Women's Schooling, Fertility, and Investments in Children in South Africa

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Abstract

It is widely observed that parental schooling has a negative effect on fertility and a positive effect on children's schooling outcomes. This paper explores the mechanisms through which schooling affects fertility and investments in children, and examines empirical evidence from South Africa. Modeling the effects of schooling on choices about the quality and quantity of children, we demonstrate that a plausible outcome of increased parental schooling is that parents will increase investments in child quality while decreasing the quantity of children. We show that increases in wives' labor supply need not accompany the decrease in fertility, since home productivity may rise as fast as labor market productivity, especially at low levels of schooling. Empirical evidence from South African survey data indicates surprisingly weak effects of schooling on female labor supply at low schooling levels, in spite of declines in fertility and increases in market wages. There are much stronger effects of parental schooling on children's schooling attainment. The results suggest that the most important effects of schooling on fertility work through increased investments in child quality, with a relatively small role played by increases in wages and labor market opportunities.

I. Introduction

Empirical evidence from a wide variety of high-income and low-income countries has established a strong negative association between women's schooling and fertility, and a strong positive association between women's schooling and child outcomes such as health, survival, and schooling attainment. Schultz (1993) calls the strong link between women's education and fertility "one of the most important discoveries in research on nonmarket returns to women's education," documenting in his survey that women with seven or more years of schooling have substantially lower fertility than women with zero years of schooling in all parts of the world.[1] The effects of schooling at low levels appear to differ across regions, with large negative effects in Asia and Latin America, but with small negative or even small positive effects in Africa (Ainsworth, Beegle, and Nyamete, 1994). Increases in education appear to affect both the desired fertility of couples and the couples' ability to realize those goals. Several studies, such as Rosenzweig and Schultz (1985), indicate that better educated women have fewer unwanted births. The negative relationship between schooling and realized fertility is not simply due to increased ability to control fertility, however, with data on fertility preferences indicating negative effects of women's education on desired family size in all parts of the world (Schultz, 1993).

A large empirical literature also documents the beneficial effects of mother's schooling on numerous health and human capital outcomes for children.[2] Strauss and Thomas (1995) survey a large literature documenting the strong positive association of mother's education with child survival in developing countries. Effects of father's education also tend to be positive, although generally smaller than the effects of mother's education. In addition to the effects of parental schooling on child health, parents' schooling is associated with positive effects on other child outcomes, especially schooling (Strauss and Thomas, 1995, Barros and Lam, 1996). Recent analysis by Behrman et al. (1997) for India suggest that effects of mother's schooling on children's schooling result from real productivity returns to mothers' human capital, an interpretation consistent with the approach we take below. The well-documented positive effects of maternal schooling on child outcomes have been widely noticed by international agencies, and have been in the forefront of policy forums such as the 1994 International Conference on Population and Development in Cairo. The empirical evidence has had a large influence on policy, as exemplified by the statement in a well-known address by Lawrence Summers (1992), then Chief Economist of the World Bank, that "once all the benefits are recognized, investment in the education of girls may be the highest return investment available in the developing world."

While the negative relationship between mother's schooling and fertility is well documented, the causes of this relationship are not well understood. Sociologists have emphasized the relationship between women's education and women's status. Mason (1986) argues that women's

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[1] See also Cochrane (1979) Weinberger (1987) Cleland and Rodríguez (1988), and Weinberger, Lloyd, and Blanc (1989).

[2] Excellent surveys are provided by Schultz (1993) and Strauss and Thomas (1995).

education increases female autonomy, leading to later marriage, increased contraceptive use, and lower fertility. Mason finds support for a link between women's autonomy and fertility in the widely observed result that wife's education has a more negative effect on fertility than does husband's education (Cochrane, 1983, Cleland and Rodríguez, 1988). Economists have emphasized the effect that increased schooling has on women's labor market opportunities, with schooling raising market wages and inducing substitution out of time-intensive activities such as children (Birdsall, 1988; Schultz, 1993). Economists have estimated strong negative effects of women's wages on fertility in a variety of countries, with wife's wages having a more negative effect on fertility than husband's wages.

Examining cross-sectional data from Brazil, Lam and Duryea (1999) find that although women's education is correlated with dramatic decreases in fertility and increases in wages, women's labor force participation does not increase until high levels of education are reached. They also find strong effects of maternal education on child quality, and conclude that the effect of schooling on fertility works through increased investment in child quality, with only a minor role played by rising women's wages.

This paper extends Lam and Duryea's approach, and tests it using survey data from South Africa. Noting the strong positive effect of parental schooling on human capital outcomes, we model the effect of schooling on parents' tradeoffs between the quantity and quality of children. We consider the responses that parents will make to schooling-induced increases in their productivity in producing better-educated children. We show that a plausible outcome is that parents will reduce fertility at the same time that they increase investments in child quality. We also consider the link between productivity in the market and non-market sectors, and analyze changes in fertility and labor supply as a function of wives' schooling. We show that if productivity at home rises as fast as productivity in the labor market, fertility may decline without an increase in women's labor supply.

Our empirical analysis is based on retrospective fertility histories of over 100,000 South African women. Study of demographic trends in South Africa has been hindered by data quality and data access issues (see Caldwell and Caldwell 1993, Thomas 1999 for discussion), but available evidence suggests South Africa underwent perhaps the earliest fertility transition in sub-Saharan Africa, with Total Fertility Rates for all races falling during the 1960s and 1970s (Caldwell and Caldwell 1993, Thomas 1999). As in the rest of the world, a negative relationship exists in South Africa between education and fertility (Thomas 1996, 1999). Our results will reinforce this conclusion. We will show that increases in education are associated with decreases in fertility, but that declines in fertility are only weakly associated with increases in women's labor force participation, especially at low levels of schooling. We find much stronger links between increases in schooling and improvements in children's schooling attainment. Our interpretation of this evidence is that the effects of parental schooling on fertility work primarily through parents increasing investments in child quality in response to increased productivity in dimensions such as child schooling. Effects working through the labor market appear to play a relatively minor role in explaining the effect of schooling on fertility.

II. Modeling the effects of schooling on fertility

It is beyond the scope of this paper to develop a complete theoretical model capturing all of the potential factors linking parents' schooling, fertility, and children's human capital. We think it is instructive, however, to begin by laying out a set of theoretical issues that we believe are central in understanding the widely observed empirical patterns. The analysis here builds on the approach in Lam and Duryea (1999), adding additional theoretical detail. As in Lam and Duryea, we focus on two fundamental economic tradeoffs in analyzing the relationship between schooling and fertility. The first tradeoff is between the quantity and quality of children. Since there is generally observed to be a strong effect of schooling on both fertility and children's human capital, it seems important to look at both the "quantity" and "quality" outcomes simultaneously. The second fundamental tradeoff is the allocation of women's time between time spent in home production and time spent working in the labor market. The value of women's time has played a key role in economic theories of fertility, and we want to consider the role of market wages and labor force participation as we analyze the relationship between schooling on fertility. In this section we present some of the theoretical issues that we believe are critical in thinking about the tradeoff between quantity and quality of children and the tradeoff between home production and employment.

The tradeoff between quality and quantity of children

We begin by considering the role of schooling in a model of quality-quantity interactions. We follow the models of child quantity and quality developed by Willis (1973), Becker and Lewis (1973), and Becker (1991), which consider a static decision problem in which parents choose the number of children, the quality of children, and the wife's lifetime labor supply. Assume that parents maximize a utility function $U(N,Q,Z)$, where N is the number of children, Q is the children's average quality (where quality refers to outcomes such as children's health and schooling), and Z represents all non-child uses of time and goods.[3] Child quality is produced using inputs of time and goods by a production function assumed for analytical convenience to be constant returns to scale, represented by the unit production function

$$q=f_q(t_{qw}, t_{qh}, x_q ; s_w, s_h),$$

where t_{qw} and t_{qh} are the amount of wife's time and husband's time used for each unit of child quality per child, x_q is the amount of purchased goods used for each unit of quality, and s_w and s_h are the schooling of the wife and husband. Non-child consumption Z is produced by an analogous CRS production function.

[3] We make several simplifying assumptions. Since our model can explain the data without appealing to bargaining models, we maintain the assumption of a single household utility function. We also do not incorporate life cycle dynamics. The fundamental insights of our model will not be altered by moving to a dynamic model, however. Finally, we assume that parents choose a single level of quality for all children, an assumption which captures in a simple way the realism that the quality chosen for one child will be related to the quality chosen for other children.

The wife's total time, T_w, is allocated between market work, T_{mw}, children, and non-child consumption, subject to the time constraint $T_w = T_{mw} + NQT_{qw} + ZT_{zw}$. We assume for now that the wife is at an interior solution at which some time is allocated to all activities, implying that the market wage is an appropriate marginal valuation of her time. An analogous time constraint describes the allocation of the husband's time, T_h. Labor market earnings of the husband and wife plus unearned income A are used to purchase the market inputs for children and non-child consumption, $A + w_w T_{mw} + w_h T_{mh} = NQx_q p_x + Zx_z p_x$. The CRS assumption means that the choices of optimal inputs of time and goods into home production are a function only of the production technology and the input prices, and can be separated from household consumption decisions. This separability implies that we can define the shadow price $p_q = w_w t_{qw} + w_h t_{qh} + p_x x_q$, the cost of producing one unit of child quality for a single child, a cost that is independent of the amount of quality produced. The shadow price of Q, the average quality of all children, is $p_Q = Np_q$. This shadow price depends on N, child quantity, and thus cannot be separated from the household's consumption decisions. Similarly, the shadow price of N is $p_n = Qp_q$, and is directly dependent on the choice of child quality. The endogeneity of these shadow prices with respect to the chosen levels of quantity and quality is at the heart of the intriguing comparative statics of quality-quantity models, as discussed by Theil (1952), Willis (1973), Becker and Lewis (1973), and Becker (1991).

