C H L R W O R K I N G P A P E R S E R I E S
中 国 人 力 资 本 与 劳 动 经 济 研 究 中 心 工 作 论 文 系 列

How Does Family Planning Promote Development? : Evidence from a Social Experiment in Matlab, Bangladesh – 1977-1996

T. Paul Schultz

Working Paper 26
December 2009

CHINA CENTER FOR HUMAN CAPITAL AND LABOR MARKET RESEARCH
CENTRAL UNIVERSITY OF FINANCE AND ECONOMICS
中央财经大学中国人力资本与劳动经济研究中心
39 Xueyuan South Road, Haidian District, Beijing, China 100081
Web: http://humancapital.cufe.edu.cn
Phone & Fax: 86-010-62288298

August 22, 2008
T. Paul Schultz
Yale University

How Does Family Planning Promote Development ? : Evidence from a Social Experiment in Matlab, Bangladesh – 1977-1996 *

1. Introduction

If a social welfare program reduces the private costs of assessing, adopting, and using birth control, fertility is expected to decline. But by how much will fertility decline, for how long, among which groups in the population will it be most effective, what are the wider welfare consequences of this program-induced decline in fertility for the family and for society, and finally, how does such a program-induced decline in fertility affect the inputs of labor and capital that appear critical to economic development? Answers to these questions are relevant to determining population policies involving family planning and maternal and child health programs and how these programs should be designed and targeted in different parts of the world. But these types of questions have not been answered with much confidence from long run empirical studies, though family planning programs have been widely prescribed and subsidized as a component of the system of social welfare programs in many countries for many decades.

The rate of population growth of the low income countries increased from 0.5 percent per year in 1900, to 1.2 percent by 1940, and accelerated to 2.5 percent by 1960. This unprecedented rapid rate of population growth was expected to overwhelm the capacity of poor countries to accumulate the capital required to employ productively their populations as they reached the age to enter the labor force (Kuznets, 1966; United Nations, 2003; Coale and Hoover, 1958; National Academy of Sciences, 1971). Research in reproductive biology in the 1950s developed and clinically tested oral steroids (i.e. the pill) and improved the design of the intrauterine device (IUD), both of which were shown to be reliable methods for reversible birth control in high- and low-income settings in the 1960s. These new methods of birth control provided women with control over their reproduction by means that were separated from the sexual act. Several private foundations (e.g. Ford and Rockefeller) assigned priority to research on reproductive biology and its application to contraception well before NIH entered the field. The diffusion of

---

* An earlier report on this research was presented at a Gates Foundation/Center for International Development Conference on Health Improvements for Economic Growth, May 30-31, 2007. I appreciate the computational assistance of Paul McGuire, the comments of conference participants and Ted Miguel at ASSA meeting January 3-5, 2008, and support from the MacArthur Foundation. The usual caveats hold.

these new birth control technologies to populations in low-income countries was also pioneered by these foundations, and eventually incorporated into many overseas development assistance programs, both bilaterally (e.g. USAID) and multilaterally (e.g. International Planned Parenthood Federation and UN Fund for Population Activities). However, nearly 50 years later there are relatively few statistical assessments of what these family planning and reproductive health programs achieved, based on either randomized social experiments or statistical evaluations which compare long term outcomes for persons offered a program with persons in a control population, matched in various systematic ways to hold constant for other determinants of fertility. From 1960 to 2005 total fertility rates declined in Latin America and Asia from 6 to 3 children per woman, on average. Recently public and private resources to subsidize family planning have begun to decline, whereas other challenges to development have attracted increased support, notably in public health in the wake of the HIV/AIDS epidemic, and the resurgence of infectious and parasitic diseases, such as tuberculosis and malaria. What is the economic and humanitarian justification today for public assistance in family planning and reproductive health, and in which countries and environments are these programs most valuable in reducing poverty and increasing economic growth?

