International Journal of Multidisciplinary Research and Development
Online ISSN: 2349-4182, Print ISSN: 2349-5979, Impact Factor: (RJIF 5.72)
www.allsubjectjournal.com
Volume 3; Issue 3; March 2016; Page No. 263-269

Socioeconomic analysis of fertility determinants in Zambia: A count data model application

Lincoln Daka

Member of the Economics Association of Zambia (EAZ) Lecturer, School of Business, Department of Economics,

The Copperbelt University, P.O. Box 21692, Kitwe, Zambia

Abstract
This paper analyzes the socioeconomic determinants of fertility in Zambia. The Poisson regression model is used. The dependent variable is a count variable denoting the number of Children Ever Born (CEB) to a spouse which takes on non-negative integer values. Analysis of this study is based on the 2014 cross sectional data from the Zambian Demographic and Health Survey collected by the Central Statistical Office (Zambia) and Macro International Inc. The results indicate that the woman's wealth/income, education, female autonomy, use of contraceptives place of residence, region, labour force participation and access to media affect fertility in Zambia.

Keywords: Fertility, Count Data, Poisson Regression, Zambia, Socioeconomic Development.

1. Introduction

Fertility analysis is important in understanding past, current and future trends of population size, composition and growth. Information on fertility levels, patterns and trends experienced by a country is important for socio-economic planning, monitoring and evaluating programs. In Europe, the declining population growth and the ageing population causes concern about the future of the welfare states, while the same trend in developing countries is regarded as good news because high population growth usually is seen as closely linked with low economic and human development (Gudbrandsen, 2010) [38].

According to classical economic theory, population growth and economic development are closely linked. Malthus (1798b) claimed in the eighteenth century that the size of a nation's population always will be limited by economic resources and possibilities. Becker (1960) argues on the other hand that economic development will reduce the number of children ever born. When a country gets richer, women will get better income possibilities and the cost of raising children (lost income) will increase. This and the fact that improved economic conditions also implies better schools and a better health system may induce families to reduce the number of children and use more resources on each child. Household members may, however, have different preferences over this Quantity - Quality trade-off.[1]

High fertility rates could be one of the major deterrents to sustained economic growth in Sub Saharan African countries. The ill-effects of population growth can be examined at macro and micro levels. At a macro level, high population growth combined with stagnant income can result in growing income inequalities, lack of economic opportunities and high level of unemployment (Acsadi, 1990) [1]. In Sub Saharan African countries where productivity level is low, food production cannot keep up with population growth, which leads to food insecurity.

Another problem created by high population growth is congestion and rapid depletion of resources, especially in developing countries where property rights governing access to the resources are not well-defined. This leads to overexploitation of resources, pollution, and degradation of the environment. Moreover, pressure on limited land availability in the rural areas due to high population growth has contributed to a massive migration of peasants to urban centers (Acsadi, 1990) [1]. Indeed, migration to the city has led to the mushrooming of slums in the cities, which has exacerbated the problems of unemployment, lack of proper hygiene, and education opportunities.

At the micro level, high population growth leads to a more serious issue of poverty. Poorer families, especially women and marginalized groups, bear the burden of a large number of children with fewer resources per child, further adding to the spiral of poverty and deterioration in the status of women. Low levels of income among the poorer families with many children leads to inadequate food availability, which perpetuates malnutrition, which in turn accelerates high levels of infant and maternal morbidity and mortality. Sub Saharan Africa has, until very recently, been characterized by high population growth rates and high levels of fertility. Fortunately, new evidence suggests that fertility levels have begun to decline in the region. However, the pace and intensity of such change among the countries of the region, has by no means been uniform (Palamuleni, 2010) [55].

The Zambia Demographic and Health Survey (ZDHS, 2014) results show that Fertility levels have declined slightly from 7.2 in 1980 to 6.7 in 1990 6.2 in 2007 and 5.3 in 2014, with only Copperbelt, Lusaka and Western provinces experiencing

[1] This theory argues that while an overall increase in household income may be expected to increase the demand for children (i.e. the quantity of children), it may instead lead to an increase in the cost of children (i.e. the quality of children) Thus, parents should choose between a large number of children and a smaller number of children of better 'quality'.

