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Demand for Children in India: Poisson Regression Estimation of Household Fertility Decision

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Abstract: Economic growth not only entails social changes but also brings about demographic changes through declining fertility and mortality rates. Population growth mainly depends on household fertility decisions and human capital investments including healthcare and nutritional aspects. This paper analyses the determinants of demand for children by households in India. The data is derived from the 2011-2012 Second India Human Development Survey. Since the number of children born to a household is a count data, the Poisson regression method is used in the empirical analysis. The estimates of Poisson regression show that the age and employment of women, and household income have positive effects while female education and household urban residence have a negative effect on the number of children a household has in India.

Keywords: Household fertility decision, number of children, count data, Poisson regression

INTRODUCTION

The 20th-century increase in economic and social development has been historically unprecedented which has also considerably brought down not only mortality rates but also fertility rates. This has considerably reduced global population growth rates though differentially across the world (Myrskyla *et al.* 2013). It is no surprise that socioeconomic development negatively influences fertility is an established and accepted empirical regularity in social sciences (Becker, 1960; 1991; Easterlin, 1975; Easterlin and Crimmins, 1985). While women averaged six to seven births in the early stages of economic development, the average number of children per woman declined to two or even fewer births in most countries, with improved health, education, employment, and social and environmental developments

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(Bongaarts and Hodgson, 2020). However, the reverse is not always true: a fall in the fertility rate of a country does not necessarily result in economic development. The fertility decline can also happen due to poor health care conditions, increased infant mortality rate, improper sanitation facilities, poverty, unemployment and various other social factors (Davis and Blake, 1956). On the other hand, fertility decline can be mainly due to increased women's education and labour force participation which postpones age at marriage and pregnancy, especially of first births (Bongaarts, 1978). Importantly, the modern contraceptive pill has played a key factor in the sharp decline in fertility in Western countries during the 1960s and 1970s (Westoff, 1983).

In India, the fertility level has been declining gradually since 1971. While Bihar has the highest fertility rate, Tamil Nadu has the lowest fertility rate. In Uttar Pradesh, Rajasthan, Madhya Pradesh, Jharkhand and Chhattisgarh the fertility rates are more than the average fertility of India. Since the women's age is considered to be an important factor affecting fertility levels, the number of live births per thousand women in the reproductive age reaches a peak in the age group 20-24 and declines after that. Compared to rural women, urban women's fertility is low. The rural age-specific fertility rate has declined very steeply after attaining a peak for the age 20-24 while the urban fertility curve has gradually declined up to the age 25-29 after attaining a peak at the age group 20-24.

The variations in the fertility rates are due to various socio-economic factors. The literature on fertility has evidence that the educational attainment of women is directly related to their opportunity cost of time and inversely related to fertility. The inverse relationship is predicted to be stronger the higher the women's education level lower her preference. It is evident that there exists a negative relationship between the education level of women and their fertility rate. However, a different scenario is reported in Kerala. It is the only state where the general fertility rate increases as the women get a better education.

In his seminal work on household behaviour, Becker (1960) argues that household fertility decisions are just like household decisions on consumption and therefore children can be considered as consumer durable goods. Each family produces its own children and tries to achieve their desired number of children. As usual, there is a positive relation between the income of the household and the number of children and a negative relationship between the price of children and the number of children. The price of children is the amount spent on having and raising children as well as the opportunity cost of time of parents measured in terms of wage rates. Becker also takes into account the knowledge of contraceptive use by parents.

Therefore, according to Becker income, knowledge of contraceptive use and cost of children are the significant fertility determinants.

Easterlin (1975) and Easterlin and Crimmins (1985) point out that family fertility decisions depend also on the potential number of children and the costs of fertility regulation besides demand for the children. The demand for children is the number of surviving children parents would want if the fertility costs were low which is determined by the income, the price of children compared with other goods. The potential fertility is the number of children parents would want to produce if they did not deliberately limit their fertility depending on the natural fertility (biological and physiological factors) and the survival prospects of the child. Motivation for fertility regulation also has a huge influence where if the family doesn't receive any incentive upon following the regulation or the costs of fertility control are high then they are likely to increase the output. On the other hand, if the situation is an excess supply where the motivation for fertility control is higher than the fertility costs, then the family is likely to produce less number of children. The growing literature on household fertility decisions also incorporates models of intrahousehold conflict and bargaining to bear on fertility choice, as the review by Doepke and Kindermann (2017) shows.