First, policies or programs should be shown to have achieved their initial objective of reducing fertility among those who were offered voluntarily program services, in other words, local average (intension to) treatment effects (LATE) of programs on *fertility* should be statistically significant and substantial relative to their social cost (i.e. public and private costs). It is important to then disentangle whether by helping couples reduce the number of unwanted or ill-timed births, the couples substitute their lifetime resources that they would have otherwise used to raise their children to achieve other objectives. Some of these other family objectives may be viewed as "positive social externalities" or spillovers caused by the program, in part because these objectives are already supported by other social welfare programs, such as improvements in women's health, increases in women's productivity, and increases in the human capital of their children, reflected in their health, nutrition, schooling, and migration. Other systematic consequences of program-induced declines in fertility may be investments that increase economic development, if the reduction in fertility increases life cycle savings and physical asset accumulation, as suggested in Samuelson's (1958) overlapping generations (OLG) model, and potentially implied by Modigliani's life cycle savings framework, when extended to include children (Modigliani and Brumburg, 1954; Modigliani, 1970). If public family planning services that induce fertility decline also generate desirable social externalities, public subsidies of these services might thereby be justified, even when the program is not sustainable from private user fees or government resources (Kremer and Miguel, 2007). Yet comparative policy studies argue that programs should in the long run be self sustaining, as unit costs generally decline with increased scale and experience in managing programs. Under-utilization of improved inputs by households, such a birth control, should diminish over time as social learning occurs and optimal input use is eventually achieved. Input subsidies can then be phased out, except where justified by social externalities, or at least restricted to otherwise difficult to serve sub-populations, just as conditional cash transfer programs are targeted only to the poor to encourage their added investments in the human capital of their children, who may thereby escape poverty in their lifetime (Parker, et al.,2008).

Early evaluations of family planning programs estimated the cross sectional association between the regional intensity of program treatment and the regional level of fertility (e.g. Schultz, 1973, 1992; Rosenzweig and Schultz, 1982; Gertler and Molyneaux, 1994). Even when panel data are analyzed and fixed effects are included for regions and time, estimated effects of program changes on fertility changes may be biased by nonrandom placement of programs and omitted factors (Schultz, 1973, 1980; Miller, 2004; Bleakley, 2006). If the government's placement of the program and its expenditures per beneficiary are positively correlated with regional conditions that also reduce fertility, the estimated inverse relationship between the program and fertility will not be entirely causal. Similarly, if migrants determine their destinations in part by the strength of their preferences for the locally provided social services, the relationship between program treatment and behavioral outcomes encouraged by the program may overestimate the program's causal effect, because the composition of the population in the program and control areas are no longer randomly determined, due to selective effects of migration (Rosenzweig and Wolpin, 1986).

The most convincing evidence of program impact, other things being equal, relies on randomized social experiments (Duflo et al., 2008). But the only documented randomized experiment I can find in the extensive literature on family planning is the pioneering study conducted in the city of Taichung in Taiwan from 1963 to 1966 by Freedman and Takeshita (1969) (Chandrasekaran and Hermalin, 1976; United Nations, 1985). They randomized three program components (direct mail brochures, and information campaigns directed either to husbands, or to the wives) and varied the intensity of each component according to three levels of treatment "density" across 2389 neighborhood Lins within the city. They then calculated the effectiveness of these nine distinct treatment packages for encouraging the adoption of modern contraceptives, such as IUDs, compared with the baseline of "no program". Spillovers of information about birth control methods beyond the limits of the small neighborhood (Lin), and the mobility of urban residents to obtain family planning services from outside their residential neighborhood, may have eroded the power of the experimental design to identify behavioral differences induced by the program. Program effects on contraceptive behavior in the first couple of years of the experiment were well defined, but long term family outcomes and behaviors were not explored in Taichung, or indeed studied in other randomized program trials in other countries. Moreover, a national family planning program was promptly initiated in Taiwan in 1964, which soon spread across all 361 local administrative areas of the island, making it still more difficult to learn about the long run consequences of the Taichung program's randomized social experiment. The cross sectional association between the regional levels of Taiwan's national family planning program intensity and fertility levels (n =361), and between the changes in the program and changes in fertility by age within these small administrative regions for the initial several years of the program. But these estimated program effects between regions, or over time within regions, become smaller and statistically become insignificant after the national program has operated for five years (Schultz, 1973, 1992).