Total Fertility Rates[2] (TFRs) below the national average. The decline in fertility seems to be concentrated in urban areas, while fertility in rural areas has remained almost constant. Different fertility regulation mechanisms such as use of modern contraceptives, termination of pregnancies and delayed marriages that have contributed much towards fertility reduction in urban areas are not available in rural areas to play similar roles in most Sub Saharan African countries (Markos, 1997) [51].

High fertility rate is one of the fundamental causes of relative underdevelopment in any developing country. This is because it reduces resources by drawing upon the limited government revenues that would otherwise have been used to provide rudimentary economic, health and social services for everybody in the country, especially for the poor and disabled persons; and which could have otherwise been used for increased production and development.

Empirical Model and Estimation Procedure

The dependent variable is a count variable denoting the number of children ever born to a spouse which takes on non-negative integer values. The expected value of the count variable (y) conditional on a set of explanatory variables x is modeled as:

$$\mathrm{E}\left(\frac{y}{x}\right) = e^{(x'\beta)} \quad \text{(i)}$$

The specification above insures that $\mathrm{E}\left(\frac{y}{x}\right) > 0$ Thus, the number of children ever born to a spouse conditional on x is the Poisson distribution with the probability density of

$$P(Y = y/x) = \frac{e^{-e(x'\beta)}e^{(x'\beta)^y}}{y!} \quad \text{Where } y=0, 1, 2,\ldots N \text{ (ii)}$$

The maximum likelihood Poisson fertility equation is then specified as:

$$L(\beta) = \sum_{i=1} \left\{ y_i x_i \beta - e^{x_i \beta} \right\} \quad \text{(iii)}$$

The explanatory variables $x_i's$ in the fertility equation refer to socio-economic and demographic variables describing household and parents' characteristics.

The full model is therefore given as:

$$\mu_i = e^{\beta_0 + \sum_{j=i}^{k} \beta_j x_j} \quad \text{(iv)}$$

Where;

μ_i = the expected number of children per woman i;

e = the base of natural logarithms;

β_0 = the intercept;

$\beta_j's$ = regression coefficients;

$x_j's$ = explanatory variables.

[2] **Total Fertility Rate (TFR):** is the number of children that a woman would have by the end of her childbearing period if she lived through all her fertile years.

Data Sources and Variable Definitions

The study employs cross sectional data from the Zambia Demographic and Health survey (ZDHS), 2014. The ZDHS 2014 is a nationally representative sample of 18,052 women age 15-49 and men age 15-49 who were interviewed. This sample provides estimates for Zambia as a whole, for urban and rural areas, and, for most indicators, an estimate for each of the nine provinces.

The DHS data is usually weighted. We used STATA's svy (survey) commands to take into account the complex survey design of the DHS by incorporating women's sampling weights and adjusting the standard errors for the cluster sampling of primary sampling units. Thus, population-based estimates take into account the differential probability of selection into the survey. Survey data analysis method (svy) is usually employed to analyze the survey data with unequal weight for the given sample data.

The number of total children ever born is modeled as a function of socio-economic variables. These include the following independent variables in table 1 below.

