The Effects of Education on Fertility Change in Ghana: A Decomposition Analysis

Ama A. Ahene-Codjoe
December 2007

Abstract

Comparing two surveys conducted in Ghana (1987/88 and 1998/99), this study examines whether there has been a substantial decline in fertility over the decade. Oaxaca – Ransom, 1994 decomposition method is employed in the analysis. The method determines the change in fertility and whether the difference is attributed to observed characteristics of individual women or coefficients. The study finds that, fertility has indeed declined; but the change is very small. This confirms doubts expressed in studies like Bongaart et al, 1984, Caldwell, 1992 and others. They noted that, although transition has begun in SSA, the continent is not likely to see any substantial decline before the beginning of the next century. This study further finds that, the decline in fertility albeit small is mainly attributed to differences in characteristics (80.5%) and the most important of these characteristics, is expenditure. The findings suggest that, an increase in expenditure per adult significantly contributes to fertility decline. This particular result concurs with the quantity – quality trade-off theory expounded by Becker, 1960. It also mimics the kind of effect that is normally observed in developed countries and some developing countries that are far into their fertility transition. The main determinant of the study, education, is also found to contribute to fertility decline; but not as much as earnings.

Author
Ama A. Ahene-Codjoe is a research student at the School of Economics, University of Nottingham. I am very grateful to my supervisor Dr. Simon Appleton for guidance and comments. Contact email: lexaaa1@nottingham.ac.uk

Introduction

Education is widely deemed to be one of the determinants of economic growth and development. Therefore every nation desires to have its population acquire as much as possible either through formal or informal channels. High fertility on the other hand seems to retard these favourable economic changes since resources do not readily increase with population growth[1]. Sub-Saharan Africa (SSA) is found to be the least responsive to the fertility transition spreading in developing countries. Studies such as Bongaarts et al., 1984 and Caldwell et al., 1992 identified high illiteracy, cultural and religious practices as some of the causes of minute declines if any, in the region. Other studies have also endeavoured to find the established relationship between education and fertility in the sub-region. Methods used in these studies are both descriptive and empirical with micro data such as the household living standards survey (Appleton, 1996; Benefo and Schultz, 1996), the Demographic and Health Surveys (Ainsworth et al., 1996; Martin, 1995) as well as focus group discussions (DeRose et al., 2002). The findings are mixed. However, there is the general consensus that, education has some effects on fertility, and transition has begun in Africa. It is more than two decades since Bongaarts' fertility verdict on SSA and this paper seeks to find whether it still holds. Female education has improved over the years and many studies have predicted its favourable outcome on fertility. Therefore using data with a decade's interval, this study aims to find a likely decline in fertility as well as the magnitude in Ghana[2]. First, Ordinary Least Square (OLS) is used to estimate reduced form models of education and other socio-economic characteristics on number of children in the two survey years. Oaxaca – Ransom (1994) decomposition is then estimated to determine the source of fertility difference. That is, whether the difference is attributed to observed characteristics of individual women or coefficients in both survey years.

[1] Unless technology developments increase as much as (if not more) population growth.
[2] This is a country located on the west coast of Africa with a population of about 18.9 million and an annual average population growth rate of 2.7 (GSS, 2005)

Literature Review

Theory

One of the earliest literatures on the economic model of fertility is Becker, 1960 who stipulates that children are desired for the benefits they generate towards household activities. That is children are seen as one of the many consumer goods that compete in the household utility function. Consequently, parents compare the utility of having more children with that of other goods and make a choice thereof. He thus assumes that parents have preferences concerning the number and quality of children they would want to have in the household unit of production. The quality of children produced is linked to their educational level which is influenced by total time and resources parents invest in them. These investments are subsequently determined by income and prices. Hence the conclusion drawn by this theory is that, as earnings increase, parents increase their investments in the quality of their children (human capital) whilst decreasing number of children. Thus there is a trade-off between quantity and "quality" of children.

Becker and Lewis, 1973, further supported the quantity-quality demand for children with their shadow price analysis theory. In this scenario, they explained that, the shadow price of children with respect to their number is bigger the higher their quality. That is an increase in quality is more expensive if there are more children. In the same vein, an increase in quantity is more expensive if the children are of higher quality. The paper elicits the income and price effects of an increase in number and quality of children as well as of other commodities in the household demand function. They find that an increase in income, holding prices constant, has the direct effect of increasing number and quality of children, as well as other commodities. However, such increase in the quantity and quality of children goes on to increase their shadow prices. They also think income is more elastic with respect to quality than quantity of children. This implies that, when household income increases, there is a likelihood of more investments in the quality of children than their quantity. Their analysis of the price effect show that, increases in the shadow price of quantity of children, for

example contraceptives, relative to the shadow prices of quality of children and other commodities consumed by the household will cause the quantity of children to decrease. The decrease in the number will also result in the reduction of the shadow price of the quality of children leading to its preference over quantity. Similarly, if the price of quantity falls, the demand for quality will rise which will cause the shadow price of quantity to increase and thereby reduce the demand for quantity. This suggests the inverse relationship between education of mothers and the number of children; quality is substituted for quantity.

One criticism of the quantity – quality trade-off theory is that of Robinson, 1997. He argues that most of the assumptions and proposed theories explaining fertility decline as a result of economic development are not crucial. According to him, the relative time-intensity of the technology necessary for child services compared to other household production as well as the increasing value of time of women as a result of the high opportunity cost of labour market participation are sufficient reasons for the inverse relationship. In addition, fertility is likely to be driven by a fall in the expected total utility of child services[3] rather than a change in consumer preferences towards quality over quantity. In conclusion, he reiterates that given the desire for sexual pleasure, and that in most developing countries control over the processes of conception, pregnancy and child-birth is difficult, unreliable and costly, fertility can increase independent of the effect of benefits or costs. Also, expanding links of household to external markets may open up new sources of leisure other than child-service production. Since the value of children is not unique anymore, it maybe replaced by these services. Besides, children are by far more risky way of acquiring a future flow of certain household services than other potential sources.