One possible explanation for why social experiments in family planning have not been more widely undertaken is that there was an early consensus on the need for national family planning programs of a standardized form in most countries. The high costs of a long-duration

social experiment in family planning could therefore not be readily justified, economically or ethically, unless these program evaluation studies could improve dramatically the design of population policies, not only in the specific country where they were initiated, but also be applicable to guide other countries. For whatever reason, the case for such social experimentation was not accepted. One interpretation of the Taichung City experiment results is that first the randomization of program treatments should have occurred for larger population units , and these units should be more isolated and self contained than neighborhoods in an urban setting, such as rural villages in which population mobility is relatively restricted, and second the program evaluation should include follow up surveys to record the longer term consequences of program for a decade or longer. Even then, migration among the regions for which program treatment may randomly vary requires analysts to collect migration histories, and explain migration as well as the environmental and household determinants of fertility, which are included as control variables to improve the precision of estimated program effects.

Macro- and micro-economic hypotheses are advanced to suggest why declines in unwanted fertility due to a family planning intervention might be expected to relieve population pressures on the land, and also contribute to parents substituting their lifetime resources from child care and family labor intensive activities to other purposes, and why the decline in fertility could be a source of social externalities for other households in the village or nation. Ignoring migration, having fewer unwanted children would imply a slower growth in the labor force 15 years after a family planning program became effective, and the marginal product of labor in the residential locality should be relatively higher in villages provided the program compared to villages without the program, i.e. control areas. This "Malthusian effect" of family planning raising wages after about 15 years would be reinforced if the program also fostered an increase in lifetime savings of parents, presumably if the savings were a substitute for the numbers of children parents can rely on for support and care in their old age. In addition to the effects of fertility on factor supplies for production (decreased labor supply and increased physical capital), the program could affect human capital formation of two types. If parents, who were able to have fewer unwanted births, substitute their released resources into increasing the schooling of each of their children, as widely hypothesized in the social sciences (Becker and Lewis, 1974; Blake, 1989; Zajonc, 1976), this would tend to raise hourly wages of their children. In analyzing the consequences of a family planning program on wage rates, it is therefore important to allow for heterogeneous labor, by controlling in the log wage function for schooling as well as post schooling potential experience (Mincer, 1974).

Interregional migration tends to occur from low wage to high wage regions, which is expected to diminish interregional wage differences, other things equal. But because interregional migration tends to occur more frequently among better educated individuals, youth, and members of wealthier families (Schultz, 1982, 2003), average wages may not converge toward national averages under all circumstances, even though wages of those who migrate may rise and the reduced size of population at origin should boost wages at origin. Transfers from out-migrants to their extended families at origin may also appear to be regionally equalizing, but may also increase inequality at origin if the transfers flow primarily to the wealthier families at origin. The convergence in wage or income inequality across regions will also depend on the

compensating interregional movement of capital, which may flow toward regions where the cost of labor of a given skill level is lower, and this labor is complementary to capital, raising the local return on new capital investments (Foster and Rosenzweig, 2008).

Parents may also respond to the decline in unwanted fertility and the released time of women from the responsibilities of childcare by investing more in the productive skills of the mother, while the reduced physical burdens of childbearing may improve women's health status, both of which developments would increase the shadow value of women's time in home production and the opportunity value of their time working outside of the home, other things being equal. Because the timing of marriage and early childbearing may not be significantly affected by the program provision of birth control services (Joshi and Schultz, 2007), these program consequences on women's human capital accumulation, wages and labor supply will be evident primarily for older women, who space out their final births and terminate childbearing earlier, namely, for women age 25-54. In contrast, the Malthusian pressure of population growth in the local labor market, and the effect of the parents substituting child quality for quantity would be most evident on the wages of younger members of the population, less than 5 years old when the program is initiated, i.e. for males and females less than 25 in 1996. The relative importance of the family planning program on the wages of adult women versus adult men is a test of the hypothesis linking family planning to women's human capital and the comparison of adult women's wages to those of youth of both sexes should help to distinguish among the relative importance of macro and micro mechanisms relating effective family planning programs to economic development.