Table 1: Variable Definitions

Variable	Description
Total Children Ever Born (CEB)	Total number of children ever born to female respondents between age 15 – 49 years – Dependent variable
Age	Age of the female
Age squared	Age squared of the female.
Education	The educational attainment of the female 0=No education 1=Incomplete primary 2=Complete primary 3=Incomplete secondary 4=Complete secondary 5=Higher
Female autonomy	Final say on deciding what to do with money husband earns. Dummy variable. 1 = female respondent alone, 0 otherwise.
Age at marriage	The age at which ever married women aged between 15 – 49 years get married.
Wealth index	The index is based on assets, housing characteristics, sanitation and water facilities. This variable is the Proxy for income. Wealth quintile1=Poorest Wealth quintile 2=Poorer Wealth quintile 3=Middle Wealth quintile 4=Richer Wealth quintile 5=Richest
Rural	Type of place of residence. Dummy variable. 1 = rural, 0 otherwise.
Ruralage	Interactive coefficients of rural and age
Province	Regions of the country
Work status	Work status. Dummy variable. 1 = employed, 0 otherwise.
Ever use of contraceptives	Female's ever use of any form of contraception. Dummy variable. 1= Ever used any contraception method, 0 otherwise.
Sex of household head	Sex of the household head. Dummy variable. 1 = male, 0 otherwise.
Reads newspapers	Frequency of reading the newspaper, Dummy variable. 1 = respondent ever reads, 0 otherwise.
Listens to Radio	Frequency of listening to the radio, Dummy variable. 1= respondent ever listens to radio, 0 otherwise.

Empirical Analysis

Table 2 shows the descriptive statistics of the sample which is representative of the Zambian women population aged 15-49 years. The table shows that the average woman has 4 children, with a standard deviation of 2.8. About 10 percent of the women have no formal schooling, while about 35 percent have incomplete primary with about 18.5 percent having completed primary. In addition, about 6 percent have completed secondary education with 5 percent having completed tertiary education.

The table also shows that the average age at marriage is 17.8 years, with about 55.5 percent of the population living in the rural area, while the other 44.6 percent live in the urban area. About 63 percent of the female respondents have used some form of contraceptive before. Further, the table shows that about 43.8 percent of the women are working while 74.6 percent of the household heads are male. About 35.5 percent of the women have access to media through reading newspapers while about 70.2 percent have access to media through listening to radio. Finally, the table also shows that about 63 percent of the women who used contraceptives had children at their first ever use.

Table 2: Descriptive statistics

Variable	Statistic	
Children Ever Born (CEB); mean (standard deviation)	2.99	2.79
Age in years; mean (standard deviation)	28.28	
Level of education (%)		
no education	8.29	
incomplete primary	31.32	9.37
complete primary	15.33	
incomplete secondary	31.24	
complete secondary	8.65	
Tertiary	5.16	
Total	100	
Female autonomy; mean (standard deviation)	0.05	
Age at marriage; mean (standard deviation)	18.23	
Wealth index; mean (standard deviation)	3.12	
Rural (%)	52.04	0.22
% of women who have ever used contraceptives	54.91	3.73
% of women who are working	50.87	1.40
Sex of household head (% male)	73.95	
% of women who read newspapers	35.34	
% of women who listen to radio	62.51	
% of women who had children at first use of contraceptives	62.76	

Table 3: Poisson Regression Output

Variable	Coefficient	Linearized standard error
Age	.2112151***	.0044256
Age squared	-.0022849***	.0000642
No education (reference)		
Incomplete primary	-.0143986	.0139242
Complete primary	-.0561592***	.0170539
Incomplete secondary	-.135065***	.017872
Complete secondary	-.2486004***	.0309964
Higher	-.3119989***	.0325495
Female autonomy	-.0128267	.0150556
Age at marriage	-.0404146***	.001835
Wealth quintile 1 (Poorest, ref.)		
Wealth quintile 2 (poorer)	-.0137496	.0123024
Wealth quintile 3 (middle)	-.0398535***	.0141999
Wealth quintile 4 (richer)	-.1362877***	.0180522
Wealth quintile 5 (richest)	-.2283827***	.0230157
Rural (rural=1; urban =0)	.0719814*	.043583
Rural x Age	.000078	.0012418
Central (reference)		
Copperbelt	-.0619108***	.0201761
Eastern	-.0854118***	.0194706
Luapula	-.0216465	.0194896
Lusaka	-.0911731***	.0202225
Muchinga	-.0582822***	.0207297
Northern	-.0266594	.0187841
Northwestern	-.0101431	.021464
Southern	-.0359647	.0231622
Western	-.0514502	.0215911
Ever use of contraceptives	-.1910167***	.0121301
Work status	-.0024672	.0098309
Sex of household head	-.1388466***	.010467
Reads newspaper	-.0171842	.0110196
Listens to radio	-.0004591	.0092077
Constant	-2.341513***	.0799819

