Fertility rates and the socio-economic environment in Missouri

Linda M. Manning and V.A. Samarayanake
Department of Economics, University of Missouri-Rolla, Missouri, USA

Introduction

Recently there has been increased interest in an aggregate approach that explores the connection between economic growth, investment in human capital and economy-wide birth rates. The desire to understand fertility as an aggregate variable arises from the observation that highly developed nations tend to have far lower fertility rates than those that are less developed (Anker, 1978; Becker *et al.,* 1990; Murphy, 1992; Rios, 1991). As a result, most of the research in this area has focused on comparisons of developed and developing countries. The differences between these countries are not limited to size and economic growth, however. For instance, cultural differences are important factors in birth rates. Consequently, to understand the impact of economy-wide socio-economic forces on fertility, it is helpful to look at economies that are relatively homogeneous with respect to political, cultural and historical character, but that contain subsectors that are characterized by socio-economic diversity. Missouri represents an example of just such an economy. It has the advantage that the people share a common federal and state government, language and culture. At the same time, its 115 counties are also autonomous economic entities, with diverse levels of economic growth, education and opportunities. Within such a group of economies, there may also be cultural diversity (e.g. race and religious differences).

Previous research

The literature on birth rates falls into two general categories:

(1) studies that investigate rates for individuals; and

(2) studies that examine the interrelationship among education, fertility and economic development.

The study of individual fertility choices can be viewed as an evolutionary process. Early research, which derived from the assumptions of the classic Malthus model of population growth focused on the role of income in fertility choices. This emphasis has continued to reappear in the literature, and much of the research finds that increased fertility is associated with increases in income. For instance, Gardner (1973) used family income, Michael (1975) used husband's income, and Murphy (1992) used expected male hourly wages. A study by

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Boyer (1989) examined the fertility response of low-income families in South-eastern England to increases in child allowances. He found that, "adoption of child allowances after 1795 appears to have been a major cause of the increase in birth rates during the first decades of the nineteenth century" (p. 111). If increased income leads to higher fertility, then children are "normal" goods (Becker, 1960).

The literature provides examples of studies in which increases in income appear to depress fertility, however. Simon (1969) chronicles several studies that report conflicting income results and summarizes a set of relevant demographic determinants of fertility from those studies. These determinants include income, education, child mortality, rural-urban residence, religion, knowledge of contraception, investment value of children and the cost of raising children. Murphy (1992) suggests that higher incomes lead to substitution of children for luxuries. Empirically, he found that since 1945 fertility and real incomes have generally been negatively related in both cross-section and time series analyses in developed countries.

As researchers sought to explain differences in fertility, and income failed to produce consistent, predictable results, interest in the impact of education began to emerge. Michael (1975) postulates that couples with more education prefer fewer children because they tend to provide their children with high-quality education, health and child care, making the cost of child rearing high. He suggests that these parents substitute quality children for quantity, arguing that high levels of education may increase the proficiency with which parents produce human capital in their children, reducing the cost of higher quality children, thus reducing the quantity of children desired. Better-educated couples may be better equipped to control the number of children they have because they use birth control more efficiently, and also use more effective contraceptive techniques.

In examining this hypothesis for individual families, Michael found that the wife's education is significant and negatively related to fertility while the husband's education level is not statistically significant. This can be explained both by better use of contraceptives, which are typically managed by the female, and by the tendency for educated women to enter the labour force, increasing the opportunity cost of raising children to the woman (Liebowitz, 1975). Because better-educated women also tend to spend more time with children (Datcher-Loury, 1988), this raises the opportunity cost even more.

Michael (1975) also reported income effects in fertility decisions. He found that increases in the husband's income alone tended to contribute to the family's propensity to have more children. However, in an analysis including the spouses' education and income, taking the husband's income into account did not offset the negative effect of the wife's education on fertility.