2. A Social Experiment in Bangladesh

This paper starts by summarizing a previous study of a family planning social experiment conducted from 1977 to 1996 in rural villages in the poor agricultural district of Matlab, Bangladesh called the Family Planning and Maternal Child Health (FPMCH) program.[1] All married women of childbearing age living in 70 of the 141 villages included in the Demographic Surveillance Area (DSA) of the Matlab district were visited every two weeks by a locally recruited female health field worker, who supplies women with a variety of contraceptive methods and information on their use and side effects. Married women in the other 71 villages surveyed in 1996 have access to only the regular Bangladesh government health and family planning program community clinics, which provide about the same birth control supplies, which are also freely available, but require a woman to come to the clinic to obtain information and supplies (Phillips, et al.,1982). Women may also confront a less favorable or friendly environment in the government clinics within which to learn about birth control techniques and their side effects and obtain regular supplies than would women contacted in their homes by the FPMCH experimental program (Schuler, et al. 2001). The Matlab district was chosen for this

[1]The program's name has varied over time. It was initially called the family planning-health services project. It was then referred to as a family planning and maternal child health project as the program expanded its range of services, and more recently it is called the Maternal Child Health and Family Planning program (Fauveau, 1994).

family planning social experiment because its population of about 180,000 was systematically registered in 1966 as part of field experiments to test the efficacy of new cholera vaccines and censussed again in 1974 and 1982. Starting in 1966, monthly DSA vital records were maintained on all births, deaths, marriages, and population movements in the entire district. Few places in rural South Asia had at this time such reliable data from which birth and death rates could be calculated, assuring that any demographic consequences of a family planning social experiment in Matlab could be inferred with considerable confidence from an analysis of available vital records, censuses, and sample surveys maintained by the Centre for Diarrhoeal Disease Research, Bangladesh (ICDDR,B).

An important question for development policy is whether subsidies for birth control and the diffusion of information regarding alternative birth control techniques reduce fertility, and if they do, are these declines in fertility associated with improvements in family long term welfare and possibly economic growth? Do the programs benefit some specific sub-populations more than others? Any heterogeneity in program effectiveness could improve or worsen the private distribution of welfare, and might be useful for targeting the program to those groups who are most likely to benefit from the program and modify their behavior, and thereby increase the ratio of program benefits to its cost. The gender distribution of social benefits from such programs may also affect policy priorities in some countries, and could modify the optimal program design (Schultz, 1992, 1997). A program that disproportionately helps the relatively poor and disadvantaged is a further factor to weigh in setting policy priorities.

The Matlab FPMCH program was designed as a social experiment and has been extensively analyzed in demographic and public health literatures (Phillips et al. 1982; Fauveau, 1994). The program focused initially on the home delivery of birth control information, and after about five years, from 1977 to 1982, the health field workers were assigned the additional responsibility of promoting "best practices" in maternal and child health. Some of these practices appeared to be effective and were subsequently incorporated into the national family planning and health programs of the Bangladesh government, such as oral rehydration therapy for diarrhea and measles vaccinations. The door to door provision of information, services may have been especially effective in Matlab because this a traditional Muslim rural society in which many women are restricted in their ability to travel alone beyond their homesteads (Bari) by the customary practices of purdah. These cultural restrictions on women's movement may have prevented some married women from adopting birth control and obtaining regular supplies at their local government family planning-health clinics. Consequently, the design of the Matlab program to include home visits may have reduced the coordination costs and the burden of stigma for a woman who wanted to evaluate and adopt alternative birth control methods herself and obtain her own birth control supplies.

Phillips, et al. (1982) found from the birth registration data (DSA) that after two years (1978/79) women in the program areas reported general fertility rates (i.e. births per woman age 15 to 49) which were 25 percent lower than in the comparison villages. But changes in the timing of births and the dynamics of life cycle fertility control could lead to a larger short-run association between the introduction of the program new methods and age-specific birth rates,