Empirical

In line with most proposed theories, a large and growing body of empirical research proposes that education considerably reduces fertility. The inverse relationship of education and fertility is established in many studies especially when education is above the primary level or when some percentage of women gets educated (Bongaarts

[3] Leibeinstein, 1975 (cited in Robinson, 1997), explain child service as three types of utilities that parents derive from having children: consumption, labour productivity and old age security utilities.

et al., 1984; Appleton, 1996; Benefo and Schultz, 1996; Ainsworth et al., 1996). Bongaarts et al., 1984 for instance noted in their findings that, fertility declined only after literacy had reached levels above 70 percent of women of reproductive age in SSA. They examined two distinctive determinants of fertility which are proximate variables as well as socio-economic variables. The increase in use of contraceptives is one of the channels through which fertility decreased in the study. The effects of delayed age at cohabitation also outweighed that of shorter duration of breastfeeding and postpartum abstinence. The net effect caused the observed fall in fertility. However the study projects that, for 20 percent decline in marital fertility in SSA, not less than 45 percent of married women must practice contraceptives use. The study is somewhat doubtful of SSA experiencing any substantial reductions in fertility by the end of the century due to the unique characteristics observed in the region.

Similarly, Caldwell et al., 1992 pronounce unlikely immediate fertility transitions in SSA. In their analysis, they outlined factors such as cultural practices and religious emphasis on ancestry and descent; polygyny; the desire for big families and the perception of family planning as foreign culture among others, as the main constraints to the fertility decline. Consequently, early fertility transition is inhibited. Of the three transitional countries they studied, they found high levels of education as the link to fertility decrease. They conclude that, though fertility decline has started in Africa, a broad regional decline is not imminent due to the above cultural constraints.

Martin, 1995 conducted an in-depth analysis on 26 countries in relation to fertility and characteristics that affect its decline. The study used the Demographic and Health Survey (DHS) and analysed contraceptive use, age at marriage, fertility differentials as well as a decomposition analysis for source of fertility change. Some of the findings are that, the differentials between the upper and lower educational subgroups are relatively moderate, between 2 and 3 children in most SSA countries whilst in other developing countries like Peru, it differs by 5. She also noted that, large differentials in the number of children between the higher and lower educated are more prominent in countries in the midst of fertility transition rather than those at the early stages. However one of her conclusions is that women with advanced education have considerably lower fertility than uneducated women in every society examined.

Also the study finds that, in sub-Saharan Africa, majority of the countries exhibit no significant impact of education between women with no formal education and those with formal education of between four to six years of schooling. On the whole, only a slight change in fertility is found in SSA by the study with improvement in female education contributing about one-tenth. The study however cautions a wider interpretation of this finding on SSA since it used only two countries in the analysis.

Schultz, 1997 also found the negative effect of education on fertility. He added that the changing composition of income between labour and non-human capital, as well as between male and female productivity are as important for fertility decrease as the overall level of national income. The study concludes that, children are important source of human capital investment whose increase in returns leads to parents having to invest more, (usually through education) which consequently reduce fertility.

DeRose et al., 2002 argue in their paper that schooling per se has little effect on fertility preferences and that differentials by education observed in national level data may be heavily determined by selection factors determining school continuation[4]. Their study found that fertility preferences of girls at the Junior Secondary level and higher do not reflect the inverse pattern of education and fertility. The better-educated women in the sample expect to get better jobs which would enable them to care for more children. They explained such response as a possibility of a different relationship between fertility and schooling. This is when fertility decline is crisis-led than family limitation due to economic development.

Also female participants of the focus group with more education did not expect greater reproductive autonomy for themselves than did those at lower levels. Therefore the assumption of women's autonomy in productive work or in household decision-making indicating women's autonomy in reproductive decision-making could be wrong in Ghana. This is because independent women's economic activities are part of fulfilling traditional female obligations to family and does not necessarily

[4] Girls who participated were selected by school administrators. The paper assumes that, if they were chosen to favourably reflect the school, it is likely that they may be the kind of students who will continue in the educational process and therefore not represent the attitudes of girls whose education ended when or before secondary school was completed. Therefore their fertility preferences may better reflect the attitudes of the university women they will become than attitudes of women who attained up to the junior or senior secondary school level.

confer reproductive control (DeRose et al., 2002). One of the conclusions drawn is that if economic hardship limits the ability of less educated women to provide for their children more than it limits women with higher levels of schooling, the expected inverse relationship between schooling and fertility may not emerge. It therefore appears that it will take more than schooling to change the balance of power in reproductive decision-making in the Ghanaian society.

In 1996, Benefo and Schultz published a paper analysing the relationship between child mortality and fertility using the GLSS survey data in the late 80s. They examined the idea that high levels of child mortality encourage parents to have large numbers of births. The study finds that child mortality is significantly lower for each year of completed primary education of the mother. In addition, women's education beyond primary school level is strongly related to declines in fertility in both Cote D'Ivoire and Ghana, but the education of husbands is not associated with similar declines. The paper concludes that, given the relationship observed between female education, wages and productivity and reduced fertility, it is expected that the changing composition of income sources in Ghana will be more favourable for women and hence contribute to an earlier national decline in fertility. Also, a more equal distribution of social services is likely to hasten the decline in child mortality and fertility, particularly if women's education increases more rapidly in rural areas and rural sanitation and health problems are effectively addressed.

Using a reduced form effects of education and other socio-economic variables upon age at cohabitation and the duration of breast-feeding, Appleton, 1996 estimated a 'reproduction function' which identifies the effects of the above-mentioned proximate determinants on fertility. Some of the findings are that, female secondary schooling has the effect of increasing the age at cohabitation and decreasing the duration of breast-feeding. For example, delaying cohabitation by three years is predicted to reduce the number of children a woman has ever given birth to by one whilst a year's increase in the duration of breast-feeding will reduce the number of children ever born to a woman of fifty-five by over four. Ainsworth et al., 1996 found that the last years of female primary schooling have negative effects on fertility in half the countries under-study; and secondary has a substantial negative effect on fertility in all the countries.