Therefore, deciding on the number of children a household would like to have is an important household decision as it influences the economic status of the family. It is therefore important to understand how the education and employment of women affect the fertility decisions of households and what happens to household preferences for children when the income of the family increases. Further, it is also useful to know whether the place of residence of the household has an influence over the fertility decision and whether social factors like religion have any impact on the household decisions on fertility. Hence, the main objective of this paper is to identify the factors influencing household fertility decisions in India. This paper uses the 2011-2012 India Human Development Survey II in the empirical analysis. Since the variable of interest in this paper, the number of children is in the form of counts, the appropriate statistical tool to be used is the Poisson regression method.

REVIEW OF LITERATURE

Theoretically, the pathbreaking work of Becker (1960) who formulated the economic theory of household behaviour, has been the cornerstone for much of the substantial albeit controversial works on household fertility behaviour. The economics of population literature has advanced many theories of fertility, the prominent being the new home economics based on the microeconomic theory of consumer behaviour (Becker, 1960). For most

parents, children are a source of pleasure, a psychic income or satisfaction and therefore children are treated as 'consumer durables'. Accordingly, in the household production function approach, children are viewed as household production and the demand for children is influenced by the cost-benefit calculations, the chief cost being the value of time inputs of parents evaluated by the wage rates. Easterlin (1975) and Easterlin and Crimmins (1985) incorporate supply-side considerations like biological birth function and costs of fertility regulations. Within the microeconomic tradition of fertility behaviour Rosenzweig (1977) and Rosenzweig and Evenson (1977) regard children as a form of 'capital' – a means of earning income, and Nugent (1985), Nugent *et al.* (1983), Chennichovsky (1982) and Cain (1983) view children as a source of 'security against risk and old age'. However, many non-economists object to the reduction of children as commodities and favour fertility as an outcome of biological factors that are 'proximate' determinants and the diverse socio-economic and cultural conditions (Blake, 1968). Moreover, neither the monetary income nor the old age security provided by children is fixed and reliable as they vary with the age and earnings of children, making children vulnerable to durable consumption and production goods.

One of the problems faced by economists is the issue of seeing children as 'inferior' as fertility declines with rising income. However, children cannot be treated as inferior goods as they are demanded by all households irrespective of income status. Education, especially female education, is often seen as a significant factor in the fertility decisions of couples. Moreover, an increase in female education increases the opportunity cost of women's time and thereby childcare is costly. Hence, fertility decisions respond to education through the price of women's time and relative income within the household. Becker and Tomes (1976) develop such a price-of-time model with a 'quantity-quality' trade-off, where potential parents can trade quality for quantity. The parental demand for quality children implies a rapid rise in the demand for quality relative to the demand for quantity with increases in income. Therefore, though income increases increase both the quantity and quality of children, the respective elasticities differ. With the rise in income of the household, the quantity elasticity is relatively smaller than the quality elasticity.

In the related literature, an alternative explanation offered by Richard Easterlin (1975) argues that the number of children a household has is based on the interaction between rising income in relation to the accompanying rising aspirations of the household. This relative income hypothesis explains that households focus on their per capita disposable income rather than absolute income and with rising material aspirations households have to

necessary adjustments in the demand for children in order to keep it on par with material aspirations. In the case of less developed economies, the growth in the wages of younger workers is slower than that of elder workers due to labour market crowding. Therefore, the earnings of the young worker will be low compared to his material aspirations. Hence, young couples either postpone or forego marriage in order to maintain their level of per capita disposable income.

Though both models of fertility decline underline a positive relationship between income and fertility, the explanations for the negative relationship offered seem to be different. However, a deeper insight implies that fundamentally the difference is only myopic as the 'rising material aspirations' and the 'increasing demand for quality' with rising income are intertwined and the one influences the other. Hence, the 'price of time' and 'relative income' models are relevant in developing countries as well as developed countries to explain the fertility transition.

Empirically, Wang and Famoye (1997) analyse household fertility decisions using the US national-level longitudinal data applying the generalized Poisson regression method of estimation. The effects of the income of the household, the employment status of the wife and her educational level on the number of children in the household are significantly negative. The substitution effect due to higher price associated with high quality of child is larger than the income effect. The empirical results of this paper also support the neoclassical theory of the opportunity cost of raising children.