We are interested in the effects of mother's and father's schooling on the couple's choices of N and Q. An increase in the schooling of either parent may lower the amount of time or goods required to produce a unit of quality, thus reducing the shadow price of a unit of quality, p_q. Market wages may increase at the same time, with the partial effect of raising p_q. Whatever the resulting change in p_q, the comparative statics of this price change on Q and N are complicated by the non-linearity of the budget constraint. A reduction in p_q will reduce the shadow price of both quality and quantity, which are intrinsically connected, and any adjustments in N or Q in response to the change can be thought of as causing further changes in these endogenous shadow prices. A large increase in Q, for example, implies a large increase in the shadow price of N. Willis (1973) provides an important bottom line for the implications of these interactions, which in our model lead to the following expressions for the effect of a compensated change in the unit price of quality on the demand for quantity and quality:

$$h_{n,p_q} = h_{n,p_n} + h_{n,p_q} \qquad (1)$$

$$h_{q,p_q} = h_{q,p_q} + h_{q,p_n} \qquad (2)$$

where h_{n,p_q} and h_{q,p_q} are the compensated elasticities of N and Q with respect to p_q and the h_{i,p_j} terms on the right-hand side are the compensated own-price and cross-price elasticities of N and Q with respect to the shadow prices p_n and p_q. The price elasticities on the right-hand side of Equations (1) and (2) are defined for the hypothetical case in which the two shadow prices can be varied independently, meaning they are entirely determined by the utility function as if the budget constraint were linear, and hence obey the usual restrictions.

Equations (1) and (2) have several important implications. First, the theoretical restrictions on the own and cross-price elasticities imply that N and Q may move in opposite directions in response to a change in the price of a unit of quality, even abstracting from income effects. This

means that the substitution effect of an increase in parents' ability to produce higher quality children may plausibly be to decrease either fertility or average child quality, though not both. The second implication of this type of quality-quantity model is that substitution effects can be greatly exaggerated beyond those of a linear budget constraint. This effect, as noted by Becker (1991), may help explain the rapid declines in fertility and corresponding rapid increases in children's human capital in response to relatively modest changes in the shadow price of children. In our model this tendency for large substitution effects applies not only to changes in contraceptive technology or market prices, but also to the effect of schooling on parents' productivity in producing child quality.

An increase in the wife's schooling has two effects on the shadow price of a unit of child quality. First, increased schooling should increase productivity, corresponding to a decrease in the amount of time and goods required to produce a unit of quality. This effect, ceteris paribus, decreases p_q. Schooling should also increase the market wage for the wife, an effect that tends to increase p_q and potentially offsets the productivity gains. It is an empirical question whether an increase in wife's schooling tends on net to increase or decrease p_q. Since the predicted effect on child quality and quantity of an increase in p_q is theoretically ambiguous (even abstracting from income effects), the response of the household in either the quality or quantity dimension to an increase in schooling will not identify the direction of the underlying price change. One result that is theoretically plausible is that an increase in schooling will lower the relative price of child quality, leading to an increase in the average quality of children and a decrease in the quantity of children. Becker (1991) argues that the empirical relationship between quality and quantity of children from virtually all populations implies that parents rapidly increase child quality in response to increases in income, with associated decreases in the quantity of children. (See also Kaplan 1996.) Such responses imply in our model that reductions in p_q will lead to increases in child quality and decreases in the quantity of children.

Labor market productivity versus home productivity

The second dimension in which couples are making tradeoffs is the allocation of time between the labor market and care for children. The mother's schooling may have important effects here, as emphasized in many economic theories of fertility decline. As noted above, increases in a mother's schooling can be expected to simultaneously increase her productivity in home production (including child care) and in the labor market. It is often assumed that increases in market wages associated with higher schooling represent an increase in the relative price of labor market time versus home production time. This clearly does not have to be the case, however, since it is possible that an increase in schooling raises home productivity by as much as it raises wages. This could occur because wages do not adjust to the actual increase in productivity, or simply because the increase in home productivity is as large as the increase in labor market productivity.

We assume for simplicity that woman i's potential (or actual) market wage w_i is not affected by her hours worked. A woman will enter the labor force if w_i is greater than her reservation wage r_i, the marginal value of her time when she is working zero hours. We are interested in the difference between the reservation wage and the market wage, which we will denote $d_i = r_i - w_i$,

with particular attention to how this difference is affected by schooling. We note that $d_i > 0$ (as indicated by non-participation in the labor market) for a large fraction of women in our sample, with this fraction varying significantly with schooling. As shown below, roughly 65 percent of women without schooling are out of the labor force, falling to under 25 percent at the highest levels of schooling.

Increased schooling will increase the probability that a woman works in the labor market if and only if the schooling causes a larger increase in her market wage than in her reservation wage. Assuming that schooling increases productivity in both the home and market sectors, we expect that $\partial r_i / \partial S_i > 0$ and $\partial w_i / \partial S_i > 0$. The empirical question is which derivative is larger, determining whether $\partial d_i / \partial S_i$ is positive or negative. While the experience of high-income countries suggests that labor market productivity increases faster than home productivity (e.g., Jorgenson and Fraumeni 1989), it may well be the case that for women with low levels of schooling (and large numbers of children) the increase in home productivity from an additional year of schooling is large. It may also be the case that while schooling raises labor market productivity at all levels of schooling, effects of schooling on home productivity face diminishing returns. It may thus be the case that $\partial d_i / \partial S_i > 0$ at low levels of schooling, but $\partial d_i / \partial S_i < 0$ at higher levels of schooling. In this case increases in schooling would not increase labor force participation at low levels of schooling, but would increase participation at higher levels of schooling.

We will not attempt to estimate individual reservation wages directly, but given the number of outcomes we are observing we will be able to make some general observations about the path of mean reservation wages as a function of schooling. Given some assumptions, it is possible to estimate the mean reservation wage at each schooling level by looking at the market wage and the proportion of women who work. Assume that the log of the market wage and log of the reservation wage for the *i*th woman with *S* years of schooling can be described as the mean log wage for her schooling level plus a normally distributed disturbance $r_{si} = \bar{r}_s + u_{si}$ and $w_{si} = \bar{w}_s + v_{si}$, where $\bar{r}_s$ and $\bar{w}_s$ are the mean log reservation wage and mean log market wage at schooling level *S* and u_{si} and v_{si} are draws from zero mean normally distributed random variables. The gap between the reservation wage and the market wage is $d_{si} = \bar{r}_s - \bar{w}_s + u_{si} - v_{si}$, with mean $\bar{d}_s = \bar{r}_s - \bar{w}_s$ and variance $s^2_{ds} = s^2_{vs} + s^2_{us} - 2s_{vs,us}$. An instructive special case is to assume that the variance of d_s is some constant s^2_d at each level of schooling.[4] Then the proportion of women working at schooling level *S*, P_s, is the proportion for whom $d_{si} < 0$, $P_s = \Phi[(\bar{w}_s - \bar{r}_s)/s_d]$, where Φ is the cumulative standard normal distribution. If 50 percent of the women at a given schooling level are working, then $\bar{d}_s = 0$, the mean reservation wage equals the mean market wage. If $P_s < 0.5$, then $\bar{r}_s > \bar{w}_s$. It follows that if we observe P_s, $\bar{w}_s$, and s_d then we can estimate the mean reservation wage as

[4] As would be the case, for example, if *u* and *v* have some constant and equal variance and some constant correlation at each level of schooling. Since the variance of log market wages can be directly estimated, this provides at least some guidance for assumptions about s_d.

$$\bar{r}_s = \bar{w}_s - s_d \Phi^{-1}(P_s) \qquad (3)$$

We will use this result below to provide an illustrative characterization of the relationship between changes in the reservation wage (reflecting home productivity) and changes in the market wage as functions of schooling.

The effect of schooling on fertility, child quality, and women's labor supply, then, can be viewed theoretically as being driven by tradeoffs along two margins. On the one hand is the race between home productivity and labor market productivity, driving the extent to which better educated women are pulled into the labor force by higher wages. On the other hand is the adjustment in child quality and child quantity that results from the effects of schooling on home productivity. Although the theory offers no unambiguous predictions, it does suggest that looking at the effects of schooling on fertility, labor supply, wages, and investments in children simultaneously will be more revealing than looking at any single outcome alone. It also provides a useful foundation for interpreting our empirical results, which we believe point to a powerful role of quality-quantity tradeoffs in explaining the effects of schooling on fertility.

Data

The analysis here is based on the South Africa October Household Survey (OHS), a national survey collected by Statistics South Africa, the national statistical agency (formerly the Central Statistical Service). This is an annual cross-sectional household survey which uses a stratified random sampling scheme to collect data a representative sample of the country. The analyses presented in this paper use the data files from the 1995, 1997 and 1998 waves of the OHS[5], which when concatenated contain information on a total of 353,065 individuals living in 78,492 households. Because we are interested in the trade-offs between women's education, employment, and investment in children, we restrict our sample to women ages 35-44 and 45-54 at the time of the survey. The younger age group was selected because these women are young enough to be potentially economically active and are likely to have dependent-aged children, yet their children will be old enough to observe variation in schooling outcomes among them. However, differences in fertility among younger women may disappear if sub-groups increase fertility later in life; Thus, we include the older group of women, who have completed fertility but are still likely to be economically active, and in many cases will also have dependent-aged children.