than would occur in a longer-run equilibrium as new cohorts of women in the program villages adjusted the timing and total number of children they would bear over their lifetime. On the other hand, child mortality may also have declined due to the program, in which case the effects of the program on fertility, either age-standardized or cohort children ever born, would overstate the program's effect on population growth, a possible policy objective based on a Malthusian model with negative social externalities of population growth (Schultz, 1981). Sinha (2005) estimated from the comprehensive 1996 Matlab Health and Socioeconomic Survey (MHSS) (Rahman, et al., 1999) that women under the age of 57 residing in the 70 villages with the program reported 14 percent fewer children ever born than women residing in the comparison 71 villages, holding constant for the mother's age and schooling, father's schooling, farmland, and distance to the district's headquarters, i.e. Matlab Bazaar. However, Sinha did not find greater school enrollment among boys or girls in the program villages compared with the children in the comparison villages, holding constant for the child's age and sex, and the other mentioned factors. This finding appears to challenge the quality-quantity hypothesis associated with the work of Becker and Lewis (1974), among others. Moreover, Sinha estimated child labor was greater for boys in the treatment villages compared with the rest of Matlab, and the labor supplied by girls did not differ between treatment and control villages. Four questions related to this unusual social experiment remain unanswered in Sinha's study or in the other analyses I have read of the data from Matlab (e.g. Fauveau, 1994) : (1) were the program and comparison areas actually comparable before the program was launched, justifying the interpretation of the post-program differences between program and comparison villages as arising from a true social experiment, (2) did migration or attrition of individual women from 1977 to 1996 differ in the program and comparison areas, calling for a correction in program evaluation methods based on the 1996 survey, (3) was the program treatment effect on fertility and family outcomes comparable for all married women in the sample, or were program effects heterogeneous, which would require a different program evaluation methodology, and (4) what were the longer-run consequences of the program-induced declines in fertility on other family outcomes, such as the following: child and maternal health, women's productivity and earnings, household assets which might be affected by lifecycle savings, the woman's children's age-specific mortality rates, the nutritional/health status of surviving children and their years of schooling, and out-migration of women and their children.

A paper by Joshi and Schultz (2007) based primarily on the 1996 MHSS addresses some of these questions and is first summarized in section . Then the program induced declines in fertility are associated with the age and sex structure of wages, parent accumulation of assets, the family labor supply decisions which might reveal what actions substitute for the number of children parents have, or complement the labor children in this poor agricultural area.

3. Pre-Program and Post-Program Levels of Fertility in the Social Experiment

A 1974 Census of Matlab is first analyzed to confirm that three years before the FPMCH program was launched the differences between the villages designated to receive the program in 1977 did not differ significantly from the other "comparison" villages in the Demographic Surveillance Area. Because fertility is not reported in the 1974 Census, an aggregate measure of

surviving fertility is analyzed at the village level, namely the ratio of children age 0-4 to women of childbearing age 15-49. The villages subsequently provided the program have slightly higher surviving fertility pre-program (1974) than did the control villages, but the difference is not statistically significant. These two groups of villages do not differ significantly in the mean years of educational attainment of adults (age 15 +) or children (age 7-14) in 1974. In a 1982 Census, land holdings of households are reported for the first time, and this physical measure of land owned per household, or per adult in the household, is not statistically different between the treatment and comparison villages.

A difference-in-difference analysis of changes between the program and comparison villages pre-program (1974) and post-program (1982, and 1996) indicates that by 1982 surviving fertility is 17 percent lower in the program areas than they were pre-program in 1974, and surviving fertility remained 16 percent lower in the program villages in the 1996 sample survey, after the program had been in operation for nearly two decades. It is notable that child-woman ratios had declined by 38 percent from 1974 to 1996 in the comparison villages, and yet the program villages remain persistently at a lower surviving fertility level than in the comparison villages, according to this difference in difference framework.[2] Models of diffusion of information, and adoption of new improved technologies, could lead to the expectation that the program and comparisons areas would have converged over time more rapidly in terms of their fertility than actually observed. Apparently, the home visits design of the FPMCH program reduces a major "cost" factor that persistently encourages effective use of birth control, causing lower fertility.