Dependent variable – Total Children Ever Born (CEB)

Pseudo R2 = 0.2460

LR $\chi^2(33) = 6167.61$,

Prob > χ^2 = 0.0000

* $p<0.1$, ** $p<0.05$, *** $p<0.01$

Results from the multivariate analysis follow. The Poisson table of results is presented in Table 3 above. Individual-level controls include the age of the woman measured in years and an age squared variable accounting for the non-linearity associated with age-related variables. The study found that the coefficients have the correct signs, indicating that the number of children increases with age.

Wealth/Income

Following the results of the analysis, taking the poorest as our reference, being poorer decreases fertility by 1.4% ($e^{-0.01374}$=0.986), holding all other variables in the model constant. Compared to the poorest females, respondents in the middle category decrease their fertility by 3.9% ($e^{-0.0398}$=0.961), keeping all other variables in the model constant. For those women in the richer category compared to the poorest, there is a further decline in fertility. Fertility decreases by 12.7% ($e^{-0.136}$=0.873), all other aspects being equal. The richest have the furthest decrease in fertility, according to our results. Taking the poorest as our reference, being richest decreases fertility by 20.4% ($e^{-0.228}$=0.796),

keeping all other factors in the model constant. Wealth is highly significant in explaining fertility.

Education

Compared to those women respondents with no education, women who have incomplete primary education have their expected number of children ever born decrease by 1.4% ($e^{-0.014}$=0.986), holding all other variables in the model constant. Compared to not being educated, having completed primary decreases fertility by 5.5% ($e^{-0.056}$=0.945), holding all other variables in the model constant. Again compared to no education, having incomplete secondary education decreases fertility further by 12.6% ($e^{-0.135}$=0.874), all other factors being equal. For those women with complete secondary compared to those with no education, their fertility decreases by 22% ($e^{-0.249}$=0.78), holding all other variables in the model constant. In the same line, those women with higher education compared to those with no education, their fertility decreases furthest by 26.8% ($e^{-0.312}$=0.732), all other factors being equal. These coefficients are highly significant.

Female autonomy

Compared to the case where other respondents besides the female have the final say on deciding what to do with money husband earns, cases where only the female respondent has the final say, fertility is lower by 1.3% ($e^{-0.013}$=0.987), holding all other variables in the model constant.

Rural

Findings indicate that fertility is much higher in the rural areas than in the urban. For women living in the rural area compared to those living in the urban area, their fertility is higher by 7.5% ($e^{0.072}$=1.075), holding all other variables in the model constant. This coefficient is highly significant in explaining fertility.

Province

Compared to Central province, fertility on the Copperbelt is lower by 6% ($e^{-0.062}$=0.94), holding all other variables in the model constant. In Eastern, compared to Central province fertility is lower by 8.1% ($e^{-0.085}$=0.919), all other factors being equal. In Luapula province compared to Central province, fertility is lower by 2.2% ($e^{-0.022}$=0.978), all aspects being equal. Female residents living in Lusaka Province have a lower fertility by 8.7% ($e^{-0.091}$=0.913), compared to those in Central province. Female residents living in Muchinga Province have a lower fertility by 5.6% ($e^{-0.058}$=0.944), compared to those in Central province. In Northern Province, the fertility is 2.7% ($e^{-0.027}$=0.973) less compared to that in Central Province. In Northwestern Province fertility is 1% ($e^{-0.01}$=0.99) lower with reference to that in Central Province. Southern Province female respondents have a lower fertility by 3.6% ($e^{-0.036}$=0.964) compared to those in Central Province. In Western Province, fertility is 5% ($e^{-0.051}$=0.95) lower compared to that in Central Province, all other variables in the model kept constant.

Ever use of contraceptives

Regarding ever use of contraceptives, the women who have ever used any form of contraception, compared to those who have never used, have a lower fertility by 17.4% ($e^{-0.191}$=0.826), holding all other variables in the model constant. This coefficient is highly significant in explaining fertility behavior.