The 1997 and 1998 waves of the OHS obtain full reproductive histories of all women who have ever given birth; the 1995 wave obtains these histories for women younger than age 55. Unfortunately the birth dataset contains entries only for women who are recorded as giving birth at least once; women who do not match up to this module either were not asked the questions, were

[5] The 1996 OHS contained a retrospective birth module; however, the date files available for this wave do not contain that module. The 1999 OHS, the most recently available wave, did not obtain retrospective birth histories from women.

not correctly matched to the module, or had no children. We have adopted the assumption that women who do not match to the birth module have had no live births, but we acknowledge that this is likely to underestimate fertility.[6]

The OHS contains several important limitations arising from its nature as a household survey. No information is available on non-resident family members; thus, we can observe the correlation between spousal characteristics and outcomes, or parental characteristics and outcomes, only for those couples who co-reside, and for parents who live with their children. This may introduce an important selection bias into our results, since individuals choosing to live with their spouses and/or children may differ from those who choose not to. In South Africa the realities of the migrant labor system results in many married couples living apart (e.g., Posel 2000); similarly, roughly a quarter of school-aged African children live with neither of their genetic parents (Anderson 2000). Additionally, the 1997 and 1998 waves of the OHS do not ask relationship questions for children, other than relationship to head; all individuals who are biological children, stepchildren, and adopted or foster children are grouped into a single category. Because fathers of children are not identified in reproductive histories or in the household roster (except in 1995), we cannot directly identify fathers of children. Additionally, although the questionnaire asks for the respondent number of an adult's co-resident spouse, this question was not answered if the person was unmarried, and thus likely ignores coresident unmarried couples. This is potentially problematic because the definition of who is married appears to vary across the years.[7]

Schooling attainment is measured using the standard completed education question in the OHS. The OHS measures the highest standard that a person has completed; unfortunately, it does not provide any details about grades attended but not completed, nor does it provide measures of school attendance, school quality, the number of grades repeated, the time since non-enrolled persons were last in school, or the age at which the person started school. (See Anderson 2000, Anderson, Case and Lam 2001 for further discussion and criticism of South African education measures.) Schooling in South Africa is measured in standards: Sub A (grade 1), Sub B (grade 2), Standard 1 (grade 3), etc. up through Standard 10 (grade 12). At the completion of Standard 10, students take a national matriculation examination (the "matric"), which qualifies them for higher education. Failure rates on the matric exam are quite high, especially for blacks (Anderson, Kaplan and Lam 2002). The 1995 OHS collapses the lower three levels of schooling (Sub A, Sub B and

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[6] Thomas (1999) notes that the OHS is generally acknowledged as underreporting fertility. Our comparisons of the fertility estimates from the OHS with those from the 1993 SALDRU/PSLSD survey show that OHS estimates are much lower than SALDRU/PSLSD, even when the sample is restricted to women who reported any live births. Infant mortality rates are also low in the OHS—especially in 1995—and thus we will not examine child mortality as an outcome in this paper.

[7] For example, the proportion of "never married" women ages 15-55, which was approximately 50% in 1995 and 1997, fell to 23% in 1998; the proportion of "divorced/separated" women in that age group increased from 3% in 1995/1997 to 52% in 1998.

Standard 1) into a single level of the education variable; thus, we cannot distinguish between individuals who have completed grades one, two or three. The 1997 and 1998 questionnaires do distinguish between these lower levels of schooling; however, to keep them consistent with the 1995 measure we have collapses all individuals in grades 1 through 3 into grade 2. None of the surveys provide detailed information on schooling beyond high school; for example, college attendance and college completion are treated as identical. We have collapsed everybody with any post-secondary schooling into a single level, "grade 15."

Measure of schooling are often treated as equivalent to "years of schooling," although this is decidedly not the case. Near universal enrollment at younger ages and slower academic advancement for blacks and coloureds suggests grade repetition is quite common (Anderson 2000, Lam 1999), an inference that is supported by detailed retrospective educational histories among black students in Cape Town (Anderson, Kaplan and Lam 2002). While a typical white student may take 12 years to complete secondary school and take the matric exam, black students often takes 14 or 15 years to complete grade 12. This has obvious and important implications for interpreting returns to schooling, because students who anticipate taking longer to reach a given educational level must discount their returns from that level according. Because no information on schooling histories is available in the dataset, we have no choice but to group all students completing the same level of schooling together.

As a result of these various issues of data quality and identification, we have chosen to restrict our analyses to women who are identified in the household roster as head of household or spouse of head, and who live with a man identified as head or spouse of head. We treat as "married" a male and female couple listed as head and spouse of head, regardless of their actual marital status. We rely on women's retrospective reproductive histories to operationalized women's fertility; however, for the analysis of children's schooling outcomes we will focus on co-resident household members identified as children of the household head, excluding those whose parents are known to be deceased.[8] "Husband," "wife," "father," "mother," and "child" are therefore broadly defined for the purposes of the current paper. As a result, we cannot examine the effects of differences in family structure, such as the presence of grandparents, stepparents and single mothers (see Anderson 2000, Anderson et al. 1999, Case and Deaton 1998 for further discussion on these issues). This restriction is unfortunate, but is necessitated by limitations of the dataset itself.

Table 1 presents descriptive statistics for the two groups that will be the focus of most of our analysis, black women ages 35-44 and 45-54. The older women report an average of 4.2 live births ever born, a number that presumably represents completed fertility. Women ages 35-44 report 3.5 births. Many of the women ages 35-44 will have also completed fertility, but some childbearing

[8] The 1995 OHS obtained the specific ID number of co-resident parents; subsequent waves asked only if the child's parents were alive. Although the 1997 and 1998 waves specifically asked about parents "by birth," social parenting is widespread in South Africa, and we cannot be fully confident that the children we have identified as offspring of the women in the sample are necessarily their biological children.

may continue during this age range. Because we will be looking at employment behavior as well as fertility, we do not want to focus exclusively on the older women, since the link between fertility and employment may be weaker for these women. Table 1 shows that female employment rates for black women are relatively low, about 40% for women aged 35-44 and 34% for women aged 45-54. Cohort improvements in schooling can be seen by noting that the younger women have over 1.5 years more schooling, 6.5 completed grades compared to 5.0. The proportion with no schooling is 29% for the older women, falling to 18% for the 35-44 year-olds. In the following section we will present some basic descriptive patterns for separate racial groups in order to illustrate differences and similarities in fertility, labor force participation, and child schooling. We will then focus exclusively on the black women shown in Table 1 for the more detailed analysis of the links between schooling, fertility, employment, and child outcomes.

III. Fertility and schooling in South Africa

Previous research indicates that the relationship between fertility and education is not as steep in African countries as in developing nations in other parts of the world, especially at low levels of schooling. Unlike Brazil, for example, which features a steep drop in fertility at low levels of education (Lam and Duryea 1999), fertility rates in Africa are often flat at low levels of schooling, only beginning to drop sharply at fairly high levels of education (Ainsworth et al. 1996). Fertility rates in South Africa declined significantly for all racial groups during the 1960s and 1970s (Caldwell 1993, Thomas 1999). At the same time, education levels have increased steadily and significantly throughout the latter half of the twentieth century (Case and Deaton 1999, Thomas 1999), so that non-whites born in 1970 completed roughly twice as many levels of schooling as non-whites born in 1940 (Lam 1999). This situation, in which fertility drops as educational attainment is rising, provides an excellent situation for examining the trade-offs between fertility, education and investment in children.

Figure 1 shows the number of children ever born to women aged 35-44 and 45-54 at the time of the OHS surveys, classified by single years of completed schooling. The figure demonstrates the large differences in fertility across years of women's schooling, and across races. For women aged 35-44, black women with zero years of schooling (about 20% of black women in this age group) report having about four live births; coloured women with no schooling (13% of coloured women in this age group) report slightly over three births. Too few white women are observed at low levels of schooling to provide meaningful estimates. Fertility remains fairly flat across low levels of schooling, but begins to drop after Grade 7, the completion of primary school. Black women age 35-44 with Grade 12 or above have approximately one fewer birth than same-race women with the lowest levels of schooling. For women ages 45-54 there is a steeper relationship between schooling and fertility. Between Grade 0 and Grade 8 there is about a 0.75 reduction in fertility for black women. The difference between black women who have completed Grade 12 and black women with no schooling is about 1.5 births.

Figure 2 plots the proportion of all women who have worked in the past seven days, by race and schooling. The proportion of black women working is close to 30% until the completion of primary school. Coloured women have somewhat higher employment rates than black women, but

also exhibit relatively constant rates until at least Grade 8 or 9. Married white women typically have lower employment rates than married black or coloured women. Employment rates increase dramatically at higher levels of schooling for all racial groups. Compared to those with no schooling or primary schooling, employment among the college educated is almost three times as high for blacks and whites and twice as high for coloureds. Comparing Figures 1 and 2, we see a somewhat milder version of the paradox noted by Lam and Duryea (1999) in Brazil. Over the range of schooling from zero to about Grade 9, substantial declines in fertility occur with virtually no corresponding increase in employment rates. Looking at black women ages 35-44, for example, women with 9 years of schooling have about 0.7 fewer births than women with zero schooling, a decrease of about 20%. The employment rates for these two schooling levels are almost identical, however, slightly over 30%.

Figure 3 plots the mean log wages for employed women reporting non-zero wages, relative to black women with no schooling. There is a strong positive relationship between schooling and wages beginning around Grade 4. The implied rate of return to schooling is very high above Grade 5, in the range of 15%-25% per completed grade. One surprising feature of this plot is that although coloured women are more likely to be employed than black women (Figure 2), they report lower earnings before the ninth grade. (A similar pattern is observed for men's earning, not shown.) Given South Africa's high unemployment rates, this may indicate that blacks with low schooling who do work are positively selected on unobservable characteristics. Comparing Figure 3 and Figure 2, it is striking that employment rates for women remain low and relatively constant over ranges of schooling in which wages are rising substantially. Among 35-44 year-old black women who work, those with 9 years of schooling report wages about 1.0 log points higher than those with 4 years of schooling, implying 2.8 times higher wages. The percentage of women working at these two schooling levels is almost identical, however, only slightly above 30%.

While the patterns are not as dramatic and striking in South Africa as in Brazil, we nonetheless observe a situation in which schooling appears to have a negative effect on fertility over ranges in which there is very little relationship between employment and fertility. This suggests that the effect of education on fertility is not working primarily through price of time effects. Wages increase substantially over this range, without any corresponding increase in women's employment, additional evidence that there is some aspect of women's time allocation other than labor market activity may be explaining the link between education and fertility. As suggested in the theoretical discussion above, investments in child quality may be the margin in which education and time allocation interact with fertility.

Figure 4 plots the schooling attainment of children ages 13-17 as a function of mother's schooling.[9] The measure of schooling is years of completed schooling per year of age since age six,

[9] We chose to include all mothers of children ages 13-17, rather than only those who were 35-54 years old. The results are similar if we use the restricted age range for mothers, but the sample of children is correspondingly smaller.

a measure that will equal one for children who have made steady progress through school. As shown in Lam (1999), this measure is relatively constant within racial groups between ages 13 and 17, a reflection of the fact that racial differences in grade attainment result more from differences in grade repetition than from differences in school enrollment (see also Anderson 2000). Two patterns emerge from this plot. First, maternal education is correlated with significant improvements in children's schooling advancement. Children of mothers with no schooling have advanced about seven tenths grades for each year of life since age 6, while children of mothers who have completed high school have advanced over nine tenths of a grade for each year of age, rough a 30% improvement. A second, very interesting feature is that, controlling for mother's schooling, there are almost no racial differences in children's schooling accomplishments, a pattern that also holds true for actual grades completed (see Anderson et al. 2002). Although the educational distribution of mother varies greatly across races (Table 1), children of well-education mothers benefit equally well, regardless of race.