Methodology and Data

The Oaxaca – Ransom (1994) decomposition methods is used to estimate the change in fertility and also identify the source. This is a follow-up to the Blinder – Oaxaca (1973), where based on standard OLS assumptions, the model estimates two equations and the difference in prediction of the dependent variable is attributed to the effects of mean characteristics and coefficients. Based on the group chosen as the competitive standard to be compared, decomposition of the difference in analysis, traditionally wage differentials, could be relatively more in characteristics or coefficient against the other. This causes the index number problem. The model was later adopted in further studies but reformed to take on a weighting matrix that will appropriately apportion differentials in the wage structure. The studies include those of Reimers (1983), Cotton (1988), Neumark (1988) and Oaxaca – Ransom (1994) to overcome the index number problem. The approach of using weights in the decomposition analysis is on the assumption of what the estimates of the wage structure would be in the absence of discrimination (Oaxaca – Ransom, 1994). Thus a decomposition equation is formulated as:

$F_1 - F_2 = (X_1 - X_2)\,\beta^* + X_1(\beta_1 - \beta^*) + X_2(\beta^* - \beta_2)$…….. (1)

where β^* is the weighted average and estimated as:

$\beta^* = \Omega\,\beta_1 + (1- \Omega\,)\,\beta_2$ ……(2)

Also Ω is a weighting matrix whereby any assumption about β^* reduces to an assumption about Ω (Ibid). Blinder – Oaxaca (1973) assumes Ω equals 1 or 0; Reimers (1983) suggests a midpoint decomposition of coefficients and characteristics of the two comparing equations, therefore Ω should be equal to (0.5) I; Cotton (1988) proposes Ω = wI, where w is the relative sample size of the majority group; and Neumark (1988) and Oaxaca – Ransom (1994) estimate a pooled model to derive β^*. This study adopts the Oaxaca – Ransom pooled weighting matrix with estimated

$\Omega = (X_1' X_1 + X_2' X_2)^{-1} (X_1' X_1)$ ……. (3)

$F_{i \text{ and }} \beta_i$ are the predicted fertility for the two survey years and a vector of coefficients from OLS estimations respectively which is given as:

$F_i = c + \beta_i X_i + e$ …… (4)

X_i is a vector of mean characteristics that determines fertility levels. GLSS 1 has a higher mean of fertility therefore used as the high group ($\beta_1 X_1$) and GLSS 4 is the low group ($\beta_2 X_2$) due to its relatively lower fertility mean. The first term in equation one represents the difference in fertility that is due to differences in characteristics of the observed women. The second and third terms in the same equation indicate the effects of the estimated coefficients of the two groups of women on the difference in fertility. They also include all variables that ought to be part of the model but are not due to lack of data, inappropriate measurements or proxies (Vartiainen, 2002). These unobserved variables could also contribute to the difference in fertility change in the study. One of the problems of the model is that, it does not consider the distribution of characteristics that may cause the differences in fertility within the two groups but rather the average fertilities which could lead to inappropriate inferences with regards to differences in fertility level due to differences in attributes.

The analysis uses data from the Ghana Living Standards Survey (GLSS 1 and 4). The data in GLSS 4 is such that, there is more than one woman in some of the households unlike GLSS 1[5]. In order to have a comparative data sample, a random sample is generated in GLSS 4 to statistically select one woman in each household for the analysis. Therefore, each observation represents a different woman and household in both samples. The sample sizes for estimations are 2266 and 4305 for the GLSS 1 and 4 respectively. Robust regressions are estimated due to failed homoscedasticity tests of initial regressions using Breusch-Pagan test.

Definitions of variables

Education: Controlled in categorical terms including No education; Primary; Middle; Secondary and Higher for the GLSS 1 when the new system of schooling had not yet been introduced; and No education; Primary; Middle&JSS[6]; and Secondary and Higher[7] for GLSS 4;

[5] In GLSS 1, one woman is randomly selected in each household for the fertility sections of the questionnaire; whilst in GLSS 4, all women of reproductive age in a household are interviewed.
[6] Junior Secondary School was introduced to replace the Middle School. Middle/JSS will hence forth be referred to as Middle in this study.
[7] Secondary and Higher will also be referred to as Secondary in this study.

Age: categorically controlled to capture the behaviour of cohorts concerning reproductive issues;

Religion: Dummies are created in relation to religious beliefs of households. Unlike GLSS 1[8], GLSS 4 has religious records for all individuals in the households. Thus in this study, the head of household's religion is assumed for the whole household in the first survey year's estimations.

Ethnicity: Similar to the religious variable, the question of ethnicity is recorded for only the head of household in GLSS 1. Thus, the ethnic group of the head of household is again adopted for the entire household. The adoption is based on the assumption that, the practices of the head of household would dominantly influence the activities of the family.

Water Source: A proportion of cluster sample with protected water is calculated. This includes indoor plumbing, inside standpipe, water vendor, water truck/tanker service, and neighbouring household, private outside standpipe/tap, public standpipe and well with pump.

Distance to water source: nearest source of water is calculated in metres.

Toilet/Latrine: A proportion of cluster sample with toilet or latrine.

Log of Real Cost of Schooling per Child: A cost function is created to calculate cluster averages of total cost per child of schooling for primary; middle; and secondary. The cost is calculated for the past 12months and includes: contributions to Parents/Teachers Association; uniforms and sports clothes; books and school supplies; transportation to school; cafeteria, board and lodging; tuition and registration fees; and others like clubs and extra classes.

Rural: A dummy variable is created as one for women who currently reside in rural areas and zero otherwise.