The Michael and Liebowitz studies were seminal in that they considered the wife's education and labour market participation. Early studies assumed that husbands' or total family income and education were the primary determinants of fertility. However, as increasing numbers of women enter the labour force,

research results have shown that, "the number of children is strongly negatively related to the wage rate or other measure of the value of time of wives and is more often positively rather than negatively related to the wage rate or earning of husbands" (Becker, 1981). At the same time, in a study on the size of North Carolina families, Gardner (1973) found that women's schooling was one of the most consistently significant variables, and showed "remarkable stability" in several regression analyses. In addition, Gardner found that the wife's wage rate lowered fertility, but that family income, (non-white) race and rural-farm residence were positively related to fertility. Also, Zsembik (1990) hypothesized that federal transfer payments to Puerto Rican women would reduce the opportunity costs of bearing children to those participating in the informal labour market. Thus, they would be expected to have fertility levels more like women who had never worked than like women active in the formal labour market. The hypothesis could not be rejected. The conclusion drawn was that expansion of economic opportunity serves to reduce reproductive activity in the long run, because "productive and reproductive activities appear to be mutually inhibitive" for women (Zsembile, 1990, p. 147). Since education determines social status, female work incentives and female employment opportunities, it was found that higher levels of education were consistently associated with fewer children.

All the above research deals with individual fertility choices. A separate phase of the investigation took a broader, macro-economic view, linking fertility and economic growth. Becker *et al.* (1990) developed a theoretical model of economic growth that suggests the initial endowment of income, fertility, education and capital investment is a major determinant not only of population growth, but also current and future education investment, and ultimately, the future rate of economic growth. They suggest that at low levels of development, there is a proclivity towards fertility and away from education investment that obstructs economic growth. An important implication of the model is that only after some critical level of human capital (e.g. education) has been accumulated will the returns to that investment become self-sustaining to provide long-term growth. This may explain why underdeveloped areas tend to remain underdeveloped, and why the birth rate appears to decrease in developed areas. It also provides valuable insight into the phenomenon of low-income families whose fertility response to increases in income are positive, while high-income families tend to have fewer children (Murphy, 1992).

Becker (1988) suggests that birth rates are higher in a stagnant or developing economy because "children are cheaper during recessions". Research further suggests that economic development and ensuing increases in education will reduce fertility. In fact, the demographic transition necessary to sustain long-term growth requires a fall in fertility. This is difficult to achieve in developing areas because, while having children is relatively inexpensive, the cost of educating them may be prohibitive; not only are there limited resources available, but there are indirect opportunity costs of the child's withdrawal from economically useful work. Also, in underdeveloped areas, less educated parents

may not appreciate the benefits of education enough to sacrifice the immediate returns to children's work. Michael (1975) found that the higher the schooling level of the husband and wife, the higher the expected level of schooling of the child. As a result, "fertility rates are much less sensitive to socio-economic change in the early stages of economic development than in later stages of development" (Anker, 1978). This means a threshold level of human capital investment is required before reductions in rates can be expected.

Data and model

All data were drawn from county tapes for Missouri from the 1990 US Census. Initially, a theoretical model was developed based on previous research. Variables considered for inclusion in the model were:

- an income variable;
- several measures of county-wide educational attainment and economic performance;
- a race variable;
- a measure of rural population;
- the median age; and
- several variables specific to females.

These last measures were included because of the recurring findings in the literature that the effects of female economic and social attributes are significant in determining birth rates. Table I presents summary statistics on all variables. Since it is reasonable to assume that the relationship between these variables and birth rates may not be linear (e.g. the effect of income), square terms of the main effects were allowed to enter into the model. Another general assertion

Variable name	Mean	Standard deviation
Income	1,0080.89	1,790.63
High school education (HS)	38.38	5.04
Bachelor's degree (BS)	7.08	3.23
Professional degree (GRAD)	3.73	2.03
Age	36.04	3.84
Unemployment rate (UR)	6.69	2.02
Black	2.91	6.09
Rural	69.59	27.53
Female employment (FEMP)	44.70	2.22
Poor	17.70	5.98
Female labour (FLABOUR)	39.01	4.68
Female headed households (FEMHEAD)	1,041.67	3,225.01

Table I.
Summary statistics

considered was to allow interactions, such as those between income and education, to enter the model.