IV. Explaining the effect of schooling on fertility

We now turn to analysis of the mechanisms through which schooling affects fertility. Drawing on our theoretical discussion, we will analyze the relationship between schooling and other important outcome variables, specifically women's fertility, women's labor force participation and children's schooling. Table 2 presents results for regressions analyzing determinants of fertility for women ages 35-44 and 45-54 in the combined October Household Surveys for 1995, 1997, and 1998. The first regression for each age group includes only the schooling of the wife, using dummy variables for each level of schooling. The second regression adds the schooling of the husband using the same set of dummy variables. We chose this flexible specification to allow the relationship between schooling and fertility to assume its true shape, rather than forcing it to be linear, quadratic, or some other simplified relationship. Other variables in the regressions include age and age squared, a dummy variable for rural areas, dummy variables for province, and dummy variables for each sample year.

Models 1 and 3 in Table 2 confirm the pattern presented in Figure 1: there is a significant and negative relationship between education and live births for married black women. Among women 35-44 (Model 2), those with the highest levels of schooling have about 0.6 fewer children than those with no schooling, once background factors are controlled; among 45-54 year olds (Model 3), the effect has roughly doubled for women with highest schooling. When husband's schooling is factored in, a woman's own education loses significance for the younger age group (Model 2), but remains an important predictor for older women (Model 4). Figure 5 plots predicted fertility as a function of wife's and husband's schooling, based on the regression in Table 2; non-education variables were set equal to the means listed in Table 2, while the other spouse's schooling was held constant at grade 6. The series labeled "wife's ed" shows predicted fertility as a function of wife's schooling, holding her husband's schooling constant at 6 years. The series labeled "husband's ed"

shows predicted fertility as a function of husband's schooling, holding the wife's schooling constant at 8 years.[10] Compared with the raw data plotted in Figure 1, the effect of schooling on fertility appears to be less steep once the other spouse's schooling is partialed out, but the slope remains negative for women in both age groups. For husbands, however, the slope is roughly constant for older women; wives of men at the highest level of schooling have approximately as many children as wives of men at the lowest level of schooling, once wives' schooling is controlled.

Fertility and female labor force participation

As pointed out in the theoretical discussion, an important mechanism through which women's schooling affects fertility is through its effect on wages. Increases in schooling should increase productivity in the labor market, leading to increases in wages and employment opportunities. Given the relative time intensity of children, this plausibly leads to a tradeoff between fertility and labor market work. As a first test of the importance of this link, we estimate probit regressions for labor force participation of wives as a function of wives' and husbands' schooling. These regressions use the same sample and the same flexible specification of schooling as the fertility regressions shown above. The results of these probits are presented in Table 3. For both age groups, women's education has a strong effect on women's employment, consistent with Figure 2 (Models 1 and 3). Husband's schooling, when added to the model, has no overall effect on women's work, while the effect of women's schooling is generally unchanged (Models 2 and 4). These patterns are depicted visually in Figure 6, which plots the predicted employment rates for wives as a function of the schooling of the wife and husband. As in Figure 5, the series marked "wife's ed" shows the effect of varying the wife's schooling when the husband's schooling is held constant at six years and other variables are set to their mean values. The series marked "husband's ed" shows the effect of varying the husband's schooling when the wife's schooling is held constant at six years and other variables are set to their mean values. The plots show the flat effect of husband's schooling (once the wife's is controlled) for younger women; women whose husbands have the lowest and highest levels of schooling are equally likely to be employed, once the woman's schooling is partialed out. For older women (bottom panel of Figure 5), husband's schooling has a flat effect except for men with schooling beyond matric. For both age groups, there is an enormous increase in employment rates for women with high levels of education, even with husband's schooling controlled for. Women who have completed high school or beyond are two to three more times likely to be working than women with less than a high school education.

The apparent effects of schooling in both the fertility and labor force participation regressions may be confounded by life-cycle timing issues. Our fertility measure is a cumulative outcome, while labor supply is measured at the time of the survey. Since we are looking at 35 to 54 year olds,

[10] The level of 6 years for spouse's schooling is chosen because it is close to the mean year of schooling for husbands and wives in both age groups (Table 1). Choosing some other level of spouse's schooling would simply cause a parallel shift in the series.

it is possible that some of the patterns in Figure 6 and Table 3 result from differences in the timing of fertility and labor supply by women at different schooling levels. The fact that the patterns of schooling, fertility, and labor supply for women ages 35 to 44 and 45 to 54 are similar may mitigate against this argument. It is also worth considering the possibility that the weak relationship between participation rates and schooling over the first 7 years of schooling may conceal some stronger relationship between schooling and hours worked. There is a significant negative relationship between women's schooling and mean hours worked for blacks, conditional on working positive hours (not shown). However, the variation is relatively small; mean hours worked in the labor market are between 39 and 45 hours at all schooling levels.

Fertility and investments in child quality

The above results suggest that an increase in the opportunity cost of children due to rising wages is unlikely to be the major reason that increases in women's schooling are associated with declines in fertility in South Africa. In spite of increases in market wages, women do not substantially increase their market labor supply as their schooling increases. In this section we consider an alternative mechanism that focuses on "quality-quantity" tradeoffs in parental time allocation. As argued in our theoretical discussion, increases in schooling will plausibly have large effects on parents' tradeoff between the number of children and investments in children's human capital.

In order to analyze the effects of parents' schooling on child quality, we estimate regressions for children's schooling attainment. As above, we use single years of schooling of wife and husband as regressors. We will focus on children ages 13 through 17, and model the average number of grades completed per year of life since age six. (This will be equal to one for students who were enrolled every year and never repeated a grade; the measure will be less than one for students who did not enroll or who repeated one grade or more.) Models of grades per year are presented in Table 4. Consistent with Figure 4, mother's schooling has a tremendous impact on children's schooling progress (Model 1); children whose mothers have high levels of schooling advance through school at one fifth of a grade or more per year faster than children whose mothers have no schooling. When father's schooling is added, it is also a significant predictor, although the effect size of mother's schooling decreases by about one third (Model 2). (Incidentally, note that girls advance through school at a faster rate than boys; see Anderson et al. 2002 for additional discussion on gender and grade repetition.)

Figure 7 plots predicted educational advancement by parental education, with each parent's schooling held constant to grade six, child's gender set to female, and other variables set to their mean value. Once background factors and the other parent's schooling are controlled, the slope of parental education on child's education attainment is less steep than in Figure 4, but still quite impressive. In contrast to women's fertility and work, where the wife's schooling tends to have a much stronger effect on the outcome than the husband's, both parents' schooling has similar positive effects on children's educational outcomes.

These results suggest that there is a strong link between fertility and investments in children. We hypothesize that increases in schooling at low levels lead to increases in the productivity of both mothers and fathers in producing better educated children. Parents respond to this increased productivity in a way consistent with the theoretical model outlined above -- they choose higher levels of child quality and reduce the number of children. As argued by Becker (1991), one of the interesting implications of a model of quality-quantity interactions is that an increase in income or a reduction in the unit price of quality can lead to large responses, with large increases in quality and large decreases in quantity. Increases in women's schooling also lead to increased labor market productivity, as evidenced by the large rise in wages. In making labor supply decisions, however, women are faced with simultaneous increases in home productivity and labor market productivity. Over a large range of schooling it appears that increases in home productivity are large enough to offset even large increases in wages. Until about eight years of schooling we do not see women responding to rising wages with significant increases in labor supply. The driving mechanism through which schooling reduces fertility, then, does not appear to be rising opportunity cost of time due to rising wages. Rather, we argue, couples respond to their increased productivity in producing child quality by reducing the number of children and investing more resources in each child.

V. Conclusions

Schooling attainment in South Africa has been increasing for decades, while fertility levels have been falling. We find a significant negative relationship between women's education and their fertility, an effect that persists when husbands' schooling and additional background factors are controlled. Consistent with patterns elsewhere in Africa, increased schooling has a small and minimal effect on fertility for low levels of schooling, but a large and significant effect for high levels of schooling. Education also increases women's wages, and at higher levels of schooling it is associated with increased labor force participation as well.

Although the relationship between schooling and wife's employment is relatively weak, we estimate large positive effects of schooling on measures of child quality. Increases in both the wife's and husband's schooling at low levels are associated with large improvements in children's schooling attainment. We interpret our results as evidence that increases in schooling lead to large increases in parents' ability to produce better-educated children. Parents respond to this greater productivity by increasing investments in child quality and reducing the number of children. Increases in home productivity are large enough to offset large increases in market wages up to about eight years of schooling, with the result that wives do not increase their labor supply in spite of declines in fertility. This quantity-quality tradeoff, we argue, is much more important in explaining the link between fertility and schooling at low levels than is the effect of increasing labor market opportunities for women.