Log of Real Expenditure[9] *per Adult*: This comprises of:

- *Food*: the total amount spent on all food items as well as the value of home produced food consumed in the last year
- *Non-food items*: total amount spent on such as cigarettes, soaps, personal are products, cooking fuel, matches and candles and gasoline; shoes, cloth, clothing repairs, domestic servants, jewellery, entertainments etc.

[8] only the household head was asked about his beliefs

[9] Source: basic information, GLSS 1 (aggregate expenditure in data sets, GLSS 1 and 4)

- *Water*: the annual payments for water adjusted down for the fraction of water sold.
- *Garbage disposal*: Annual payments of garbage disposal.
- *Electricity*: annual payments of electricity.
- *School expenditure*: total amount of school related expenses
- *Employee benefits*: the total value of employee benefits
- *Imputed rent*: calculated based on physical characteristics and location of the dwelling (type of wall, roof, window, number if rooms, type of residence, type of latrine, rural, semi-urban, coastal, savannah and per capita expenditure using coefficients from a regression of the log of owner's estimate of the annual rental value of the dwellings on those same characteristics.
- *Durable goods and services*: an estimate of the annual service value of the durable goods owned by the household. It is calculated from the current value of each durable good using depreciation rates that are calculated from the entire sample.

Community Variables[10]:

- *Clinic*: Distance to the nearest clinic in kilometres (km)
- *Market*: Distance to the nearest market place (km)
- *Maize*: Log of real price of maize per kg.
- *Child wage*: Log of real agricultural wage[11] of children.
- *Adult wage*: Log of real agricultural wage of Adult males

Instrumental Variables[12]

Log of Real Household Durable Goods per Adult and its squared: These are values of goods such as sewing machine, refrigerators, air conditioners, stove, fans, radios, T.Vs, bicycles, motor-bikes and cars.

Log of Real Value of Land per Adult and its squared: These are mainly farm-lands owned by the household.

[10] These are controlled as rural cluster averages. Urban clusters are replaced with regional averages calculated from the rural clusters in the region. Community questionnaires were administered in rural areas only.

[11] Total amount of money received as a result of weeding, planting, clearing and other labour activities.

[12] Different combinations of these variables are used for different estimations for GLSS 1 and 4. The real values of these instruments are achieved by dividing the current values by the consumer price index of the period of the survey.

Log of Real Value of Assets per Adult and its squared: These are values of assets including houses, land/plot, shares, boat, canoes and outboard motors.
Occupation of Household Head: This is categorised into wage employment, self-employed (farm and non-farm self-employed) and the unemployed.
Educational Level of Household Head and its squared: Years of schooling of head of household.

Descriptive Statistics

The models are estimated on the assumption that female schooling lowers fertility through decreases in the demand as well as supply of children in a household. In this model household economic activities are captured by predicted values of expenditure per adult. This is because expenditure per adult failed the Hausman exogeneity test at 10 and 1 percents significant levels in GLSS 1 and 4 respectively. Instrumental variables used include years of schooling of head of household, its quadratic and occupation[13] and they are jointly significant. The Sargan-Hansen test for over-identifying restrictions is also used to test whether the instruments are valid. The joint null hypothesis is that the instruments are valid. This implies they are not correlated with the error term and excluding the variables from the estimated equations are justifiable. The chi-squared test statistics could not be rejected with p-values of 0.3569 and 0.0957 for GLSS 1 and 4 respectfully. Concluding that, the instruments are valid. A further test to check whether the equations are identified is conducted using the Anderson (1984) canonical correlation test. This is a likelihood ratio test of whether the excluded instruments are correlated with the endogenous variables. The null hypothesis is that the equation is under-identified. We find that, the model is identified by rejecting the null at 1 percent level in both study years.

Sampled women used in the analysis as well as some socio-economic characteristics are summarised in Table 1. This shows a representative summary of the reproductive population aged between 15 and 49 inclusive in Ghana. Women in the latter survey year are about five and two percentage points higher in primary and secondary levels of education respectively than the former. The general trend also shows an increase in

[13] Occupation is represented by dummies for wage employment and self-employment

the level of education by women over the decade with the exception of middle school. The possible reason for a lower percentage of women in that level of schooling in GLSS 4 than in 1 is the change in the educational system where the number of years spent in Middle school was reduced and renamed JSS. The overall average fertility has declined from 3.142 in 1987/88 to 3.066 in 1998/99 (Table 1). However, the fall in fertility is slight which confirms earlier findings of SSA (Bongaarts, 1984; Caldwell et al., 1992). The increase in the educational levels of women between the two survey years concurrent with the decrease in fertility, albeit small, shows the plausible link between the two. Indeed studies on the subject in both the developed and developing economies have consistently found increases in education to be one of the main sources of fertility decline.

Younger women dominate both samples, more so in GLSS 1 than 4; which could underestimate average fertility since they have not yet completed their reproductive years. Assuming women between the ages of 40 – 49 in the sample have completed fertility[14], the difference in average fertility is calculated to be 1.128 whilst women aged 25-29 show fertility difference of 0.309 in the study years (Appendix Table 2, column 6). The samples also have about 60 percent of women current living in rural areas. Separating sampled women by rural and urban dwellings depicts lower fertility on the average in urban than rural areas. Surprisingly births in rural areas increased, albeit slightly (0.063) between the two survey years (Appendix Table 4, column 6). However, a relatively bigger decrease (0.356) in urban births led to the overall decrease in fertility. The increase in the number of children in the rural areas may partly be due to the increase in education, especially at the primary level. Some studies in developing countries have noted an initial increase in fertility during the first few years of education which is as a result of low infant mortality and healthier lifestyles by women making them more fecund. On the other hand, the decrease in the number of births in urban areas could be explained by the relatively higher opportunity cost of time to the urban dweller as well as actual cost of living. Agricultural activities which usually require large family sizes are also few in the urban centres. The changed economic system of household as a unit of production to a unit of consumption and its outcome is better observed in urban areas.