The variables that were shown to influence birth rates in previous studies, as well as those that social and economic theory suggest as potential determinants of birth rates, are used as regressors in a birth rate model. Specifically, the hypothesized determinants included are as follows. The per capita county income is used to measure the effect of additional income on county birth rates. This measure is used because not only does it measure an average family's ability to afford additional children, but also per capita income provides information for an average family's ability to pay for education. If children are considered normal goods (Becker, 1960; Boyer, 1989), it can be hypothesized that as per capita income rises, the birth rate is expected to rise.

Three measures of educational attainment, which proxy for investment in education, and provide incentives to reduce the number of births, are also included. There are a number of reasons that increased education might result in fewer children. First, higher education increases the opportunity cost of time spent with children, which depresses the number of births. Also, evidence suggests that the more educated the parents, the more quality time is spent with children, that is, time spent on activities other than basic care (Hanushek, 1992). This too would reduce the number of children born. In addition to the human capital developed by parents spending more time with them, children of educated parents also tend to be better educated (Michael, 1975). The education variables included in the model were the per cent of the adult population with only a high school education (HS); with a bachelor's degree (BS); and the per cent of the county population with a graduate or professional degree (GRAD). It is expected that higher levels of education will be associated with lower county birth rates. In the county context, we follow Becker *et al.* (1990) to develop our hypothesis. They state that, "[a]n increase in the stock of human capital [education] raises per capita income and hence has a positive income effect as well as a negative substitution effect on the demand for children". The income effect dominates when human capital is low in the economy, but the substitution effect begins to dominate, reducing births, as human capital increases. Thus, high levels of education should result in lower birth rates.

Other demographic variables included were the per cent of the county population that is black (BLACK), the median age (MEDAGE), and the per cent of the county living in rural areas (RURAL). The expected sign of BLACK is unknown. Blacks tend to be concentrated in urban areas, and have a higher incidence of school drop-outs, poverty, infant mortality and birth rates than whites in those areas, but in many of Missouri's rural areas, these characteristics also accurately describe poor whites. The county's median age (MEDAGE) is expected to be negatively related to the birth rate. As the population ages, fewer children are desired. Since theory suggests that the cost of raising children in rural areas is less than in developed, urban areas, it is expected that the effect of RURAL will be positive.

Descriptors specific to females were included to capture the effects that opportunities for females have on fertility. Increases in the proportion of the adult female population in the labour force (FLABOUR) and female employment rate (FEMP) are expected to be associated with falling birth rates. Increased employment opportunities may imply an increase in the value of women's time, increasing the opportunity cost of raising children. Also, female headed households with children (FEMHEAD) is expected to be inversely related to birth rates, in spite of popular myths about these women.

Measures of the county's economic performance are also included. The unemployment rate of the county (UR) is included in the model, which may be a gauge of expectations about children's futures. Since families with low expectation horizons are less likely to invest heavily in children's education, there may be less incentive to restrict family size. Therefore, it is expected that high unemployment rates will be associated with high birth rates. In addition, the per cent of the county living under the poverty level (POOR) is included as a regressor; it is expected that as more people fall under the poverty level, fewer children will be born.

Inclusion of all the square terms and possible interaction terms would result in spurious results because of multicolliearity among the regressors. Hence, a model selection process was used to determine which of these terms belong in the model. It should be noted that all hypothesized main effects were forced into the model, and the model selection procedure, MINR, was performed only on the square and interaction terms. The MINR procedure, found in the SAS programming language package, was chosen because it assesses the performance of a much larger set of models than the standard stepwise regression technique does. Criteria such as Mallow C_p and adjusted R^2 were used to select a final parsimonious model from the best models obtained from the MINR procedure.

Results

Table II contains the results from the regression analysis. The key hypothesis in this study is whether there is an initial set of socio-economic conditions whose presence significantly affects county-wide fertility rates. The results suggest not only that such conditions exist, but that the effects depend on gender and race, as well as income and education. This implies that the direction of policies aimed at poverty reduction and economic growth should include a focus on women and minorities.