Pandey *et al*. (1998) analyse the fertility differentials due to socioeconomic and demographic factors for all of India and also state-wise using the 1992-93 National Family Health Survey data. The paper uses the method of parity progression ratios to explain the family-building process and apply the multivariate analysis to fertility. The results show that when a woman has one son, her preference to have another child is lower than the woman who has no son. Also, rural women have higher progression ratios than urban women, but this vanishes when controlled for education level. Urban women are likely to have fewer children as they have a higher educational status compared to rural women. One of the key findings of the paper is when a woman is more exposed to electronic mass media, her progression ratio is much lower than those who do not have frequent access to electronic media.

DATA AND METHODOLOGY

The empirical analysis of household fertility decisions in India of this paper uses the India Human Development Survey II (2011-2012). The IHDS II sample is drawn from 33 states and union territories covering urban as well

as rural households. The IHDS II survey consists of 42,152 households in 1503 villages and 971 urban neighbourhoods. A detailed discussion of the methodology and the survey can be found in the IHDS technical report (Desai *et al.* 2010). The data contains a wealth of information on individual age, income source, employment, wages, occupation, education level, educational expenditure, earnings, number of household members, residence, house ownership, empowerment, etc. From the IHDS II survey, this paper considers households with married women aged between 18 to 40 years. The sample size for this study has been 27,275 households. As the fertility variable, the number of children is of discrete count data ranging from 0-18, this paper uses the Poisson regression model in the empirical estimation. In the Poisson regression model, the conditional variance is restricted to be equal to the mean.

POISSON REGRESSION MODEL

In the Poisson regression model, the response variable y is a count data in the sense that the units can take only non-negative integer values {0, 1, 2, 3...}. As these integers arise from counting, the underlying function follows a Poisson distribution. Unlike the ordinary linear regression model, in the Poisson regression model, the errors follow a Poisson, not normal, distribution and the regression coefficients are the logarithm of the expected value of y which is a linear combination of the unknown parameters.

Given a set of explanatory variables x, the Poisson regression is expressed as,

$$ln\ [E(y \mid x)] = \alpha + \beta' x = \theta' x \tag{1}$$

where x is an (n +1) vector of n independent variables with a vector of ones. The θ′s are concatenated to β. The predicted mean of the associated Poisson distribution is given by,

$$[E(y \mid x)] = \lambda = e^{\theta' x} \tag{2}$$

As y_i is not linear, the θ′s are estimated by the maximum likelihood method. The probability mass function of Poisson distribution is given by,

$$p(y \mid x;\theta) = \frac{\lambda^y}{y!} e^{-\lambda} = \frac{e^{y\theta' x} e^{-e^{\theta' x}}}{y!} \tag{3}$$

Given the data on y and x, and a set of parameters θ, the probability of attaining this particular set of data is given by,

$$p(y_1, y_2, ..., y_m \mid x_1, x_2, ..., x_m;\theta) = \prod_{i=1}^{m} \frac{e^{y\theta' x} e^{-e^{\theta' x}}}{y!} \tag{4}$$

Rewriting the equation as a likelihood function in terms of θ yields,

$$L(\theta \mid x, y) = \Pi_{i=1}^{m} \frac{e^{y\theta' x} e^{-e^{\theta' x}}}{y!} \tag{5}$$

Note that the right-hand side expression has not actually changed. Then, the log-likelihood may be written as,

$$\ln L(\theta \mid x, y) = \Sigma_{i=1}^{m} [y_i \theta' x_i - e^{\theta' x_i} - \ln(y_i^!)] \tag{6}$$

As the first two terms of each term in the summation only contain the parameters è, given the interest in finding the best value for è, the term (y_i!) may be dropped. Then, the log-likelihood is simply,

$$\ln L(\theta \mid x, y) = \Sigma_{i=1}^{m} [y_i \theta' x_i - e^{\theta' x_i}] \tag{7}$$

Applying the standard optimisation techniques solves the equation for the optimal value of θ.

Finally, the estimating Poisson regression model is given by,

$$y = e^{\beta_0} e^{\beta_i x_i} = \ln y = \beta_0 + \beta_i x_i \tag{8}$$

Empirically, as the response variable is a count variable and is in log-linear form, the logit estimation method is applied to estimate the parameters of the Poisson regression. When the variance is equal to the mean, the most common way of testing count data is by the Poisson regression model. But, when the data is over-dispersed, i.e. the variance is greater than the mean, the negative binomial regression model is commonly used.