By 1996 the number of children ever born per woman in the MHSS survey is significantly lower in the program than in the comparison areas as illustrated in Figure 1, but only for women less than age 55. This could be simply explained by the fact that women who were over 55 in 1996 were already over the age of 37 when the program started in 1977. These older women had essentially completed their childbearing by the time the program had the opportunity to reduce their time and psychic costs of obtaining improved methods of birth control in the program villages. Consequently, differences in fertility associated with residing in a program or comparison village were statistically insignificant for these older women, though as noted in the double differenced village regressions, fertility appears slightly higher in the program areas before the program was initiated (Joshi and Schultz, 2007). Reduced-form estimates of the program's effect on individual fertility, conditional on other household and community control variables that are arguably exogenous to the family's lifetime choices are found in Joshi and Schultz (2007; Table 4). These estimates are summarized later in Table 5,

[2] Two cross sections of 141 village averages of the child woman ratios (i.e. n=282) are stacked, and the village observations are weighted in the regression analysis by the village number of women age 15 to 49, normalized to the size of the cross sectional sample so as not to underweight the 1996 survey village averages compared with the 1974 or 1982 Census village averages. The Stata command is "a-weight" for the OLS weighted regressions normalized for the populations observed in each cross section.

Column 1, and confirm that the number of children born is on average 0.68 less for women age 25 to 29 in the program villages than in the comparison villages, and this program reduction in fertility increases to 1.51 fewer children for women age 45 to 49, and then contracts to 1.11 fewer children among ever married women age 50 to 54. Women's education is very low among older women in Matlab, on average less than one year, but schooling of women is catching up to men's in recent years, reaching 3 to 4 years among ever married women 25-29.

Women with one more year of schooling have .06 fewer births, not a large difference though it is statistically significant. In some other studies of South East Asia and Latin America female schooling and the local availability of family planning program services appear to operate as economic "substitutes" in achieving (producing) lower levels of fertility (Schultz, 1973, 1992). In other words, program treatment and female schooling are each associated with lower fertility levels, but the estimated effect of the interaction of these variables is positively associated with fertility, even when the higher order quadratic forms for program treatment intensity and female schooling are included in what then represents second-order approximations of the estimated fertility equation estimated. But in Matlab the estimated interaction between female schooling and program treatment is not statistically significant for fertility as reported in Table 5, column 1, suggesting they are independent.

Muslim couples have .25 more births than the minority Hindus in the control villages, and the Muslims have .56 (.31 + .25) more children than Hindus in the program villages, implying that the program impact reducing fertility among Hindus is larger than the program's impact on the fertility of Muslims (Joshi and Schultz, 2007, Table 4). The larger response of fertility to the program's services from an initially lower level of fertility by the Hindus than the Muslims could be interpreted as a greater price elasticity of demand for children by the Hindu, or it could be attributed to a greater initial deficit in social knowledge of birth control. A study of social networks and learning in Matlab and their roles in the transmission of contraceptive information leading to the adoption of birth control implicates within network communication, which was stronger within religious groups than across these networked groups. The more isolated minority Hindu group, representing only ten percent of the district population, may thus have had more to gain from the program's dissemination of new information about birth control and supplies than did the majority Muslims (Munshi and Myaux, 2006).

The demographic transition involves generally both a decline in child mortality and in fertility, which implies offsetting effects on the size of surviving family or the aggregate long run rate of population growth. The Matlab FPCMH program is also associated with fertility declines and child mortality declines. As noted above, mothers age 45-49 in 1996 had 1.51 fewer births in program areas than in comparison areas, but only .84 fewer living children. Thus, 45 percent of the programs impact on fertility is compensated for in terms of its impact on child survival. Correspondingly, mothers age 35-39 in program villages have 1.02 fewer births and .59 fewer living children, indicating 42 percent of the program associated decline in fertility is offset by the program associated reduction in child mortality. Thus, the program is associated with both a 15 to 20 percent lower levels of fertility and lower surviving fertility (Joshi and Schultz, 2007, Table 4).