The estimated regression coefficients shed light on how the various socio-economic conditions affect county-wide fertility. Direct interpretation of regression coefficients is not possible for those variables that exhibit significant interactions with other determinants of fertility. Delaying such interpretations till later, we first look at variables that do not appear in interactions. These are BS, GRAD, UR, FEMP (and its square $FEMP^2$), FLABOUR (and its square $FLABOUR^2$), and FEMHEAD.

Variable	Estimate	*T*-score	Prob> | *T* |
Intercept	–1.7842	–2.988	0.0035
BLACK	0.0143	1.525	0.1306
INCOME	–2.2787E-5	–1.754*	0.0826
High school education (HS)	0.0053	0.768	0.4443
Bachelors degree (BS)	–0.0006	–0.352	0.7258
Graduate degree (GRAD)	–0.0040	–1.823*	0.0715
AGE	–0.0036	–4.037***	0.0001
Unemployment rate (UR)	0.0007	0.470	0.6396
RURAL	–0.0031	–3.138***	0.0023
Female employment (FEMP)[a]	0.1085	3.953***	0.0001
POOR	–0.0007	–0.756	0.4518
Female labour (FLABOUR)[b]	–0.0129	–1.836*	0.0696
Female headed household (FEMHEAD)	–5.232E-6	1.882*	0.0630
High school education^2 (HS^2)	–0.0002	–2.255**	0.0264
FEMP[a]	–0.0012	–3.909***	0.0002
FLABOUR[b]	0.0001	1.660*	0.1003
INC*HS	6.26E-7	1.882*	0.0630
RURAL*HS	7.6512E-5	3.048***	0.0030
BLACK*INCOME	1.893E-6	2.981***	0.0037
BLACK*AGE	–0.0011	–4.554***	0.0001
BLACK*POOR	0.0002	2.319**	0.0226

Notes:

* Significant at the 10 per cent level

** Significant at the 5 per cent level

*** Significant at the 1 per cent level

[a] Female employment rate

[b] Increases in the proportion of adult female population in the labour force

Table II.
Regression results

The education measures have the expected sign. Both the per cent of bachelors degrees (BS) and graduate degrees (GRAD) are negative, although only GRAD is significant. This supports the hypothesis that high levels of education reduce fertility.

The results associated with female characteristics are compelling, as they are all significant. As the female employment rate (FEMP) rises initially, birth rates rise, but then fall, as indicated by the negative sign of the square term (FEMP^2). Further, as more women enter the labour force (FLABOUR), fewer children are born. There appears to be a turning point in this variable also; the square term is negative. Finally, there is a negative association between female heads of household with children (FEMHEAD) and birth rates.

The effects of variables that appear not only on their own but also in an interactive form were investigated by utilizing the estimated model to determine how fertility varies in response to changes in each pair of interactive variables. This was done while holding the other variables at their Missouri averages. For example, Figure 1 shows how fertility of a county varies as the county's per capita income increases from lowest observed level (US $7,295) to the highest (US $18,625). The different lines in Figure 1 indicate the fertility vs income relationship at varying proportions of high-school-only (HS) graduates. (HS denotes the percentage of those who have a high school diploma but no higher degrees.) The graphs show a positive relationship between fertility and income, except for counties that have the lowest proportion (25.32 per cent) of individuals with only a high school education. As the proportion of individuals with a high-school only education rises, the increase in fertility associated with an increase in income becomes more pronounced. Over 95 per cent of the counties show a positive association between income and fertility, which is consistent with most other research results.