In the NFHS II data used in this paper, the variance of the number of children, the dependent variable, as reported in the descriptive statistics in Table 2 is large. Statistically, the goodness of fit tests of the Bayesian information criterion and Akaike information criterion are used to choose the most suitable model based on an F-test or a likelihood ratio test. Lower the BIC and AIC values, the model is fit. With the reported AIC and BIC values shown in Table 1, the decision is to use the Poisson regression model.

Table 1: AIC and BIC Tests of Poisson and Negative Binomial Model Selection

Model	*AIC*	*BIC*
Poisson regression	89751.56	89817.26
Negative binomial regression	89753.56	89827.47

The descriptive statistics of the variables used in the empirical analysis of the demand for children are presented in Table 2. The average number of children a household has is 2. About 66 percent of females are working and about 34 percent of households reside in urban locality. The average years of education completed by the female is 6 years which implies that she has attended primary schooling.

Table 2: Descriptive Statistics of the Variables

Variable	*Description*	*Mean*
Nchild	Number of children in a household	2.036 (1.531)
Age	Age of female (yrs)	29.863 (6.255)
Age^2	Age of female squared (yrs)	930.902 (374.607)
Edu	Education of female (yrs)	5.932 (4.993)
Ln(Conexp)	Logarithm of consumption expenditure (proxy for household income)	11.532 (0.674)
Work	If female is working=1, 0 otherwise	0.661 (0.474)
Religion	If household religion is Muslim=1, 0 otherwise	0.127 (0.334)
Residence	If place of residence is urban=1, 0 otherwise	0.337 (0.473)
N	Sample size	27275

The estimation empirical model is specified as,

$$\ln(Nchild) = \beta_0 + \beta_1 Age + \beta_2 Age^2 + \beta_3 Edu + \beta_4 Work + \beta_5 Con\exp + \beta_6 Religion + \beta_7 Residence + u_i \quad (9)$$

Table 3 presents the estimated results of the Poisson regression along with incidence rate ratios. All the estimated coefficients are statistically significant. As can be observed in Table 3, with an increase in the age of females by a year, the preference to have children increases by 1.5 times or by 40.3%. The negative coefficient of the age square shows that the preference for more children declines with the rising age of women. That is, the number of children in a household has decreased by 0.99 times or 0.6% with a further increase in the age of females. Household consumption expenditure has a positive impact on the fertility of households. With an increase in household income, the demand for children increases by 22.4% or 1.25 times. This observation reflects Becker's (1960) argument that with an increase in household income, families tend to increase the number of children. The education of women has a negative impact on fertility decisions showing that for every increase in a wife's education, the demand for children decreases by 3.3% or 0.97 times. The results are similar to the results obtained by Pandey *et al.* (1998).

The employment of a wife has a positive impact on the number of children reflecting the income effect rather than the price effect on the demand for children. With a working wife, the family is likely to have 1.12 times or 11.38% more children than a household with a non-working spouse. The urban residence of the household has a negative impact on fertility decisions. If a household resides in an urban area, its demand for children is 11.59% less compared to a household residing in a rural area. Overall, age, employment and income have a positive effect on the demand for

Table 3: Poisson Regression Estimates of the Demand for Children

Dependent variable: No. of children in a household

Variable	*Coefficient*	*Incidence rate ratio*
Age	0.403* (0.008)	1.501* (0.012)
Age^2	-0.007* (0.0001)	0.993* (0.0001)
Edu	-0.034* (0.0009)	0.967* (0.0009)
Ln(Conexp)	0.225* (0.007)	1.252* (0.008)
Work	0.114* (0.009)	1.121* (0.011)
Religion	0.240* (0.012)	1.270* (0.015)
Residence	-0.116* (0.009)	0.891* (0.009)
Constant	-7.480* (0.137)	0.967* (0.0009)
Log-likelihood	-44867.781	
LR Chi-square	5568.22	
Pseudo R-squareProb. > Chi-square	0.0580.001	
Pearson goodness of fitProb. > Chi-square	25466.261.000	
Sample size	27,238	

Note: Standard errors are in parentheses. * Significant at 1% level.

children while education and urban residence reduce the number of children a household has in India.

