise	0.031	0.175
SNNPRS	1=SNNPRS; 0 = otherwise	0.062	0.242
Gambella	1=Gambella; 0 = otherwise	0.042	0.201
Harari	1=Harari; 0 = otherwise	0.118	0.323
Dire Dawa	1=Dire Dawa ; 0 = otherwise	0.153	0.360

Source: EDHS Data

The regression is estimated using Poisson because the dependent variable was not found to have an over dispersion. This was confirmed from the test for the over dispersion parameters. From the negative binomial regression, the log likelihood test could not reject the null hypothesis that this over dispersion parameter was zero (α=0) (Annex 1). This shows that the equi-dispersion assumption holds and the Poisson regression can be applied. Accordingly, the result of the Poisson regression and its marginal effects are presented in the following table (table 4.5). After performing a simple OLS regression, test for multicollinearity was conducted using VIF and the result showed that there is no serious multicollinearity problem between the variables. Breusch-Pagan test for hetroskedasticity rejected the null hypothesis of constant variance and hence, robust standard errors are computed to correct for the hetroskedasticity.

Table 1 Regression Results

Variables	Poisson regression Coefficients	Poisson Marginal effects
Age	0.1490*** (0.0105)	0.4227*** (0.0300)
Age^2	-0.0014*** (0.0002)	-0.0040*** (0.0004)
Married	0.2817*** (0.0268)	0.7527*** (0.0669)
Age at first marriage	-0.0393*** (0.0028)	-0.1115*** (0.0080)
Muslim	0.2059*** (0.0296)	0.6174*** (0.0939)
Other religion	-0.0716 (0.3257)	-0.1958 (0.8606)
Primary education	-0.0874*** (0.0310)	-0.2422*** (0.0839)
Secondary education	-0.1749*** (0.0318)	-0.4850*** (0.0865)
Higher education	-0.2352*** (0.0499)	-0.6042*** (0.1163)
Child mortality	0.0147 (0.0093)	0.0417 (0.0264)
Middle	-0.0136 (0.0329)	-0.0384 (0.0926)
Rich	-0.0525* (0.0294)	-0.1472* (0.0827)
Income generating women	-0.0489** (0.0226)	-0.1387** (0.0640)
Tigray	0.0900** (0.0458)	0.2661** (0.1408)
Afar	-0.1529** (0.0704)	-0.4044** (0.1731)
Amhara	-0.0661 (0.0548)	-0.1823 (0.1466)
Oromiya	0.1180*** (0.0409)	0.3523*** (0.1282)
Somali	0.1930*** (0.0509)	0.5992*** (0.1724)
Ben-Gumuz	-0.0371 (0.0835)	-0.1036 (0.2288)
SNNPRS	0.3277*** (0.0403)	1.0769*** (0.1521)
Gambella	0.0606 (0.0555)	0.1768 (0.1666)

Table 1. continued …

Harari	-0.0500 (0.0379)	-0.1393 (0.1034)
Dire Dawa	-0.0397 (0.0349)	-0.1112 (0.0963)
Constant	-1.7670 (0.1747)	
Number of observations	2129	
Log likelihood	-3464.24	
Pseudo R^2	0.1980	
Wald chi2 Statistics	3306.89***	
Likelihood Ratio	1868.52***	

Notes: Standard errors in parentheses. Coefficients are significant at the *10 percent, **5 percent, ***1 percent

According to the result from the regression, it is found that fertility is positively related with age while the negative sign pertaining to the variable age squared implies a quadratic relationship between age and fertility behavior to reflect the biological factors that may limit the fertility of women as they grow older. This finding is consistent with the CSA (2005) report which indicates that fertility is low among adolescents and increases to a peak of 241 births per 1,000 among women of age 25-29 and declines thereafter.

Education has entered the model in level form, rather than by year of schooling. The reference category for analyzing the results is the variable 'no education'. Accordingly, women's education is found to affect fertility negatively. Secondary and higher education were significant at 1 percent while primary education was significant at 5 percent. The result implies that women who have acquired formal education are likely to have lower number of children than those women with no education, other variables remaining constant.

This finding is in line with the argument of Bledsoe and Cohen (1993) which indicate that throughout the world, formal schooling for women is the single most consistent variable correlated with their low fertility. Women with no formal education are also less empowered to make their own decisions in their households. Fertility decisions may not always necessarily be the choice of the woman and could be imposed by the husband or other family members. Though the woman may not want to have additional number of children, the fact that she is dependent on her husband and other family members for her welfare forces her to adhere to their fertility choices. Hence, education, by increasing the status of women in a society, empowers women to make their own choices and decisions regarding their lives and matters in their households including fertility. Those women with education and their own source of income tend to be independent in making their own choices and are less likely to be influenced by others with regards to their fertility choices.

The other mechanism through which higher level of education leads to lower fertility is through the increased opportunity of women to participate in the labor force. Women with education are likely to have their own means of income other than being completely swallowed up with the daily household chores, which mainly includes child rearing. The fact that these women are engaged in income generating activities makes the opportunity cost of childrearing activities very high. Allocating majority of time at the household could be viewed as a costly activity to the mother leading to a decision to limit her fertility. Consistent with this argument, the regression result indicates that women who are engaged in income generating activities are likely to have lower number of children than those who are not.

The wealth status of women is also found to affect fertility decisions. The result indicates richer women are likely to have lower fertility than poorer households. This finding is in line with fertility theories that speculate this negative relationship arguing that families with higher income and status tend to substitute quantity of children with quality (Becker and Lewis, 1973; Leibeinstein, 1975). Such families tend to invest more on their children in terms of their schooling and other basic needs. This shift in focus from having many children to increased consciousness about their 'quality' could be one way to explain the inverse relationship between the wealth status and fertility (ibid).