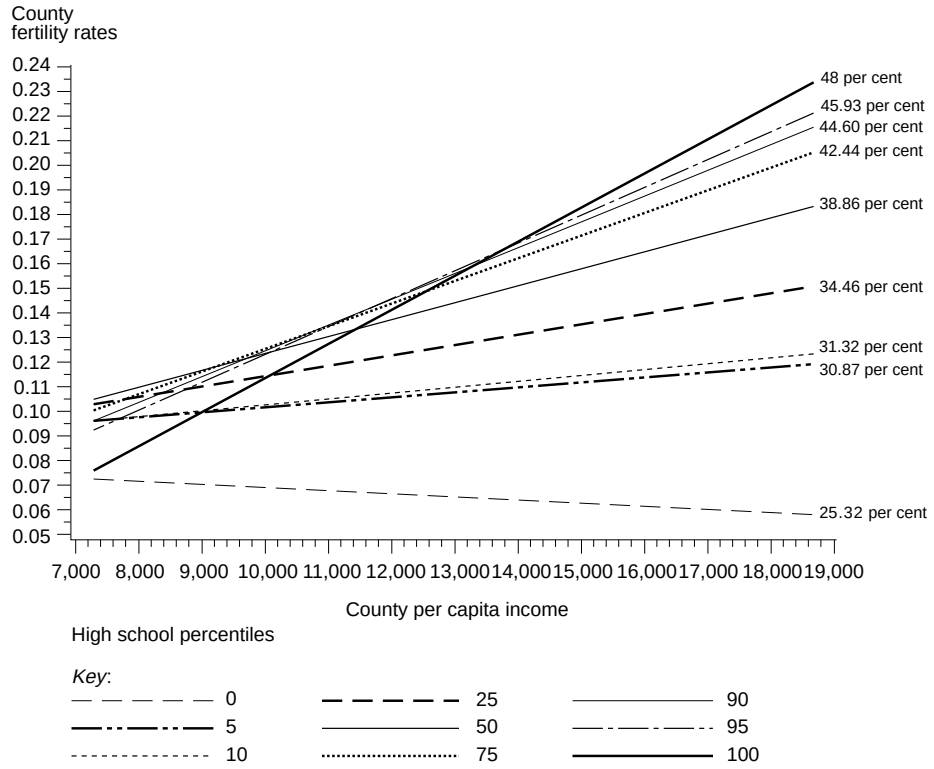

Figure 1.
County fertility rates and per capita income at 0, 5, 10, 25, 50, 75, 90, 95 and 100th percentiles of high school only

In Figure 2, the relationship between fertility and the proportion of individuals with a high-school only education is illustrated. This relationship varies as the proportion of rural residents in the county changes from a low of zero per cent to a high of 100 per cent. In counties with a 100 per cent rural population, an increase in the proportion of individuals with a high-school only education is associated with an increase in fertility. The reverse is generally true for counties with no rural population. If "high-school-only" individuals represent a certain socioeconomic class, then in rural counties an increase in those that belong to this class – at the expense of a reduction in those who do not belong to it – is associated with an increase in fertility. One explanation is that people with a basic high-school education prefer children over other normal goods provided they are in a rural environment. In an urban environment, this socio-economic group reacts differently. In counties with a mix of urban and rural populations, say a 50-50 mix, fertility increases with increases in the proportion of this group but starts declining beyond the median for the HS variable (which is approximately 29 per cent).