Although there is no accepted way to assign an economic value to improvements in child health caused by such a program, economic productive gains are nonetheless likely to follow in the long run, as the health human capital of individuals who survived with fewer permanent scars from challenged childhood health environments experience increased adult productive capacities. Biologists, physicians, and demographers conclude that a cohort who has experienced fewer inflammatory illnesses and better maternal health conditions and nutrition as a fetus and young child tend to experience fewer chronic illnesses and disabling conditions as an adult, and perhaps as a consequence tend to be more productive in the long run (Gluckman and Hanson, 2005). But these economic gains occurring at later ages have often been statistically identified in terms of improved survival after age 50, and are expected to emerge noticeably in the context of the Matlab experiment in the future, perhaps after 2025. These delayed productive benefits of improved fetal and childhood health conditions are a stylized empirical regularity in a growing number of clinical and demographic studies of the determinants of later age morbidity and mortality but they should also be heavily discounted when valued in a conventional human capital framework (Gluckman and Hanson, 2005). There is also evidence that cognitive capacities and schooling achievements are also improved as a birth cohort avoids malnutrition and acute trauma as a fetus and in early childhood, and these productive gains would be realized sooner and potentially over a longer span of the life cycle (Schultz, 2008).

Interregional migration can complicate greatly the task of evaluating the consequences of a social program such as family planning and health. Public data do not allow me to identify the characteristics of women who died or those who moved out of the Matlab district after 1977 with their entire families. Most interregional movement of women occurs at the time of their marriage, because it is common (but not universal exogamy) practice for women to marry outside of their village of birth. Comparing the rates at which women move into the program villages from the comparison villages (or from outside of Matlab), with the rates of movement for women born in program villages and move to comparison villages, the migration rates do not differ significantly. Nor are these movements of women between program and control areas at the time of marriage significantly associated with their subsequent fertility or family lifetime outcomes as observed in the MHSS of 1996, as might be expected if girls acquired different knowledge of, or attitudes toward, birth control because they had grown up in program or comparison villages and then migrated upon marriage to a different type of village. The age at first birth, an indicator of the timing of marriage, does not differ before 1996 in the program and comparison areas, though more recent birth cohorts of women start their childbearing more than a year later, on average, than those born twenty years earlier. The onset of childbearing is thus not affected by the program, whereas the program is associated with increased spacing of births after the second birth and earlier stopping (Joshi and Schultz, 2007, Table 4, col. 3-6). The MHSS provides information on a woman's children, including those who have migrated from their parent's home, when they left, and how much schooling they have completed. The reported migration rates by gender of children and their date of birth cohort do not indicate significant

differences between program and comparison villages.[3] In sum, available information on migration between program and comparison villages does not suggest significant differences in overall rates of migration or the composition of migration, although the issues deserve more study with additional data.

4. Potential Consequences of Family Planning on Local Wages and Employment

In the absence of interregional migration in response to regional differences in the surviving fertility and the rate of population growth, program villages would have a relatively smaller supply of potential workers in 1996, and experience slower population growth (Joshi and Schultz, 2007, Table 4 col. 1-2). An aggregate model of the closed local economy with homogeneous labor, analogous to Malthus' framework, would imply that wages would be higher in program villages than in comparison villages by 1996, assuming other productive inputs and technology are the same in the two regions. Moreover, if youth are an imperfect substitute for older workers in production (Welch, 1979; Freeman, 1979), the program-induced regional differences in the relative size of youth in the population should impact more strongly the wages and employment opportunities for young entrants to the labor force, than it would wages of older, more experienced workers. The elasticity of *market* labor supply with respect to own wages tends to be positive and larger (positive) magnitude among young males than for prime aged males who are virtually all participating full time in the labor force. Own-wage labor supply elasticities tends to be a larger positive value for women than for men, at least in high income countries (Killingsworth, 1983; Schultz, 1981, 1990). Thus, program villages are expected in a Malthusian world with diminishing returns to labor to have higher wages for youth and probably greater participation of youth in the market labor force, and these aggregate labor market responses could be especially evident for young women. On the other hand, cultural restrictions of Purdah in Matlab that appears to be roughly comparable between the program and comparison areas, according to responses to a 1996 socioeconomic census, might interfere with

[3] Heterogeneity in fertility response to the program is obvious with respect to the mother's age (Figure 1), due probably to biology but also possibly to differences in the unobserved conditions and experiences of the sequence of older birth cohorts. Heterogeneity in response to the program is also estimated with regard to religion and the mother's schooling. Program interactions with respect to mother's schooling are retained in all estimated reduced-form equations, because certain consequences associated with the program are expected to differ across educational levels of women, such as the adoption of modern medical inputs and vaccinations, even though the program does not appear to have affected fertility, child mortality, or mother's BMI differentially across education groups, as summarized by the an estimated coefficient on the program interacted with these group characteristics (see below Table 5). These sources of heterogeneity in response to the program are assessed by Joshi and Schultz (2007), though not in Sinha's (2005) study, or in earlier investigations, such as reported by Phillips, et al. (1982) or Fauveau (1994).