Work Status

Compared to those women who are not working, those who are working have their fertility lower by 0.2% ($e^{-0.002}$=0.998), all other factors kept constant. Although the coefficient could be undermined by high unemployment in the country, it supports the quality-quantity-tradeoff and is considered as one of the factors influencing fertility in Zambia.

Sex of Household Head

Compared to being male, if the head of the household is female, fertility is lower by 13% ($e^{-0.139}$=0.87), holding all other variables in the model constant.

Access to Media

Access to media also turned out to be a crucial determinant of fertility. For those respondents who read the newspaper compared to those that did not read at all, their fertility was found to be lower by 1.7% ($e^{-0.017}$=0.983), holding all other variables constant. In addition, listening to the radio was found to reduce fertility. Female respondents who listen to the radio compared to those women that do not at all listen, have their fertility lower by 0.05% ($e^{-0.0005}$=0.9995), holding all other variables constant in the model. These variables have a negative effect on fertility.

Concluding Remarks

Zambia faces high levels of fertility compared to other countries in the region. High levels of fertility have implications for social and economic development in any given country. High fertility can undermine the economic potential of women and is also associated with high maternal mortality. Information on fertility levels, patterns and trends experienced by a country is important for socio-economic planning, monitoring and evaluating programs. This paper analyzed the socioeconomic determinants of fertility in Zambia. The Poisson regression model is used. The data displays equidispersion that is the mean being equal to the variance. Therefore there is no need to prefer the Negative Binomial model over the Poisson. In fact, the Negative Binomial model in this case is an ordinary Poisson model due to the equidispersion property. The dependent variable is a count variable denoting the number of Children Ever Born (CEB) to a spouse which takes on non-negative integer values. Analysis of this study is based on the 2014 cross

sectional data from the Zambian Demographic and Health Survey (ZDHS) collected by the Central Statistical Office and Macro International Inc.

Results of the analysis have shown that household wealth is highly correlated with the number of children ever born. The negative effect of wealth on fertility is observed with the richest having the least magnitude in the coefficients. One explanation why households with higher wealth tend to get fewer children is that they can afford to invest in their children and therefore prefer to have few children with high quality and education, rather than many children. As family income increases, households prefer to have less but higher quality children. The negative effect of wealth on fertility is observed with the richest having the least magnitude in the coefficients. This could also be interpreted in the direction than the poorest are unable to invest money in their children, hence demanding a higher number, but as soon as a certain living standard is met, being able to invest just something in the children, largely affects demand for quantity.

Regarding schooling, a negative effect between fertility and schooling is observed. The negativity increases with the educational attainment of the female. Educated women are more likely to exercise the "quality-quantity trade-off" of their children. Education increases awareness of possible negative consequences of having large families. More education to leads to better knowledge about contraception and better ability to get hold of and understand information about issues related to family planning.

Female autonomy is found to be negatively related to fertility and the main reason is that early marriage can be associated with high fertility and female autonomy is likely to decrease the relative importance of early marriage. The fertility rate is also much lower in the urban areas than in rural areas because it costs less to raise children in a rural area and also rural communities lag behind urban centers in the distribution of contraceptive knowledge.

An increase in female labor force participation leads to lower fertility. This implies that the opportunity cost of time devoted to childcare has increased and consequently fertility has declined. This result is consistent with the theoretical explanations provided by Becker and Lewis (1973) [12]. Increasing access to media has also been found to reduce fertility. One explanation for this is that increased access to media makes information about contraceptive technology available to the woman, which helps in reducing fertility.

In line with our expectations, a negative relationship is found to exist between ever use of contraceptive and the level of fertility. We believe that the use of contraceptives will play an important role in controlling fertility in the country going forward. The use of contraceptive may help in avoiding pregnancies for women who want to limit their birth, space their birth or to avoid bearing children. This coefficient is highly significant in explaining fertility behaviour.