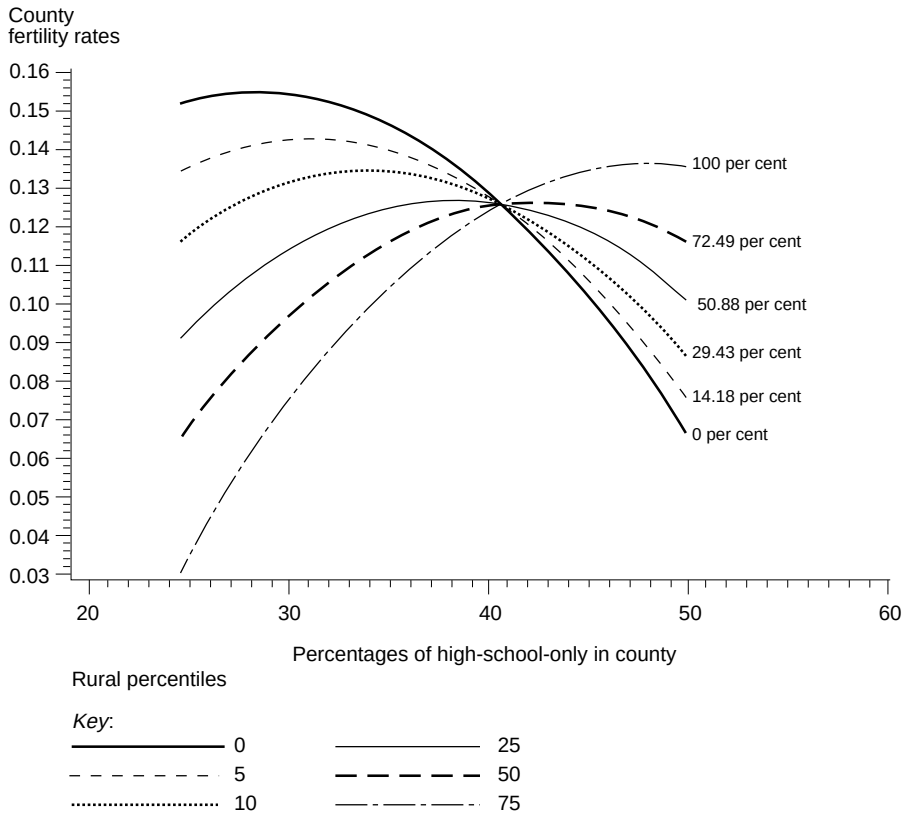

Figure 2. Fertility rates and percentages of high school only at 0, 5, 10, 25, 50 and 75th percentiles of county rural population

Figure 3 shows how the relationship between fertility and income is influenced by the percentage of blacks in the county. For counties with relatively high levels of blacks, an increase in fertility is shown to be associated with an increase in per capita income. The rate of this increase declines as the proportion of blacks in the county decreases. One implication of this result is that children are normal goods, but more so for blacks.

Figure 4 gives the relationship between fertility and median age of individuals in a county, by the percentage of blacks in the county. Counties with a high percentage of blacks show high fertility if the average age of individuals in the county is low. This fertility drops drastically as the median age increases. Counties with no blacks or a low percentage of blacks but a young median age show a lower fertility than their counterparts with a high percentage of blacks. Again, the fertility drops as the median age increases, but this drop is not as drastic as that observed for counties with a high percentage of blacks. In fact, among counties with an average age of 40, non-black counties show a higher fertility rate than counties with a relatively large percentage of blacks. This is