[14] Which they are likely to be since they are around the age of in-fecundity

Table 1: Sample Summary Statistics of Fertility Model, 1987/88 – 1998/99

Variables	GLSS 1 Mean	GLSS 1 Std. Dev.		GLSS 4 Mean	GLSS 4 Std. Dev.
Dependent Variables					
Number of Live Births	3.142	2.807		3.066	2.682
Explanatory Variables					
Women's Schooling (Dummies)					
No Education (Base Category)	0.453	0.498		0.432	0.495
PRIMARY	0.133	0.340		0.183	0.387
MIDDLE/JSS	0.364	0.481		0.314	0.464
SECONDARY	0.050	0.219		0.070	0.255
Women's Age (Dummies)					
15 - 24	0.364	0.481		0.293	0.455
25 - 29	0.214	0.410		0.194	0.395
30 - 34	0.160	0.366		0.174	0.379
35 - 39	0.108	0.310		0.141	0.348
40 - 49	0.155	0.362		0.198	0.398
Woman's religion (Dummies)					
Christian (Base Category)	0.627	0.484		0.776	0.417
Muslim	0.138	0.345		0.115	0.319
Traditional	0.170	0.376		0.064	0.245
No Religion	0.065	0.246		0.045	0.207
Woman's ethnicity or language (Dummies)					
Akan (Base Category)	0.473	0.499		0.522	0.499
Ewe	0.161	0.368		0.157	0.364
GaAdangbe	0.075	0.263		0.092	0.289
Dagbani	0.044	0.205		0.140	0.347
Hausa	0.023	0.151		0.012	0.111
Nzema	0.011	0.108		0.016	0.125
Other	0.211	0.408		0.060	0.238
Woman's current residence (Dummy)					
Urban (Base Category)					
Rural	0.628	0.483		0.644	0.479
Cost of Schooling	7.659	2.050		7.044	5.593
Prop. of cluster sample with toilet or latrine	0.807	0.328		0.793	0.345
Prop. of cluster sample with water	0.388	0.438		0.617	0.426
Distance to water source	1130.1	14504.2		533.02	12815.74
Expenditure Per Adult [15]	11.447	0.331		14.242	0.388
Expenditure Per Adult Sq.	131.46	7.554		203.306	11.008
Community Variables (Rural Averages)					
Price of Maize	3.860	0.435		6.586	0.619
Distance to the nearest Clinic	14.308	10.721		18.670	57.372
Distance to the nearest Market	11.803	10.712		18.308	41.438
Adult Agric. Wage	6.108	0.873		9.443	0.519
Number of Observations	2266			4305	

[15] Fitted values used

The proportion of households with protected water in a cluster and distance to the nearest source of water has increased and decreased respectively. This reveals an increased water availability in clusters and hence a reduction in household chores. Women are therefore less burdened and may not desire many children for help in house work. However, there is seems to be a slight decrease in the proportion of households with toilets in the clusters. This reflects the lack of importance given to the provision of toilets in communities. Landlords would rather have more sources of potable water in their homes than additional toilets. In some cases, toilets are even converted to rented stores or rooms. This is particularly in areas with increased population pressure.

Although the price of maize (which is assumed to represent commodity prices) increased over the years, it has also been matched with increases in both agricultural wages and expenditure. The economic welfare of women has probably not been made worse off over the years. The puzzle in the summary statistics is the increase in distances to both clinic and market. One would assume that when communities expand as they do over subsequent years, more clinics and especially markets are built to meet increased activities. But again, this may be observed in urban than rural areas. Unfortunately, this assumption cannot be confirmed since data on these variables were collected only in rural areas[16]. The increase in both distances could also represent lost of interest in rural markets as most traders would rather sell at the urban centres for higher prices.

Results

The results obtained from the OLS estimations of number of live births given levels of education, age and other socio-economic indicators in the data set are presented in Table 2. Consistent with many studies in the area, education shows the expected inverse relationship with fertility, all other variables held constant. The primary level of education in GLSS 1 is however found not significant even at the 10 percent level. The study also reveals that the relationship between mother's education and number

[16] Urban values for these variables are regional averages calculated from the community data.

of children is monotonically decreasing, unlike some studies of other African countries. An example is Thomas and Maluccio, 1996 where they found that the number of children tend to increase at lower levels of education, particularly at the primary level. However, beyond this threshold, the relationship reverses. Martin, 1995 also finds that fertility shows a slight rise as women increase their educational assets moderately (curvilinear pattern). Subsequently, fertility eventually declines as women advance beyond the primary stage of education.

Table 2. Regression Results on Number of Live Births in Ghana, 1987/88 – 1998/99

	GLSS 1		GLSS 4	
	Coef.	**t-ratio**	**Coef.**	**t-ratio**
No Education (Base Category)				
PRIMARY	-0.219	-1.67	-0.371	-4.51***
MIDDLE/JSS	-0.622	-6.20***	-0.820	-11.04***
SECONDARY	-1.160	-4.90***	-1.122	-5.91***
Women's Age (Dummies)				
15 - 24 (Base Category)				
25 - 29	1.446	11.95***	1.880	17.53***
30 - 34	2.605	16.09***	3.167	23.77***
35 - 39	3.964	22.64***	4.004	36.14***
40 - 49	5.709	37.84***	5.098	52.66***
Woman's religion (Dummies)				
Christian (Base Category)				
Muslim	0.328	2.10*	-0.179	-1.65
Traditional	0.228	1.64	0.257	1.53
No Religion	-0.064	-0.42	0.053	0.34
Woman's ethnicity or language (Dummies)				
Akan (Base Category)				
Ewe	-0.252	-2.33*	-0.472	-5.27***
GaAdangbe	-0.402	-2.88**	-0.194	-1.93
Dagbani	-0.795	-3.37***	0.098	0.71
Hausa	0.779	2.28*	-0.343	-1.40
Nzema	-0.310	-1.20	0.282	1.03
Other	-0.191	-1.49	0.235	1.60
Woman's current residence (Dummy)				
Urban (Base Category)				
Rural	0.472	4.01***	0.400	4.36***
Average Cluster Cost of Schooling	-0.089	-2.26*	-0.011	-1.90
Prop. of cluster sample with toilet or latrine	0.335	1.97*	-0.345	-1.97*
Prop. of cluster sample with water	-0.409	-3.43***	-0.145	-1.83
Distance to water source (m)	0.000	3.33***	0.000	1.58
Expenditure Per Adult[17]	16.032	1.53	39.233	2.91**
Expenditure Per Adult Sq.	-0.652	-1.42	-1.380	-2.91**
Community Variables (Rural Averages)				
Price of Maize (kg)	-0.029	-0.27	-0.013	-0.27
Distance to the nearest Clinic (km)	0.008	1.52	-0.001	-1.76
Distance to the nearest Market (km)	-0.001	-0.13	-0.000	-0.36
Adult Agric. Wage[18]	-0.170	-1.73	-0.101	-1.07
Constant	-95.014	-1.61	-275.911	-2.90**
Number of Observations	2266		4305	