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Table 1. Summary statistics for married black women, South Africa October Household Survey 1995, 1997, and 1998

	Women 35-44		Women 45-54	
Variable	**Mean**	**Std. dev.**	**Mean**	**Std. dev.**
Number of live births	3.535	(2.075)	4.205	(2.523)
Wife is working	0.395	(0.489)	0.341	(0.474)
Wife's years of schooling	6.505	(4.128)	4.983	(4.010)
Wife's schooling (indicators)				
No schooling	0.185	(0.389)	0.291	(0.454)
Grades 1 - 3	0.054	(0.226)	0.071	(0.257)
Grade 4	0.057	(0.233)	0.069	(0.253)
Grade 5	0.062	(0.242)	0.071	(0.257)
Grade 6	0.077	(0.266)	0.092	(0.288)
Grade 7	0.108	(0.311)	0.092	(0.289)
Grade 8	0.114	(0.318)	0.137	(0.344)
Grade 9	0.061	(0.240)	0.037	(0.188)
Grade 10	0.093	(0.291)	0.054	(0.226)
Grade 11	0.047	(0.212)	0.019	(0.137)
Grade 12	0.125	(0.331)	0.058	(0.234)
Schooling beyond grade 12	0.014	(0.118)	0.009	(0.096)
Husband's years of schooling	6.274	(4.215)	4.831	(4.113)
Husband's schooling (indicators)				
No schooling	0.201	(0.400)	0.314	(0.464)
Grades 1 - 3	0.065	(0.247)	0.076	(0.266)
Grade 4	0.063	(0.243)	0.080	(0.271)
Grade 5	0.062	(0.241)	0.057	(0.233)
Grade 6	0.076	(0.265)	0.071	(0.257)
Grade 7	0.094	(0.292)	0.086	(0.280)
Grade 8	0.127	(0.333)	0.134	(0.341)
Grade 9	0.048	(0.214)	0.031	(0.172)
Grade 10	0.085	(0.279)	0.056	(0.230)
Grade 11	0.037	(0.189)	0.023	(0.151)
Grade 12	0.123	(0.329)	0.061	(0.239)
Schooling beyond grade 12	0.018	(0.134)	0.010	(0.099)
Wife's age	39.112	(2.792)	48.921	(2.858)
Living in rural area	0.548	(0.498)	0.519	(0.500)
Province indicators				
Western Cape	0.035	(0.183)	0.027	(0.163)
Eastern Cape	0.136	(0.343)	0.156	(0.363)
Northern Cape	0.022	(0.146)	0.030	(0.170)
Free State	0.113	(0.317)	0.119	(0.324)
Kwazulu/Natal	0.175	(0.380)	0.184	(0.388)
Northwest	0.121	(0.326)	0.127	(0.333)
Gauteng	0.161	(0.368)	0.129	(0.335)
Mpumalanga	0.128	(0.334)	0.109	(0.312)
Northern Province	0.109	(0.312)	0.119	(0.323)
Survey year indicators				
1995	0.385	(0.487)	0.395	(0.489)
1997	0.375	(0.484)	0.370	(0.483)
1998	0.239	(0.427)	0.234	(0.424)
N	6974		4721	

Table 2. OLS models of live births for married black women, South Africa October Household Survey 1995, 1997, and 1998

	Women 35-44		Women 45-54	
Variable	**Model 1**	**Model 2**	**Model 3**	**Model 4**
Wife's schooling (indicators)				
Grades 1 - 3	0.068 (0.249)	0.097 (0.241)	0.019 (0.314)	0.065 (0.315)
Grade 4	0.077 (0.245)	0.112 (0.248)	-0.018 (0.264)	0.025 (0.270)
Grade 5	0.006 (0.298)	0.048 (0.305)	-0.176 (0.312)	-0.124 (0.317)
Grade 6	-0.053 (0.229)	0.063 (0.240)	-0.345 (0.288)	-0.258 (0.311)
Grade 7	-0.033 (0.208)	0.095 (0.216)	-0.204 (0.241)	-0.104 (0.266)
Grade 8	0.067 (0.193)	0.267 (0.200)	-0.694 (0.264) **	-0.626 (0.286) *
Grade 9	-0.215 (0.216)	0.065 (0.229)	-0.669 (0.362) +	-0.587 (0.405)
Grade 10	-0.426 (0.196) *	-0.126 (0.217)	-0.931 (0.305) **	-0.824 (0.363) *
Grade 11	-0.773 (0.235) ***	-0.446 (0.254) +	0.003 (0.428)	-0.018 (0.475)
Grade 12	-0.664 (0.175) ***	-0.266 (0.210)	-1.165 (0.261) ***	-1.218 (0.363) ***
Schooling beyond grade 12	-0.623 (0.377) +	-0.274 (0.359)	-1.653 (0.327) ***	-1.639 (0.436) ***
Husband's schooling (indicators)				
Grades 1 - 3		0.231 (0.246)		0.035 (0.275)
Grade 4		0.030 (0.272)		-0.469 (0.307)
Grade 5		0.007 (0.254)		-0.279 (0.315)
Grade 6		-0.195 (0.235)		-0.118 (0.275)
Grade 7		-0.401 (0.198) *		-0.428 (0.278)
Grade 8		-0.237 (0.200)		0.012 (0.273)
Grade 9		-0.677 (0.298) *		-0.291 (0.669)
Grade 10		-0.645 (0.226) **		-0.598 (0.332) +
Grade 11		-0.245 (0.274)		0.026 (0.691)
Grade 12		-0.515 (0.212) *		0.149 (0.371)
Schooling beyond grade 12		-0.295 (0.387)		-0.235 (0.498)
Age	0.698 (0.547)	0.611 (0.544)	0.354 (0.905)	0.354 (0.900)
Age squared	-0.007 (0.007)	-0.006 (0.007)	-0.003 (0.009)	-0.003 (0.009)
Living in rural area	-0.413 (0.107) ***	-0.387 (0.106) ***	-0.552 (0.159) ***	-0.544 (0.158) ***
Province indicators				
Eastern Cape	0.516 (0.243) *	0.553 (0.246) *	0.176 (0.380)	0.115 (0.390)
Northern Cape	-0.522 (0.276) +	-0.530 (0.280) +	-0.338 (0.450)	-0.406 (0.456)
Free State	-0.234 (0.223)	-0.199 (0.227)	0.191 (0.350)	0.155 (0.356)
Kwazulu/Natal	0.401 (0.243) +	0.471 (0.246) +	0.602 (0.347) +	0.533 (0.349)
Northwest	-0.180 (0.227)	-0.142 (0.232)	0.209 (0.355)	0.117 (0.358)
Gauteng	-0.402 (0.220) +	-0.320 (0.226)	-0.359 (0.321)	-0.392 (0.326)
Mpumalanga	0.530 (0.248) *	0.575 (0.254) *	0.559 (0.369)	0.452 (0.375)
Northern Province	0.402 (0.240) +	0.477 (0.244) +	0.556 (0.382)	0.507 (0.387)
Survey year indicators				
1997	0.092 (0.058)	0.082 (0.058)	0.527 (0.088) ***	0.539 (0.090) ***
1998	0.294 (0.066) ***	0.270 (0.066)	0.885 (0.103) ***	0.896 (0.105) ***
Constant	-12.438 (10.648)	-10.676 (10.606)	-5.583 (22.203)	-5.345 (22.081)
N	6,974	6,974	4,721	4,721

Robust standard errors in parentheses. The omitted baselines for indicator variables are no education (for schooling), Western Cape (for province), and 1995 (for survey year)

Table 3. Probit models of employment for married black women, South Africa October Household Survey 1995, 1997, and 1998

	Women 35-44		Women 45-54	
Variable	**Model 1**	**Model 2**	**Model 3**	**Model 4**
Wife's schooling (indicators)				
Grades 1 - 3	0.249 (0.151)	0.280 (0.152) +	0.237 (0.157)	0.263 (0.161)
Grade 4	0.045 (0.158)	0.081 (0.161)	0.048 (0.173)	0.065 (0.176)
Grade 5	-0.182 (0.161)	-0.122 (0.162)	0.016 (0.159)	0.028 (0.164)
Grade 6	0.239 (0.134) +	0.289 (0.142) *	0.036 (0.154)	0.059 (0.166)
Grade 7	0.004 (0.126)	0.045 (0.136)	0.380 (0.148) **	0.403 (0.156) **
Grade 8	0.136 (0.123)	0.151 (0.132)	0.237 (0.134) +	0.267 (0.149)
Grade 9	0.034 (0.158)	0.063 (0.167)	0.153 (0.225)	0.155 (0.239)
Grade 10	0.424 (0.128) ***	0.424 (0.143) **	0.634 (0.190) ***	0.650 (0.216) **
Grade 11	0.338 (0.168) *	0.319 (0.184)	0.202 (0.285)	0.194 (0.300)
Grade 12	1.071 (0.120) ***	1.004 (0.154) ***	1.470 (0.203) ***	1.407 (0.243) ***
Schooling beyond grade 12	2.011 (0.312) ***	1.888 (0.337) ***	1.487 (0.375) ***	1.278 (0.419) **
Husband's schooling (indicators)				
Grades 1 - 3		-0.115 (0.150)		-0.209 (0.164)
Grade 4		0.090 (0.148)		0.255 (0.154) +
Grade 5		-0.218 (0.146)		-0.209 (0.174)
Grade 6		-0.102 (0.152)		-0.195 (0.172)
Grade 7		-0.298 (0.138) *		-0.035 (0.155)
Grade 8		0.024 (0.129)		-0.089 (0.142)
Grade 9		-0.009 (0.186)		0.113 (0.243)
Grade 10		0.066 (0.149)		-0.095 (0.225)
Grade 11		-0.108 (0.199)		0.010 (0.350)
Grade 12		0.080 (0.154)		0.139 (0.231)
Schooling beyond grade 12		0.196 (0.282)		0.459 (0.456)
Age	-0.081 (0.356)	-0.094 (0.357)	-0.079 (0.526)	0.036 (0.522)
Age squared	0.001 (0.005)	0.001 (0.005)	0.000 (0.005)	-0.001 (0.005)
Living in rural area	-0.056 (0.069)	-0.061 (0.068)	-0.036 (0.082)	-0.038 (0.082)
Province indicators				
Eastern Cape	-0.037 (0.188)	-0.033 (0.188)	0.144 (0.221)	0.193 (0.220)
Northern Cape	0.495 (0.238) *	0.488 (0.238) *	0.326 (0.276)	0.334 (0.283)
Free State	0.704 (0.178) ***	0.703 (0.178) ***	0.715 (0.223) ***	0.749 (0.222) ***
Kwazulu/Natal	0.306 (0.176) +	0.293 (0.177) +	0.253 (0.222)	0.293 (0.221)
Northwest	0.437 (0.177) *	0.432 (0.177) *	0.541 (0.223) *	0.588 (0.223) **
Gauteng	0.485 (0.169) **	0.472 (0.170) **	0.654 (0.218) **	0.703 (0.217) ***
Mpumalanga	0.448 (0.178) *	0.442 (0.179) *	0.651 (0.227) **	0.700 (0.228) **
Northern Province	0.046 (0.183)	0.042 (0.184)	-0.020 (0.236)	0.006 (0.236)
Survey year indicators				
1997	-0.048 (0.039)	-0.039 (0.040)	-0.098 (0.050)	-0.106 (0.051)
1998	0.023 (0.045)	0.030 (0.045)	0.008 (0.057)	0.013 (0.057)
Constant	0.317 (6.970)	0.602 (7.004)	2.199 (12.946)	-0.661 (12.873)
N	6,974	6,974	4,721	4,721