The marital status dummy takes a value of one if the woman is currently married and zero otherwise. According to the regression result, currently married women have a higher probability of having higher number of children that those who are not married, other things remaining constant. This is also in line with the findings of Sibanda et al (2003) who, in their attempt to explain the low fertility rate in Addis Ababa, find that the single most important factor that is responsible for the low fertility is the increased proportion of unmarried women.

The sign of the variable age at first marriage is negative indicating that as the age of a woman at her first marriage increases she is more likely to have lower number of children. Early female marriage is associated with a number of poor social and physical outcomes for young women and their children. On average, girls who marry as adolescents attain lower schooling, have lower social status in their husbands' families and report less reproductive control (Field and Ambrus, 2006). Even if these women may have awareness about family planning, their status as decision makers of their households could be undermined due to their high dependence on their husbands for welfare. These factors, in addition to the fact that early marriage implies a longer exposure to fertility in the reproductive time of a woman, in turn have a high potential to increase the number of children a woman would have in her reproductive period. These individual outcomes suggest a number of larger social consequences of early marriage which includes higher population growth.

The religious beliefs of people, almost always, affect their decisions in various matters. People who accept children as 'gifts from God' are less likely to exercise control over their fertility behaviors. Hence, different religious teachings and beliefs have a significant influence on the decision of households regarding their fertility. In this study it was found that Muslim women are more likely to have more number of children than Christians. This could be a reflection of beliefs on the use of contraceptives and other particular doctrinal values that could affect fertility decisions directly or indirectly.

With regards to the regional dummies incorporated in the model, the regions that were found to be significantly different from the reference region, Addis Ababa, are Tigray, Oromiya, Somali and SNNPRS. According to the result, a person living in these regions has a higher probability of having an additional child than those living in Addis Ababa, other things remaining constant. The fact that women living in Addis have better information and access to family planning methods could have contributed to this difference in fertility. The lower fertility in Addis could also be a result of high cost of living that is witnessed in the city than the other urban towns forcing families to limit their number of children. Higher level of awareness concerning the possible negative impact of having many children on welfare could also make households living in the city more cautious on their fertility decisions.

On the other hand, child mortality was not found to significantly affect fertility decisions. One possible explanation could be the reduced experience or expectation of child mortality due to the spread of health facilities in major urban towns. Moreover, the variable that captures the participation of women in income generating activities was not found to be significant. The extended family system that lends a hand to women in taking care of their children could explain why this factor is not affecting their fertility decision significantly.

5. Conclusion

The analysis of the study has shown that the major socio-economic determinants of fertility that were found to affect fertility significantly are age, education, wealth status and religion. The effects of education and wealth status were found to be negative and significant while age affects fertility positively up to some point and negatively afterwards - as depicted by the negative sign of the variable age in its quadratic form.

The findings indicate socio-economic variables play a significant role in determining fertility decisions of households. The fact that education and income mainly affect fertility decisions has an important implication that a policy that is directed to reducing fertility should not only simply focus on family planning campaigns but should be all rounded in addressing development issues. It further sheds light on the fact that population reduction is an outcome of an overall development process of a nation with improved services on education, income and general status of its people.

Though this study mainly emphasized on those variables that affect fertility and considers a one way relationship between these variables and fertility, the possibility of feedback effect from fertility to the variables, especially income and participation of women in income generating activity, cannot be altogether ruled out. Hence, there is a room for further investigation of the possible causal relationship between these variables by employing simultaneous equation frameworks. Similar studies can also be extended to the rural settings to get a countrywide understanding of the issues pertaining to fertility.

Appendix

Table 1. Results of negative binomial regression

age	0.1490 (0.0105)***
age2	-0.0014 (0.0002)***
age at first marriage	-0.0393 (0.0028)***
primary education	-0.0874 (0.0310)***
secondary education	-0.1749 (0.0318)***
higher education	-0.2352 (0.0500)***
muslim	0.2059 (0.0296)***
other religion	-0.0715 (0.3257)
married	0.2817 (0.0268)*
income generating woman	-0.0489 (0.0226)***
child mortality	0.0147 (0.0093)
middle	-0.0136 (0.0329)
rich	-0.0522 (0.0295)*
Tigray	0.0900 (0.0458)**
Afar	-0.1529 (0.0704)**
Amhara	-0.0661 (0.0548)
oromiya	0.1180 (0.0409)*
Somali	0.1930 (0.0509)*
Ben-Gumuz	-0.0372 (0.0835)
SNNP	0.3277 (0.0403)*
Gambella	0.0606 (0.0555)
Harrari	-0.0500 (0.0379)
Dire Dawa	-0.0397 (0.0349)
_cons	-1.7181 (0.1728)*
lnalpha	-16. 5882 (.06932)
alpha	6.25e-08 (4.33e-09)

Likelihood-ratio test of alpha=0: chibar2(01) = 0.0e+00 Prob>=chibar2 = 0.500

Table 2 - VIF

secondary educ	1.92
rich	1.71
primary educ	1.46
higher educ	1.44
muslim	1.36
Somali	1.32
Ben-Gumuz	1.32
Dire Dawa	1.31
middle	1.3
Gambella	1.24
age at first marriage	1.21
Amhara	1.21
oromiya	1.21
Harrari	1.19
Afar	1.17
SNNP	1.16
Tigray	1.15
age	1.14
income generating woman	1.13
married	1.11
other religon	1.01
child mortality	1.01
Mean VIF	1.28

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