Improving the economic status of the women through increased education and labor force participation supports the quantity – quality tradeoff and will help to reduce fertility. Improvements in women's education would complement pro-employment policies by increasing the productivity of employment and multiplying its fertility-reducing effects.

Policies that encourage female labor force participation should be implemented as a female's employment status is an important determinant of fertility in Zambia. Programs need to be implemented to increase women's autonomy in the fertility decision-making process. Urbanization equally plays a key role in reducing fertility.

Furthermore, the promotion and the improvement of contraceptive methods should be constructed to focus more in meeting the need of women in younger age and those with smaller ideal family size.

It is my considered view that the results of this study could be useful in achieving the stipulated goals in the sphere of reproductive health outcomes and will go towards strengthening program review and implementation of population programs in Zambia.

This study has a few limitations. The first limitation is that the data set used does not contain some important variables which are used for more detailed analysis of the relationship between fertility and female employment. Amount of earnings of individuals and part time or full time working groups in the employment of women are not included in the data sets. Regarding earnings, this variable would be useful in determining the individual's income differential and their reaction towards fertility preferences. The same is true for part time and full time employment schemes. Scholars argue that women who are hired in part time jobs will have a better opportunity and time to have more children. Thus the absence of these important variables affects our study in some manner. The second limitation is that because this study was based on cross-sectional data we are unable to detect causality but only association between the dependent variable and the included explanatory variables. However the results do show the predictors of fertility among Zambian women.

References

1. Acsadi G, Acsadi JG. Population Conditions in Mainland sub-Saharan Africa in Population Growth and Reproduction in sub-Saharan Africa: Technical Analysis of Fertility and Its Consequences edited by George T. F. Acsadi, Gwendolyn Johnson-Acsadi and Rodolfo A. Washington, D. C., The World Bank, 1990.
2. Ainsworth M, Beegle K, Nyamete A. The Impact of Women's Schooling on Fertility and Contraceptive Use: A Study of Fourteen Sub-Saharan African Countries, World Bank Economic Review, 1996; 10(1):85-122.
3. Al-Awad M, Chartouni C. Explaining the Decline in Fertility among Citizens of the G.C.C. Countries: the Case of the U.A.E, Institute for Social and Economic Research, working paper, 2010, 1.
4. Al-Qudsi S. Labour Participation of Arab Women: Estimates of the Fertility to Labour Supply Link. Applied Economics 1998; 30:931-41.
5. Aldieri L, Vinci CP. An investigation of the Relationship between the number of children and education in Italy Brussels Economic Review, 2007, 49(4).
6. Axinn WG, Barber JS. Mass Education and Fertility Transition. American Sociological Review 2001; 66(4):481-505.
7. Ayebale L. Determinants of Cohort Fertility Preference in Uganda, Capacity Building Programme, Uganda, 2005.
8. Barro RJ, Becker GS. Fertility choice in a model of economic growth Econometrica, 1989; 57(2):481-501.
9. Becker GS. An Economic Analysis of Fertility" in Demographic and Economic Change in Developed