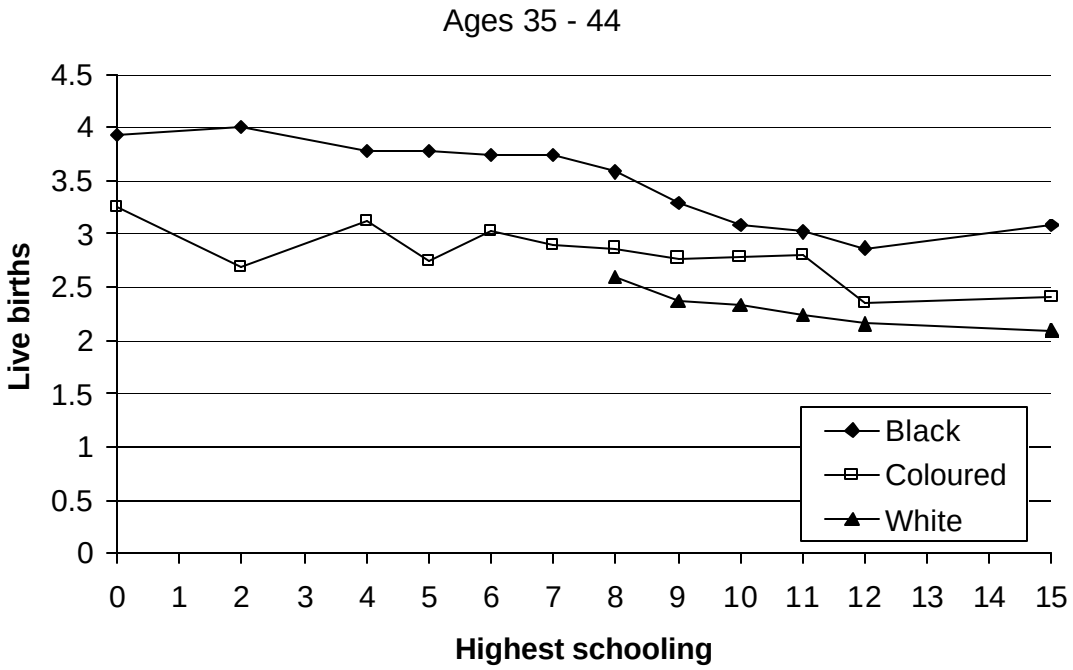
Robust standard errors in parentheses. The omitted baselines for indicator variables are no education (for schooling), Western Cape (for province), and 1995 (for survey year)

Table 4. OLS regressions of grades per year of black children ages 13 - 17, South Africa October Household Survey 1995, 1997, and 1998

Variable	Model 1	Model 2
Mother's schooling (indicators)		
Grades 1 - 3	0.024 (0.023)	0.015 (0.022)
Grade 4	0.050 (0.022) *	0.029 (0.023)
Grade 5	0.071 (0.017) ***	0.047 (0.017) **
Grade 6	0.120 (0.016) ***	0.090 (0.016) ***
Grade 7	0.114 (0.016) ***	0.082 (0.016) ***
Grade 8	0.148 (0.016) ***	0.108 (0.017) ***
Grade 9	0.136 (0.021) ***	0.092 (0.022) ***
Grade 10	0.208 (0.018) ***	0.155 (0.020) ***
Grade 11	0.206 (0.024) ***	0.159 (0.025) ***
Grade 12	0.214 (0.018) ***	0.149 (0.021) ***
Schooling beyond grade 12	0.242 (0.041) ***	0.148 (0.042) ***
Father's schooling (indicators)		
Grades 1 - 3		0.011 (0.019)
Grade 4		0.052 (0.020) **
Grade 5		0.030 (0.019)
Grade 6		0.077 (0.017) ***
Grade 7		0.087 (0.017) ***
Grade 8		0.069 (0.015) ***
Grade 9		0.070 (0.032) *
Grade 10		0.104 (0.020) ***
Grade 11		0.049 (0.026) +
Grade 12		0.106 (0.020) ***
Schooling beyond grade 12		0.145 (0.042) **
Mother's age	0.013 (0.005) **	0.012 (0.005) **
Mother's age squared	0.000 (0.000) *	0.000 (0.000) *
Father's age	-0.001 (0.004)	0.001 (0.004)
Father's age squared	0.000 (0.000)	0.000 (0.000)
Child is female	0.069 (0.009) ***	0.072 (0.008) ***
Living in rural area	0.026 (0.009) ***	0.022 (0.009) **
Province indicators		
Eastern Cape	-0.058 (0.027) *	-0.056 (0.026) *
Northern Cape	-0.020 (0.038)	-0.016 (0.037)
Free State	-0.026 (0.027)	-0.026 (0.026)
Kwazulu/Natal	0.026 (0.026)	0.024 (0.026)
Northwest	0.017 (0.028)	0.019 (0.027)
Gauteng	0.017 (0.027)	0.009 (0.027)
Mpumalanga	0.001 (0.028)	0.003 (0.027)
Northern Province	0.034 (0.028)	0.030 (0.027)
Survey year indicators		
1997	-0.048 (0.006) ***	-0.049 (0.006) ***
1998	-0.056 (0.006) ***	-0.056 (0.006) ***
Constant	0.353 (0.110) ***	0.303 (0.107) **
N	11,657	11,657

Robust standard errors in parentheses. The omitted baselines for indicator variables are no education (for schooling), Western Cape (for province), and 1995 (for survey year)

Figure 1. Live births by race and education, married women ages 35-44 and 45-54



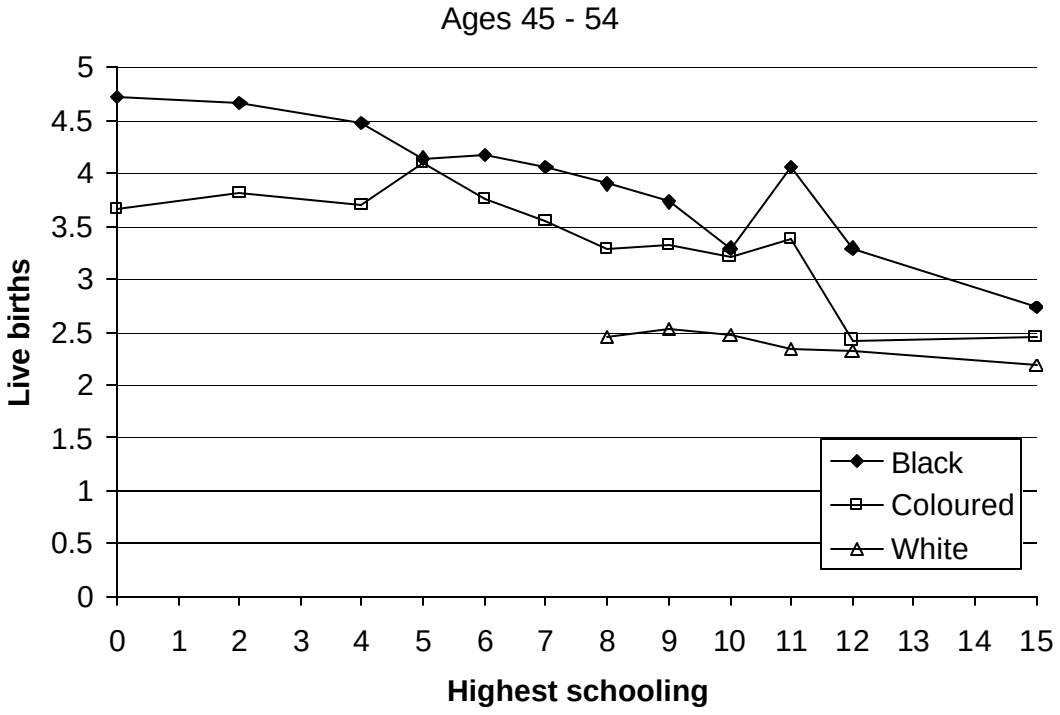
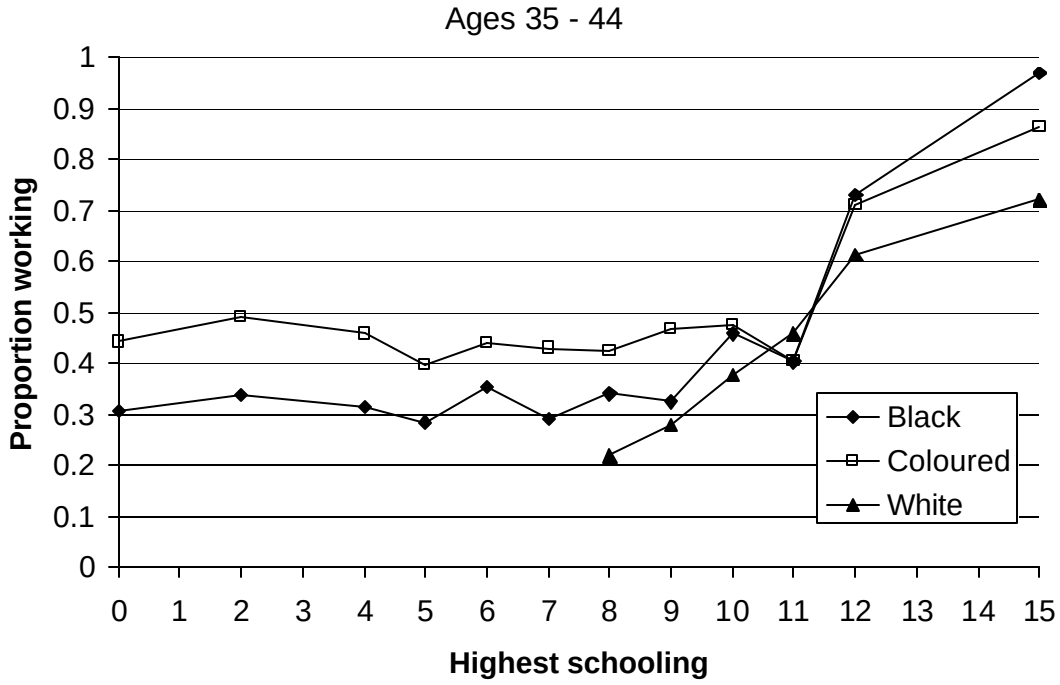