CONCLUSION

Economic growth and social development are normally accompanied not only by population growth but also by changes in the structure and composition of the population. Importantly, both fertility and mortality rates decline rapidly, but the underlying causes are different. The decline or even a rise in fertility rate is the result of a household's preference for the number of children the family wants to have. Among all decisions made by the household, the fertility decision emphasises the role of females in the household as a spouse. Female education and employment form an integral part of the household preference structure and women's empowerment in decision-making. The economics of fertility decision research maps the different factors that influence the fertility decisions of couples. Using the India Human Development Survey II (IHDS II) and applying the Poisson regression model, this paper analysed the fertility decisions among Indian households. The empirical results of this paper identify that household income, age, educational attainment and employment of women are the main forces that drive the fertility decisions of a household. The results further show that community (religion) and place of residence (urban) also play a significant role in the number of children couples have. Therefore, the policy measures should aim and encourage women's autonomy by providing education and employment. Most importantly, women need to

be given autonomy within the household so as to enable them to have control over the household fertility decision. To make independent decisions within the household the women need to have independent sources of income as well as some property rights over resources of the household. In this sense, empowering women with control over household income and property should go a long way in their participation in household fertility decisions as well as with household well-being.

References

Becker, G.S. (1960) "An Economic Analysis of Fertility", in *Demographic and Economic Change in Developed Countries*, Universities-National Bureau Conference Series No. 11, Princeton: Princeton University Press, 209-231.

Becker, G.S. (1991) *A Treatise on the Family*, Cambridge: Harvard University Press.

Bongaarts, J. (1978) "A Framework for Analysing the Proximate Determinants of Fertility", *Population and Development Review*, 4, 1, 105-132.

Bongarrts, J. and D. Hodgson (2020) *Fertility Trends in Developing World*, SringerBriefs in Population Studies.

Cain, M.T. (1983) "Fertility as an Adjustment to Risk", *Population and Development Review*, 9, 688-702.

Chernichovsky, D. (1982) "Fertility Behaviour in Developing Economies: An Investment Approach", in J.L. Simon and P. Lindert (eds.): *Research in Population Economics, Volume 4*, Greenwich: JAI Press, 235-285.

Davis, K. and J. Blake (1956) "Social Structure and Fertility: An Analytical Framework", *Economic Development and Cultural Change*, 4, 211-235.

Desai, S., A. Dubey, B.L. Joshi, M. Sen, A. Shariff and R. Vanneman (2009) *India Human Development Survey: Design and Data Quality*, IHDS Technical Paper 1.

Doepke, M. and F. Kindermann (2017) "Intrahousehold Decision Making and Fertility", in M. Cervellati and U. Sunde (eds.): *Demographic Change and Long-Run Development*, Cambridge: MIT Press.

Easterlin, R.A. (1975) "An Economic Framework for Fertility Analysis", *Studies in Family Planning*, 6, 1, 54-63.

Easterlin, R.A. and E.M. Crimmins (l985) *The Fertility Revolution: A Supply-Demand Analysis*, Chicago: University of Chicago Press. Myrskyla,

Myrskyla M., J.R. Goldstein and Y.A. Cheng (2013) "New Cohort Fertility Forecasts for the Developed World: Rises, Falls, and Reversals", *Population and Development Review*, 39, 1, 31-56.

Nugent, J.B. (1985) "The Old Age Security Motive for Fertility", *Population and Development Review*, 11, 1, 75-97.

Nugent, J.B., K. Kan and R.J. Walther (1983) *The Effects of Old Age Pensions on Household Structure, Marriage, Fertility and Resource Allocation in Rural Areas of Developing Countries*, Report to AID.

Pandey, A., M.K. Choe, N.Y. Luther, D. Sahu, and J. Chand (1998) "Infant and Child Mortality in India", National Family Health Survey Reports 11, International Institute for Population Sciences, Mumbai and East-West Center, Honolulu, U.S.A.

Rosenzweig, M.R. (1977) "The Demand for Children in Farm Households", *Journal of Political Economy*, 85, 1, 123-146.

Rosenzweig, M.R. and R.E. Evenson (1977) "Fertility, Schooling and the Economic Contribution of Children in Rural India", *Econometrica*, 45, 5, 1065-1079.

Wang, W. and F. Famoye (1997) "Modeling Household Fertility Decisions with Generalized Poisson Regression", *Journal of Population Economics*, 10, 3, 273-283.

Westoff, C.F. (1983) "Fertility Decline in the West: Causes and Prospects", *Population and Development Review*, 9, 1, 99-104.