[17] Fitted values used
[18] Total amount of money received as a result of weeding, planting, clearing and other farm activities

The level of education in the latter survey year is predicted to have a higher impact than the former at all levels with the exception of the Secondary education. Secondary level of education in the first survey year has a relatively more substantial decreasing effect on fertility than in the latter. This is not exceptionally surprising since number of years spent in schooling in the first period, 1987/88, is longer[19]; thus delaying time of marriage and subsequently reducing fertility much more than in GLSS 4. Whilst the secondary level in GLSS 1 reduces number of births by 1.160, the same level results in 1.122 fewer births in GLSS 4 than women with no education, all other predictors held constant. The lower levels of education however show a reverse impact between the periods. A woman with middle level of education for example is predicted to have approximately 0.820 less number of births in GLSS 4 whilst a woman at the same level in GLSS 1 would experience 0.622 less births. Despite the above described patterns, the magnitude of the secondary level in each survey year is much substantial than the lower levels of education. This is a clear indication that, in order for the economy to achieve its aim of reducing population and increasing economic growth, the policy of encouraging more girls in school must be continued and expanded. Indeed, there should be greater efforts at ensuring these girls remain in school, at least until secondary school, if not the tertiary level.

Findings on the age of the woman and fertility in this study also corroborate earlier findings on the topic. Number of births is generally seen to increase with the various age cohorts. All the age categories are significant at the 1 percent level. In GLSS 1 the magnitudes of the first two categories; 25 – 29, and 30 – 34, are lower than GLSS 4, with the last two categories being higher than those in GLSS 4. Whilst women between the ages of 40 to 49 have 5.7 more births than those in the base category, 15 – 24, in the first survey year, those in the latter survey year give 5.1 more births than the base category, ceteris paribus. Ethnicity is found to be significantly more influential in predicting fertility in GLSS 1 than 4. All the ethnic groups have fewer births than the Akans, with the exception of the Hausas in GLSS 1; but Nzema and other ethnic groups are not significant. The Ewe ethnic group is found to have 0.2 and 0.5 fewer births in GLSS 1 and 4 respectively than the Akans, ceteris paribus. A

[19] Secondary level of education in Ghana was interspersed with two years of national service; not to mention the number of years spent in middle school before entering the former level. This system was changed (reduction in years spent in school) by the time of the survey in GLSS 4.

possible explanation to fewer significant ethnicity categories is the gradual loss of traditional control on women due to education and the media.

It is also observed that, women in the rural areas have more children than their counterparts in the urban centres. The prevalence of better schools and higher enrolment rates in urban centres explain the relatively fewer births. Labour market participation and competition is also keen; which leads to the unwillingness of urban women to have more children, ceteris paribus. It is also estimated that, an additional household in the cluster acquiring protected water would decrease the number of births by 0.41 and 0.14 in GLSS 1 and 4 respectively. The relationship between number of children and water availability is further strengthened by the significance of distance to water source. Assuming water represents health in this circumstance, its increase in access is likely to improve the survival rate of children and hence reduce fertility. The intuition behind this is that, the higher the survival rate of children, the lower the number of family size. Usually, in instances where the survival rate of children in a region is low, women increase their fertility in order to have the desired family size. It could also be argued that, with a closer source of water, there will be no need to have more children undertaking the many aspects of house chores; one of them being to walk long distances to fetch water.

The expenditure per adult is observed to have a non-monotonic effect on the number of children born. It increases the number of births initially to a maximum of 12.29 and 14.21 percents in GLSS 1 and 4 respectively and then declines. For the first survey year, the turning point is higher than the mean (11.45%) expenditure per adult. Indeed more than three-quarters of the women are found below the turning point. Women in this group are estimated to have more births as their expenditure increases. At the lowest quarter of expenditure, births increase by 1.39 with an increase in expenditure per adult to the median (11.40%). As expenditure increases from the median to the third quarter, number of births increases by 1.11. The increase in the number of births as expenditure per adult increases however ceases at the highest expenditure quarter. Women at this level have 0.23 fewer births ceteris paribus. Expenditure per adult is jointly significant at the 1 percent level.

Similarly, women in GLSS 4 increase number of births with increases in expenditure per adult but only within the lowest quarter of the expenditure levels. The average expenditure per adult in this period is slightly above the turning point and a woman with the mean expenditure level has only 0.07 fewer births. The number of births decreases as expenditure levels increase beyond the mean. Women at the highest level of expenditure are estimated to have 3.19 fewer births. The study finds that, the economic status of households has more significant effect on fertility in GLSS 4 than 1 amongst the highest income earners. The quantity – quality trade-off theory is more observed in the latter survey year. This exposes the gradual fertility transition of the country.