Figure 2. Employment rates by race and education, married women ages 35-44 and 45-54



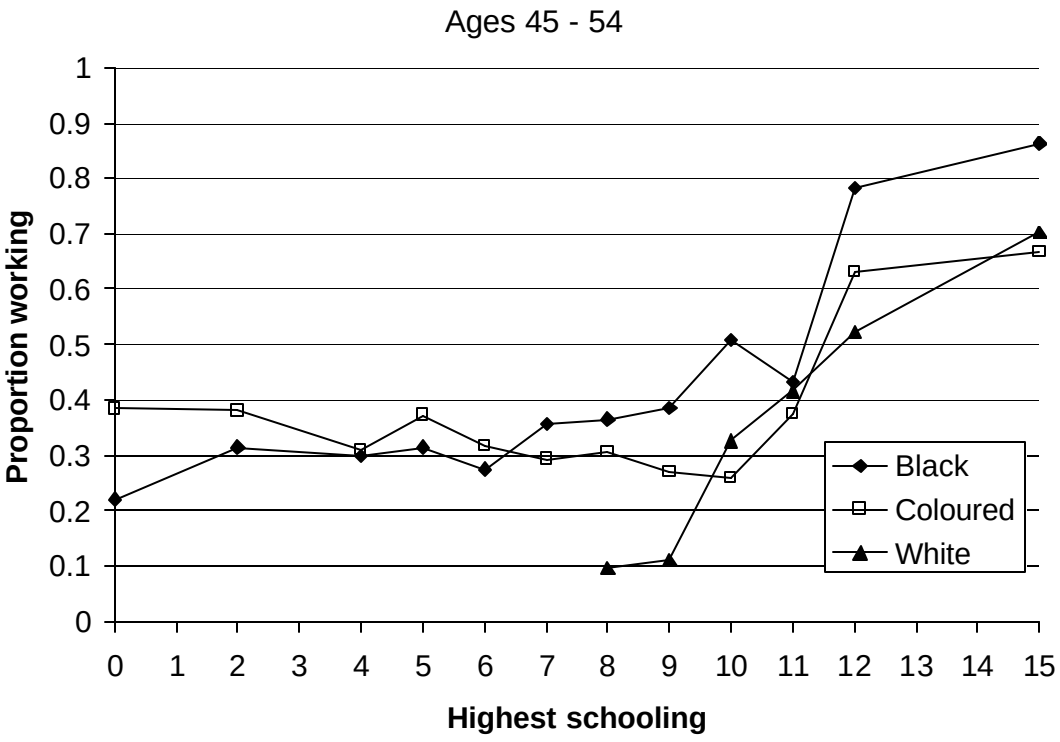
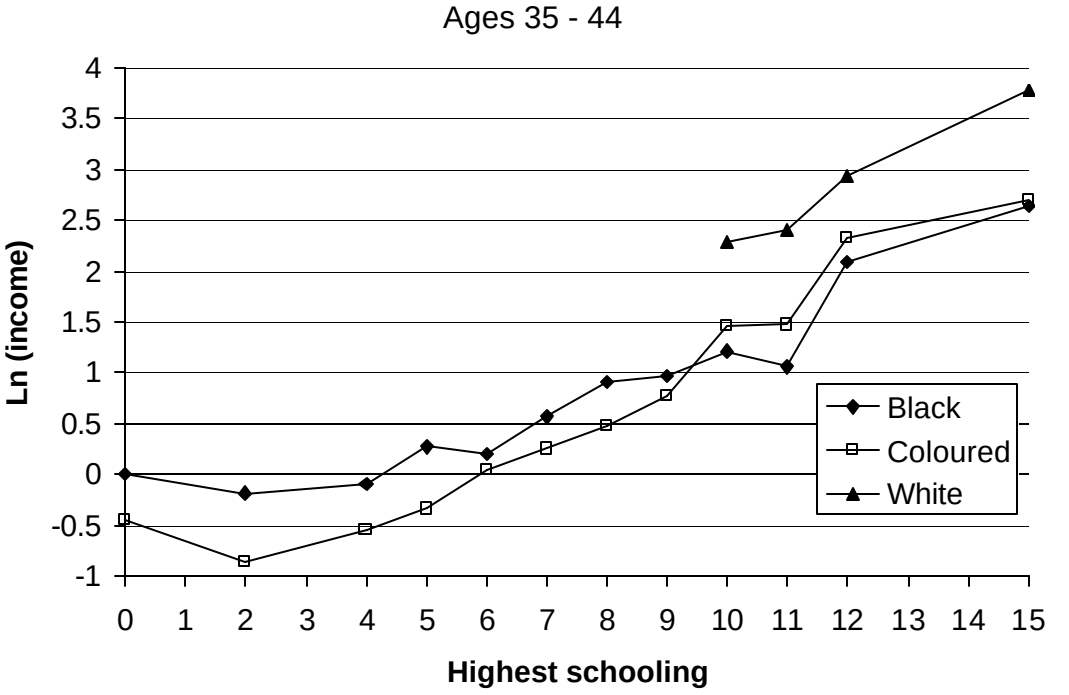


Figure 3. Mean log wage by education, relative to black women with zero schooling, married women ages 35-44 and 45-54



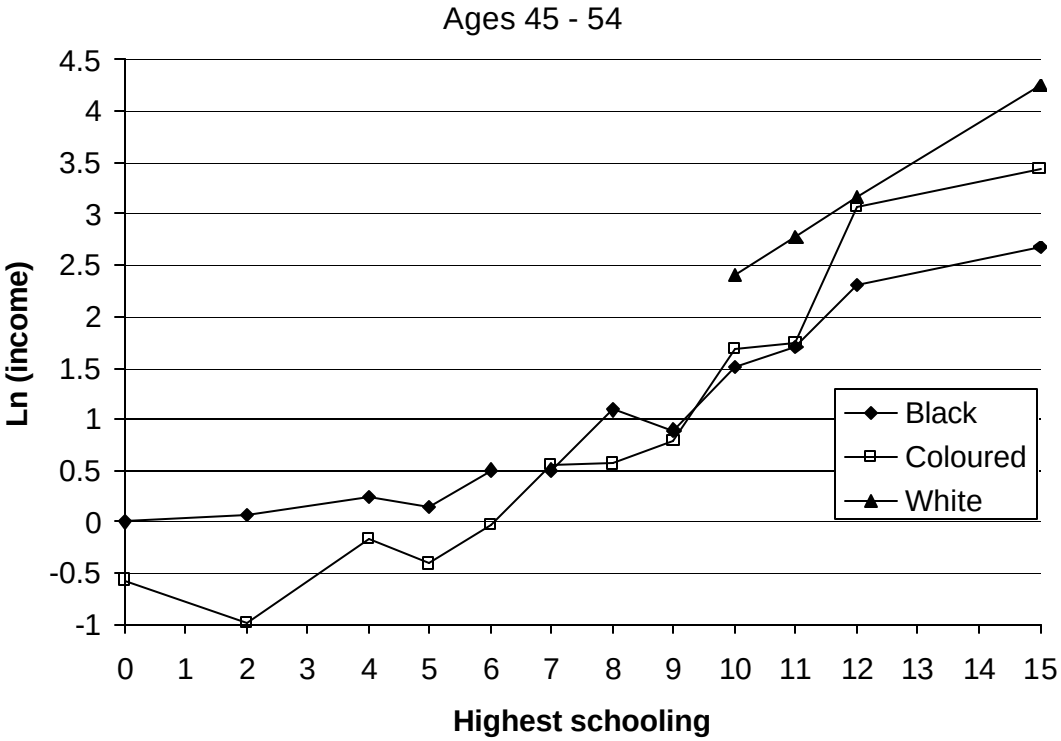


Figure 4. Average grade attained per year of age, by mother's education, children ages 13 - 17 who live with both parents