Countries Becker, Gary S. (Ed.) Columbia University Press: New York, 1960.
10. Becker GS, Tomes N. Child Endowments and the Quantity and Quality of Children Journal of Political Economy. 1976; 84(4):S143-62.
11. Becker GS. A treatise on the Family. Harvard University Press, Cambridge, MA., 1981.
12. Becker GS, Lewis HG. On the Interaction between the Quantity and Quality of Children Journal of Political Economy. 1973; 8:279-288.
13. Becker G, Barro RJ. A Reformulation of the theory of fertility Quarterly Journal of Economics 1988; 103:1-25.
14. Becker GS. Fertility and the Economy Journal of Population Economics. 1992; 5(3):185-201.
15. Berbieri M. Is the Current Decline in Infant and Child Mortality in sub-Saharan Africa a Sign for Fertility Change? In The Onset of Fertility Transition in sub-Saharan Africa. Locoh T. and V. Hertrich (Ed). IUSSP, 1994.
16. Blanc AK, Poukouta PV. Components of unexpected fertility decline in sub-Saharan Africa DHS Analytical Reports No. 5. Calverton, Maryland: Macro International Inc., 1997.
17. Bloom E, Canning D. Demographic Challenges, Fiscal Sustainability and Economic Growth" Program on the Global Demography of Aging Working Paper 8, Harvard School of Public Health, Boston, 2006.
18. Bongaarts J. A Framework for Analyzing the Proximate Determinants of Fertility Population and Development Review, 1978; 4(1):105-132.
19. Bongaarts J. Population Growth and Global Warming Population and Development Review 1992; 18:299-319.
20. Bongaarts J. The Causes of Stalling Fertility Transition" Population Council Working Papers No. 204. Policy Research Division, 2005.
21. Brass W. Demographic Data Analysis in less Developed Countries Population Studies (London), 1996; 50(3):451-467.
22. Bratti M. Labour Force Participation and Marital Fertility of Italian Women: The Role of Education Department of Economics, University of Warwick (UK), 2002.
23. Bryant J. Theories of Fertility Decline and the Evidence from Development Indicators" Population and Development Review 2007; 33:101-127.
24. Caldwell JC, Caldwell P. The Cultural Context of High Fertility in sub-Saharan Africa Population and Development Review, 1987; 16(3):409-437.
25. Caldwell JC. Theory of Fertility Decline. London: Academic Press, 1982.
26. Caldwell JC. Fertility Decline in Africa: A New Type of Transition? Population and Development Review 1992; 18(2):211-242.
27. Cameron A, Trivedi P. Econometric Models based on Count Data: Comparison and Applications of some Estimators and Test Journal of Applied Econometrics. 1986; 1:29-53.
28. Cameron D, Johansson S. Count Data Regression Using series Expansions with Application Journal of Applied Econometrics. 1997; 12:203-224.
29. Caudill SB, Mixon FG. Modeling Household Fertility Decisions: Estimation and Testing of Censored Regression Models for Count Data Empirical Economics, 1995; 20:183-196.
30. Coleman D. The road to low fertility Ageing Horizons, 7, December 2007, 7-15.
31. Central Statistical Office (CSO) [Zambia] Census of Population, Housing and Agriculture Analytical Report. Lusaka, Zambia: Central Statistical Office, 1995-1990, 10.
32. Central Statistical Office (CSO) (Zambia). 2002. 2000 Census of Population and Housing, Presentation of Selected Indicators. Lusaka, Zambia: Central Statistical Office.
33. Central Statistical Office (CSO) (Zambia). Census of Population and Housing; Analytical Report Zambia. Lusaka, Zambia: Central Statistical Office, 2003, 2000, 10.
34. Cleland J, Wilson C. Demand Theories of the Fertility Transition: an Iconoclastic View Population Studies, 1987; 41(1):5-30.
35. Cochrane Susan H. The effects of education on health World Bank Staff Working Paper, No. 405. Washington, D.C.: The World Bank, 1980.
36. Easterlin RA. An economic framework for fertility analysis Studies in Family Planning, 1975; 6(3):54-63.
37. El Lahga, Olfa. A Socioeconomic Analysis of Fertility Determinants with Count Data Models: The case of Tunisia" Tunisia Institute for Social and Economic Research, working paper, 2008, 1.
38. Gudbrandsen NH. The impact of Wealth and Female autonomy on Fertility Decisions in Nepal: An Econometric Analysis Working Papers No. 1. Chr. Michelsen Institute (CMI), 2010.
39. Guzman JM. The Onset of Fertility Decline in Latin America. In The Onset of Fertility Transition in sub-Saharan Africa. Locoh T. and V. Hertrich (Ed). IUSSP, 1994.
40. Greene WH. Econometric Analysis, fifth edition (New Jersey: Prentice- 27 -Hall), New York University, 2003.
41. Hinde A, Mturi AJ. Recent Trends in Tanzanian Fertility Population Studies, 2000; 54(2):177-191.
42. Hondroyiannis G. Fertility determinants and economic uncertainty: an assessment using European panel data Bank of Greece, 2009.
43. Hondroyiannis G. Modeling Household Decisions in Greece The Social Science Journal. 2004; 41:477-483.
44. Hotz VJ, Klerman JA, Willis RJ. The Economics of Fertility in Developed Countries in Handbook of Populatin and Family Economics, 1997, 1A. Rosenzweig, Mark R. and Stark, Oded (eds.) Elsevier: Amsterdam.
45. Jesnen P, Eric L. An Econometric Analysis of the Old-Age Security Motive for Childbearing International Economic Review 1990; 31(4):953-968.
46. Kelley V, Allen C. The Consequences of Rapid Population Growth on Human Resource Development: The Case of Education. In The Impact of Population Growth on Well-Being in Developing Countries, 1996. ed. D. A. Ahlburg, A. C. Kelley, and K. O. Mason. Berlin: Springer.
47. Khraif R. Fertility in Saudi Arabia: its Levels and Demographic, Social, Economic and Geographic Determinants Al Darah Journal. 2002; 28(2):9-84.