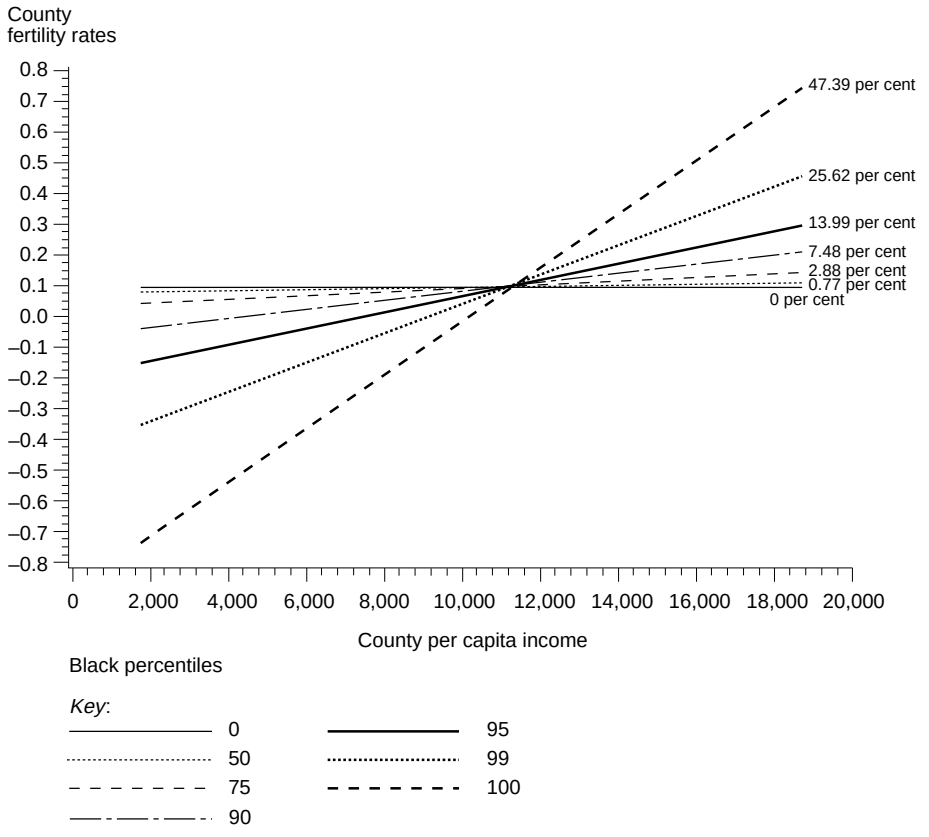

Figure 3.
Fertility rate and per capita income at 10, 50, 75, 90, 95, 99 and 100th percentiles of black populations in counties

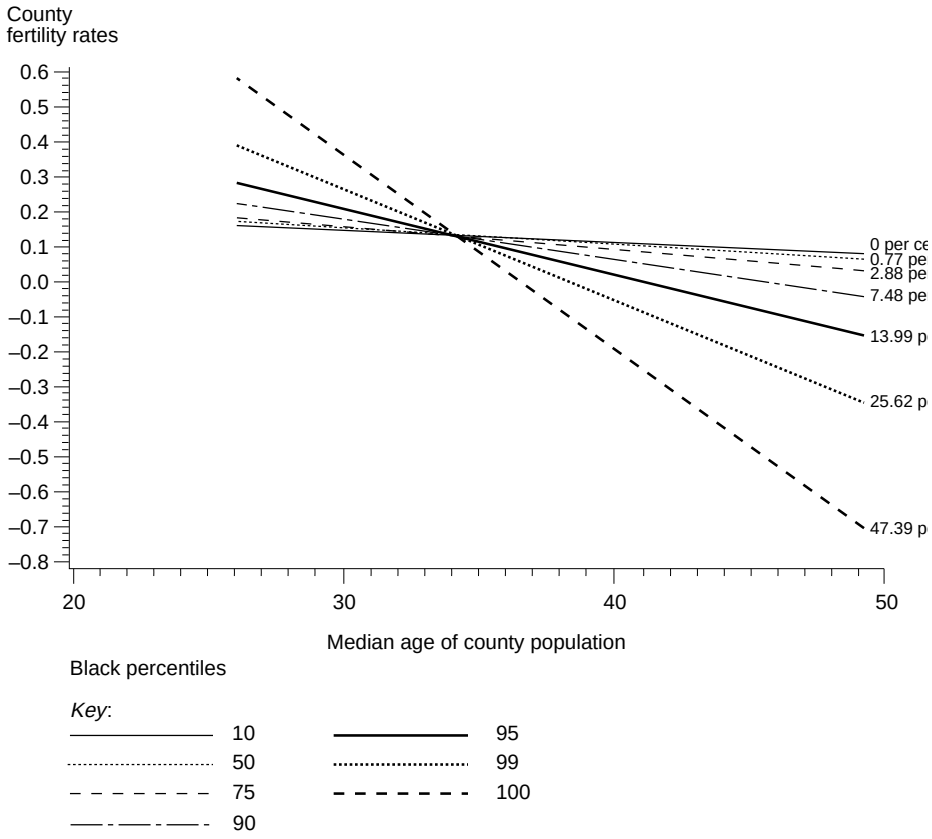

Figure 4. Plot of fertility rates and county median age at 10, 50, 75, 90, 95, 99 and 100th percentiles of black population in county

consistent with the observation that blacks tend to have children earlier in their life than non-blacks. (In fact, in Missouri, the data shows that teenage pregnancies are substantially higher for Afro-Americans than for Caucasians (Missouri Youth Initiative, 1994)).