Decomposition Analysis

This section attempts to analyse the difference in the estimated fertility gap between GLSS 1 and 4. The aim is to find the source of the fertility difference, that is, whether the difference is attributed to observed characteristics of individual women or the coefficients (effects of the variables) in both survey years. Table 3 presents the results of the Oaxaca-Ransom decomposition method which approximates the non-discriminatory scenario using estimates from the pooled model. The average fertility difference is estimated to be 0.075. This seems a relatively small fertility change over a decade considering the government's ardent pursuit of economic growth which is more feasible with lower fertility rates. The bulk of the change in fertility is however seen in the characteristics difference in the two survey years. Endowment difference explains about 80.5 percent of fall in fertility whilst coefficients constitute 19.5 percent. Education, which is the main focus of the study, explains a meagre 6.7 percent of the difference in endowments towards the fertility decrease. Although education is noted to have considerable effects on fertility change, the findings here indicate other characteristics may have much more influence in the African setting. There has definitely been an increase in the level of education in female schooling especially in the primary and secondary levels in the data but their contribution to change in fertility is relatively small.

Table 3: Decomposition of difference in Average Fertility in Ghana, 1987/88 – 1998/99

Mean Total Differential :	0.075	
- due to endowments (E):	-10.440	
- due to coefficients (C):	-2.306	
- due to interaction (CE):	12.821	
		(%)
Differences due to Coefficient:	0.015	19.5
Differences due to Endowment:	0.061	80.5
Components of Characteristics Effects:		
No Education (Base Category)		
PRIMARY	0.016	21.3
MIDDLE/JSS	-0.037	-49.3
SECONDARY	0.026	34.7
Women's Age (Dummies)		
15 - 24 (Base Category)		
25 - 29	0.036	48.0
30 - 34	-0.043	-57.3
35 - 39	-0.136	-181.3
40 - 49	-0.227	-302.7
Woman's religion (Dummies)		
Christian (Base Category)		
Muslim	0.000	0.0
Traditional	-0.004	-5.3
No Religion	0.000	0.0
Woman's ethnicity or language (Dummies)		
Akan (Base Category)		
Ewe	-0.001	-1.3
GaAdangbe	0.004	5.3
Dagbani	0.022	29.3
Hausa	0.003	4.0
Nzema	-0.001	-1.3
Other	-0.010	-13.3
Woman's current residence (Dummy)		
Urban (Base Category)		
Rural	-0.006	-8.0
Average Cluster Cost of Schooling	-0.004	-5.3
Prop. of cluster sample with toilet or latrine	0.001	1.3
Prop. of cluster sample with water	0.053	70.7
Distance to water source (m)	0.002	2.7
Community Variables (Regional Averages)		
Price of Maize (kg)	-0.022	29.3
Distance to the nearest Clinic (km)	0.002	2.7
Distance to the nearest Market (km)	-0.002	-2.7
Adult Agric. Wage[20]	-0.150	-200.0
Expenditure Per Adult [21]	-4.496	-5994.7
Expenditure Per Adult Sq.	5.036	6714.7
Constant	0.000	
Total	0.061	80.5

[20] Total amount of money received as a result of weeding, planting, clearing and other farm activities
[21] Fitted values used

The most influential determinant of fertility decline in this study is expenditure. Expenditure per adult contributes 720 percent[22] to the difference in characteristics. This contradicts DeRose et al., (2002) findings in Ghana that, even at higher levels of education, women who think they can achieve higher incomes and thus the ability to care for more children will give birth to more. Evidence of Becker, 1960 and Becker and Lewis, 1973 theory of the quantity and "quality" of children trade-off is rather confirmed. The trade-off is explained as that, when earnings increase, parents increase their investments in human capital which in effect improves the quality of their children whilst decreasing their number.

Adult agricultural wage also contributes 200 percent to the decline in fertility. However, its negative sign implies a percentage wage decrease would result in a decrease in the number of births, all other variables held constant. But again, agricultural wage also forms part of expenditure and therefore deducting from expenditure per adult's contribution still leaves total household earnings positive. The cost of commodities including schooling is also observed to have some contribution to the fertility differential. Total cost of commodities contributes 24 percent. Characteristics that represent health measures have relatively low influence on the change with the exception of the proportion of cluster with water (70.7). Distance to the nearest clinic and water source explain about 2.7 percents each; with proportion of cluster sample with toilet having 1.3 percent. Rural residence also explains 8 percent of the decline in fertility. Age has a significant contribution to the difference in characteristics. However, due to a bigger percentage of older women found in the latter survey year, its contribution rather under-estimates the fertility decline. Ethnicity and religion contribute 25.3 and 5.3 percents respectively to the fertility differential.

Conclusions

The study compares two surveys conducted in Ghana between 1987/88 and 1998/99 to find whether there has been a significant decline in fertility over the decade. Earlier studies present a gloomy picture on any substantial fertility declines in SSA. Using

[22] This is the sum of percentages of expenditure per adult and its squared

Oaxaca – Ransom, 1994 decomposition analysis, this study finds that, fertility has declined over the decade but the change is indeed very small (0.075). It confirms doubts expressed in studies like Bongaart et al, 1984, Caldwell, 1992 and others. They noted that, although transition has begun in SSA, the continent is not likely to see any substantial decline before the beginning of the next century. The study further finds that, the decline in fertility albeit small is mainly attributed to differences in characteristics (80.5%) and the most important of these is expenditure. The findings suggest that, an increase in expenditure per adult significantly contributes to fertility decline in Ghana. This particular result concurs with the quantity – quality trade-off theory expounded by Becker, 1960. The main determinant of the study, education, is also found to contribute to fertility decline in Ghana as in other developed and developing countries. However, its contribution to the decline is not as much as earnings. One disadvantage of the decomposition method is that, it does not consider the distribution of characteristics within the two datasets that may cause differences in fertility. It rather estimates average fertility in each survey year, which could lead to inappropriate inferences with regards to differences in fertility level due to differences in attributes. In this case, fertility decline could be underestimated. Further estimations would be performed analysing the change in fertility by residence and age cohorts as well as the distribution of characteristics in each survey year. This could help in determining the actual magnitude and sources of fertility decline in Ghana.