48. Kirk D. Demographic Transition Theory Population Studies, 1996; 50:361-387.
49. Leibenstein H. The Economic Theory of Fertility Decline The Quarterly Journal of Economics. 1975; 89(1):1-33.
50. Malthus T. An Essay on the Principle of Population Elecbook: London, 1798a/1997.
51. Markos E. Demographic Response to Ecological Degradation and Food Insecurity. Amsterdam: Thesis Publishers, 1997.
52. Nerlove M, Razin A, Sadka E. Population Size: Individual Choice and Social Optima. The Quarterly Journal of Economics 1985; 100(2):321-34.
53. Nguyen-Dinh H. A socioeconomic analysis of the determinants of fertility: The case of Vietnam Journal of Population Economics. 1997; 10(3):251-271.
54. Olsen RJ. Fertility and the size of the U.S. Labor Force Journal of Economic Literature. 1994; 32(1):60-100.
55. Palamuleni M. Fertility decline in Malawi: An analysis of the proximate determinants. Journal of Social Development in Africa, 2010, 25(1).
56. Pollak RA, Watkins SC. Cultural and Economic Approaches to Fertility: Proper Marriage or Mesalliance? Population and Development Review 1993; 19(3):467-496.
57. Pranab KB, Udry C. Development microeconomics, 1999.
58. Romaniuk A. Increase in Natural Fertility during the Early Stages of Modernization: Evidence from an African Case Study, Zaire. Population Studies 1980; 34(2):293-310.
59. Sachs J. The Specter of Malthus Returns Scientific American 2008; 299:38.
60. Sanderson WC. On Two Schools of the Economics of Fertility Population and Development Review 1976; 2(3/4):469-477.
61. Schultz TP. Demand for children in Low Income Countries in Handbook of Population and Family Economics Volume 1A. Rosenzweig, Mark R. and Stark, Oded (Eds.) Amsterdam, Elsevier, 1997.
62. The Zambia Demographic and Health Surveys: 1992, 1996, 2001-2002 and 2007. Calverton, Maryland, USA: CSO and Macro International Inc.
63. The Zambia Demographic and Health Survey, key findings. Calverton, Maryland, USA: CSO and Macro International Inc., 2007.
64. Wang W, Famoye F. Modeling Household Fertility Decisions with Generalized Poisson regression, Population economics, 1997; 10:75-283.
65. Winkelmann R. Econometric Analysis of Count Data, Springer Verlag, Berlin Heidelberg, New York, 1997.
66. Winkelmann R, Zimmermann F. Recent Developments in Count Data Modeling: Theory and Application Journal of Economic Surveys. 1995; 9(1):1-24.
67. Wooldridge JM. Econometric Analysis of Cross Section and Panel Data. The MIT Press Cambridge, Massachusetts, 2004.
68. Zhang J. Determinants of Fertility in China a Micro econometric Analysis Journal of Population Economics. 1990; 3(2):105-123.