Figure 5 shows the relationship between fertility and the percentage of individuals in poverty, for counties with various proportions of blacks. Counties with a relatively high proportion (47 per cent) of blacks show a distinct positive relationship between fertility and the percentage of the county population in poverty. This positive association becomes less and less as the proportion of blacks decreases. For counties with no blacks, there is a negative relationship between fertility and poverty even though the impact of poverty on fertility seems to be very slight. One hypothesis that is consistent with this finding is that for blacks, an increase in poverty is associated with an increase in fertility. It should be noted that what we find is only a statistical association with no indication as to which causes what. Another explanation is that in socioeconomic environments in which one finds a large proportion of blacks as

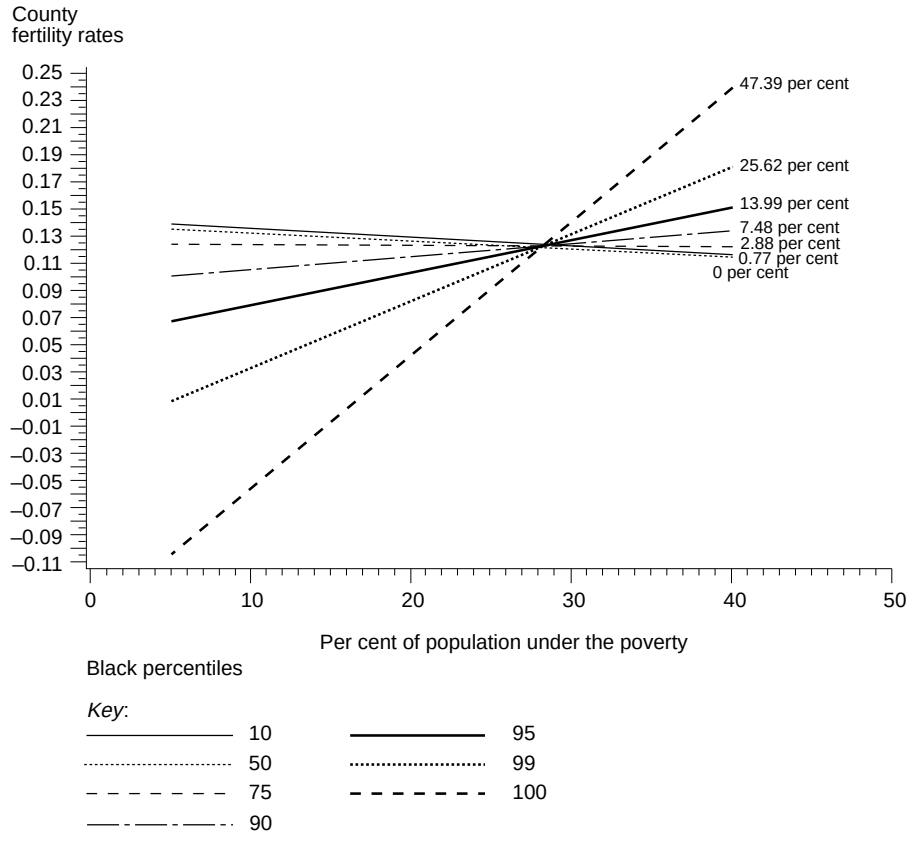

Figure 5.
Fertility rates and percent of poor at 10, 50, 75, 90, 95, 99, and 100th percentiles of black population

well as a substantial percentage of people living in poverty, an increase in the level of fertility can be found.

These results provide some compelling evidence that the socioeconomic and demographic characteristics of the environment contributes to birth rates. This is consistent with the Becker *et al.* (1990) hypothesis concerning economic growth. These results also support most of the previous research in the area of individual fertility choices, and even may help reconcile some of the conflicting results observed in that literature.

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