References

Appleton, S. (1996), "How Deos Female Education Affect Fertility? A Structural Model for the Cote D'Ivoire" Oxford Bulletin of Economics and Statistics, Special Issue Human Capital in Economic Development. Vol. 58, February, 1996, N0.1. Ed. John Knight. Blackwell Publishers Ltd, Oxford, U.K and Cambridge, MA.

Becker, G. S. (1960), "An Economic Analysis of Fertility" in Development and Economic Change. National Bureau of Economic Research.

Becker, G. S. and Lewis, H. G. (1973), "On the Interactions between Quantity and Quality of Children" Journal of Political Economy Vol. 81, No 2, Part 2.

Martin, Teresa Castro (1995), "Women's Education and Fertility: Results from 26 Demographic and Health Surveys" Studies in Family Planning, 26, 4: 187-202.

John Bongaarts, Odile Frank and Ron Lestheghe (1984), "The Proximate Determinants of Fertility in Sub-Saharan Africa" Population and Development Review, Vol. 10, No.3, pp. 511-537.

John C. Caldwell, I. O. Orubuloye and Pat Caldwell (1992), "Fertility Decline in Africa: A New Type of Transition?" Population and Development Review, Vol. 18, No. 2, pp 211-242.

Laurie F. DeRose, F. Nii-Amoo Dodoo and Vrushali Patil (2002), "Schooling and Attitudes on Reproductive-Related Behaviour in Ghana" International Journal of Sociology of the Family. Vol. 30, No. 1, Fall 2002, 50-65.

Kofi Benefo and T. Paul Schultz (1996), "Fertility and Child Mortality in Cote D'Ivoire and Ghana" The World Bank Economic Review, Vol. 10, No.1

Nicole Mellington and Lisa Cameron (1999) "Female Education and Child Mortality in Indonesia" Bulletin of Indonesian Economic Studies, Vol. 35, No. 3, pp 115-44.

Robinson, W.C. (1997), "The Economic Theory of Fertility Over Three Decades" Population Studies, Vol. 51, No.1. (March 1997), pp 63 – 74.

Appendix

Table 1: Number of Women, by Schooling and Age in Ghana, 1987/88 & 1998/99 (%)

Age	None		Primary		MiddleJSS		Sec. & Higher		All women	
	GLSS 1	*GLSS 4*	*GLSS 1*	*GLSS 4*	*GLSS 1*	*GLSS 4*	*GLSS 1*	*GLSS 4*	*GLSS 1*	*GLSS 4*
15-24	35.56	31.67	15.17	23.25	43.93	38.17	5.34	6.90	36.36	29.27
25-29	38.56	41.20	14.43	19.04	41.24	32.10	5.77	7.66	21.40	19.40
30-34	41.71	44.86	14.09	17.22	39.50	31.38	4.70	6.54	15.98	17.40
35-39	56.15	49.59	9.43	15.27	27.87	26.77	6.56	8.37	10.77	14.15
40-49	73.50	56.46	9.40	13.38	14.53	24.18	2.56	5.99	15.49	19.79
Total	45.28	43.25	13.33	18.30	36.36	31.43	5.03	7.02	100.00	100.00

Table 2: Fertility, by Women's Schooling and Age in Ghana, 1987/88 & 1998/99

Age	None		Primary		MiddleJSS		Sec. & Higher		All women	
	GLSS 1	*GLSS 4*	*GLSS 1*	*GLSS 4*	*GLSS 1*	*GLSS 4*	*GLSS 1*	*GLSS 4*	*GLSS 1*	*GLSS 4*
15-24	1.201	0.937	0.856	0.416	0.765	0.447	0.409	0.161	0.915	0.575
25-29	3.118	2.92	2.828	2.472	2.450	1.955	1.178	1.000	2.687	2.378
30-34	4.053	4.235	4.333	3.767	3.531	3.064	3.000	2.061	3.837	3.645
35-39	5.460	5.175	5.435	4.946	4.456	3.859	3.750	3.059	5.065	4.611
40-49	7.159	6.436	7.242	6.070	6.098	4.801	4.333	3.431	6.940	5.812
Total	4.037	4.007	2.947	2.732	2.289	2.274	1.763	1.689	3.142	3.066

Table 3: Number of Women, by Schooling and Region in Ghana, 1987/88 & 1998/99 (%)

Residence	None		Primary		MiddleJSS		Sec. & Higher		All women	
	GLSS 1	*GLSS 4*	*GLSS 1*	*GLSS 4*	*GLSS 1*	*GLSS 4*	*GLSS 1*	*GLSS 4*	*GLSS 1*	*GLSS 4*
Urban	31.12	26.57	13.18	19.39	45.96	40.47	9.74	13.58	37.16	35.59
Rural	53.65	52.47	13.41	17.71	30.69	26.43	2.25	3.39	62.84	64.41
Total	45.28	43.25	13.33	18.30	36.36	31.43	5.03	7.02	100.00	100.00

Table 4: Number of Women, by Schooling and Region in Ghana, 1987/88 & 1998/99

Residence	None		Primary		MiddleJSS		Sec. & Higher		All women	
	GLSS 1	*GLSS 4*	*GLSS 1*	*GLSS 4*	*GLSS 1*	*GLSS 4*	*GLSS 1*	*GLSS 4*	*GLSS 1*	*GLSS 4*
Urban	3.981	3.346	2.676	2.225	2.106	1.981	1.524	1.697	2.708	2.352
Rural	4.056	4.192	3.105	3.039	2.451	2.522	2.375	1.670	3.398	3.461
Total	4.037	4.007	2.947	2.732	2.289	2.274	1.763	1.689	3.142	3.066