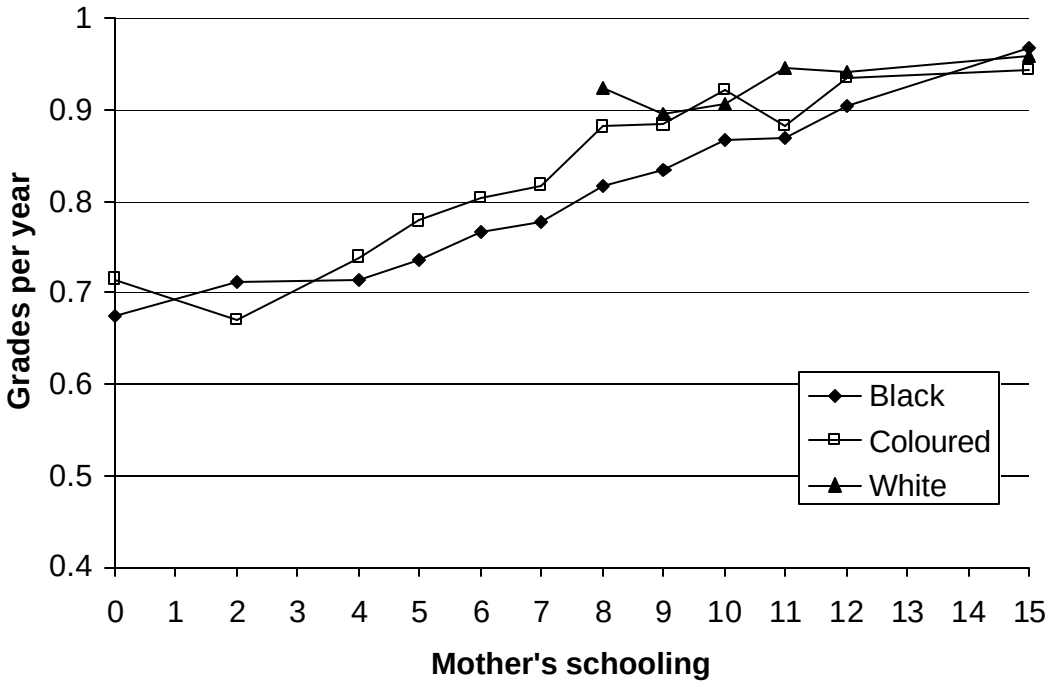
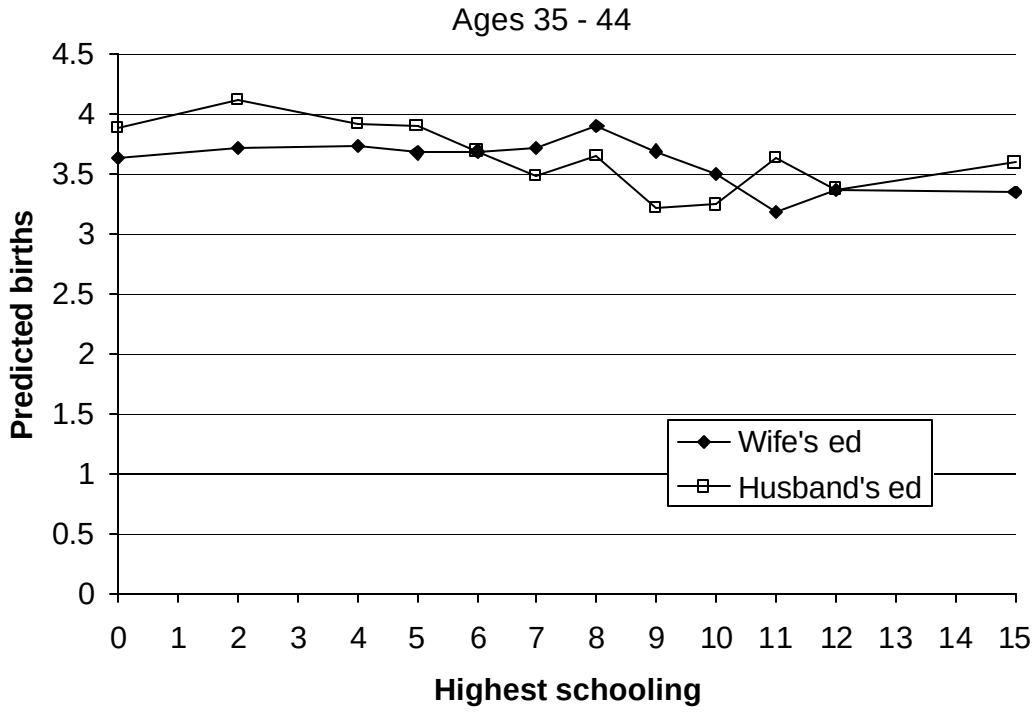


Figure 5. Predicted live births, by wife's and husband's education (schooling of other spouse held constant at 6 years), married black women ages 35-44 and 45-54



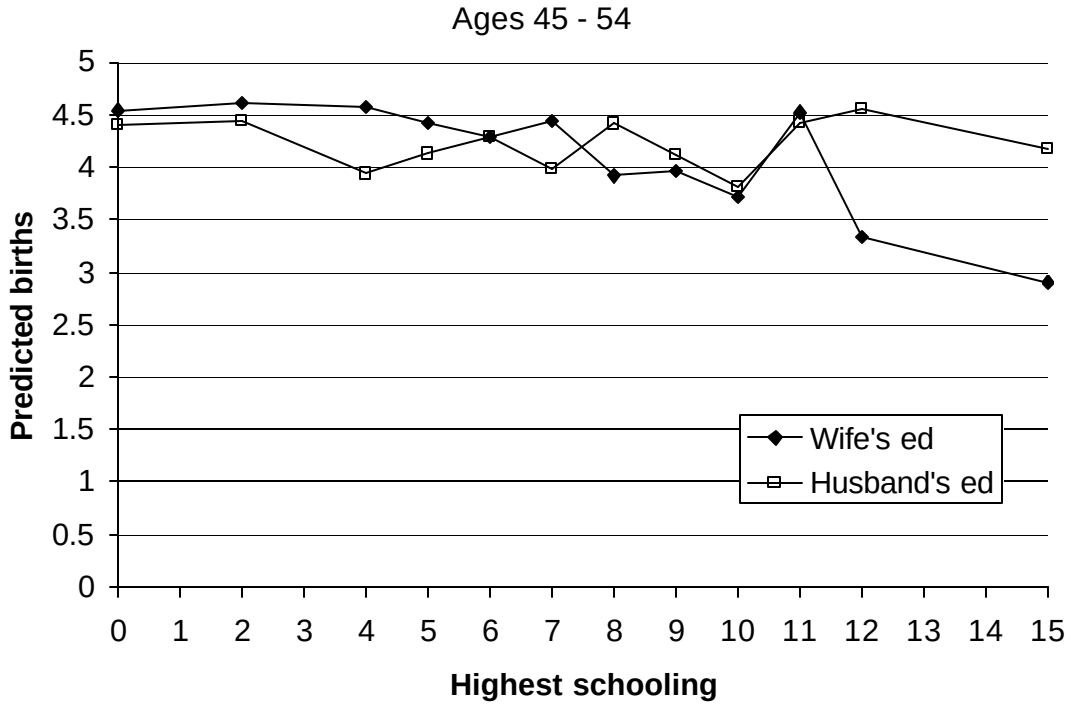
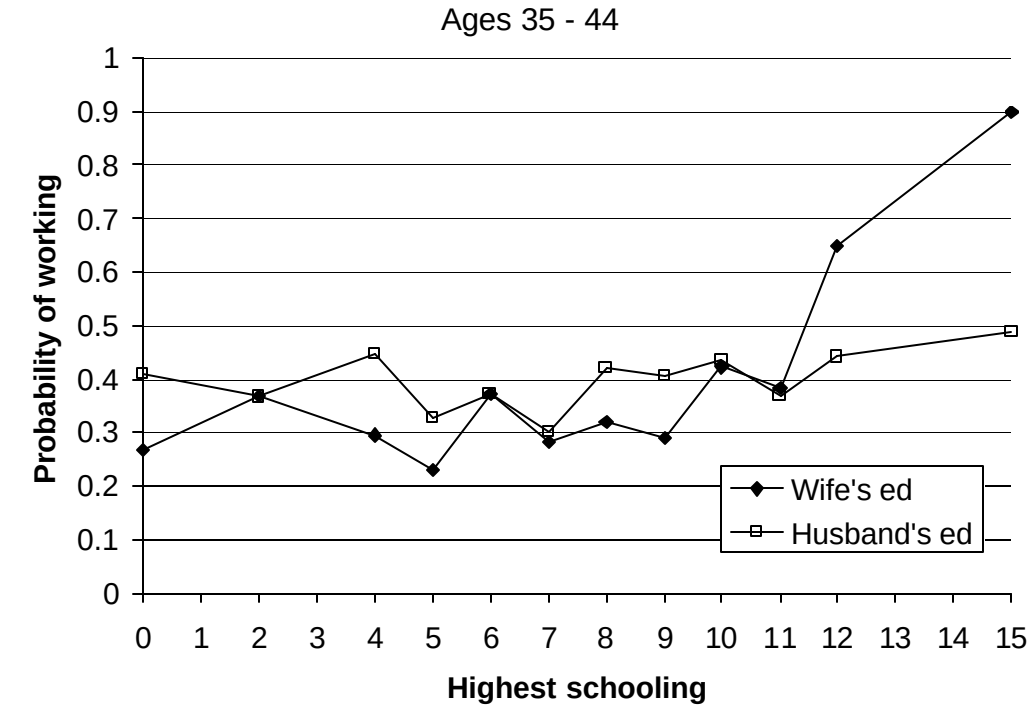


Figure 6. Predicted employment rates, by wife's and husband's education (schooling of other spouse held constant at 6 years), married black women ages 35-44 and 45-54



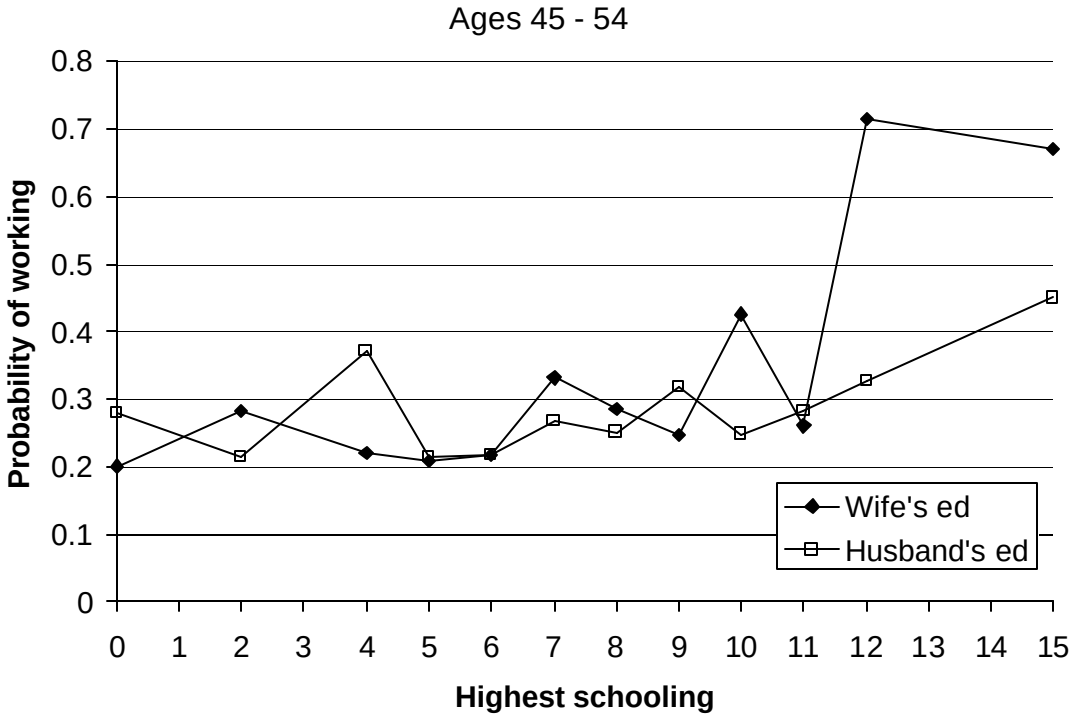


Figure 7. Predicted grade attained per year of age, by mother's and father's education (schooling of other spouse held constant at 6 years), black daughters ages 13 - 17 who live with both parents