women's pursuit of off-farm employment opportunities (Razzaque, et al. ,1998, p. 28-33).[4]

However, parent substitution of schooling of their children for having fewer (unwanted) children in the villages with the family planning program might also raise youth wages for two reasons. Attending school longer would reduce the available labor supply of children to work, which is evident in the prior study (Joshi and Schultz, 2007). And when children do enter the labor force, they would be better educated and may receive a higher wage. The latter effect on children's wages of completed years of schooling can be held constant in estimating a wage function, but any apparent program's impact on the children's schooling should not necessarily be viewed as a Malthusian consequence of slower population growth, but rather a reflection of parent behavioral response to avoiding unwanted childbearing, and thereby allowing parents to substitute their lifetime resources so as to increase per capita economic growth and advance the economic status of their children.

In the 1996 Matlab MHSS all persons in the household over age 14 are asked about their primary and secondary occupation, and if they worked for pay, they were asked their annual earnings and months worked in 1995 in up to two occupations. Table 1 reports the allocation of youth age 15 to 24 among categories of workers in the 1996 MHSS, and estimates the difference between program and comparison villages by gender : (1) "work for pay", which undoubtedly excludes work within family enterprise; (2) "self employment", which probably includes work in family enterprise where there may be a marketable surplus but no obvious way to measure individual productivity or labor earnings; and (3) "house work" which involves home chores and activities from which there may be no marketable product, and consequently the output is consumed by household members and individual's productivity cannot be measured. If a person does not indicate working in any of these three categories, I assigned them to (4) "other". [5]

Working for pay is distinctly less common in the program villages than in the comparison villages, 30 versus 35 percent, but this difference is entirely due to young males working for wages 7.3 percentage points less often in program areas, and the differences for young females are insignificant, as seen in row 1 of Table 1. The converse is that 6.5 percent more males are engaged in self employment in the program villages, as expected if households in these villages

---

[4]These developments, other things being equal, could reduce the opportunity cost for youth to leave school earlier in program areas where their opportunity wages are higher, and reckon on a lower private rate of return to schooling unless the program areas experience a technological bias in demand for more educated labor, or expect to gain added returns on their schooling by migration to other areas, such as neighboring Dhaka or even abroad. Credit constraints may also limit investments in schooling and migration and could limit regional response to variation in private wage returns to schooling.

[5] The survey indicates earnings are asked only if they report working for pay, and even then some do not respond with earnings and months worked, perhaps because their primary occupation is a student (#33). A weakness of the MHSS data is few individuals work for pay.

have fewer children and have accumulated more assets that on balance enhance the productivity of child labor in family enterprises. It is all the more surprising that with this reallocation of the labor of male youth to self-employment activities in program villages, the parents record their sons as completing ten percent more years of schooling than in comparison areas, or .40 years more schooling, while the schooling gain for girls is .51 years in program villages (Table 1, row 6). House work is more frequent for both girls and boys in program areas, though the differences are not statistically significant. About half of the youth are not otherwise classified, and this group of "other" does not differ significantly in its frequency between program and comparison villages.

One interpretation of the estimated program difference in the allocation of the time of youth is that the program villages had fewer children, but sent those they had to school longer. This pattern is consistent with parent substituting quality for quantity of children, although it may also capture an income effect on the demand for schooling associated with the increased wage opportunities later observed for women in program villages.[6] If the households own agricultural land, and owns more land per adult, they tend to employ a larger fraction of their children in the family farm or business (primary occupation), but they are nonetheless more likely to send their children to school, activities which do not appear mutually incompatible where half of the youth age 15-24 are not reported as engaged in any "occupation".

For individuals reporting earnings and months worked for pay in either or both occupations, a monthly "wage" is calculated for young persons under the age of 25 and adults age 25 to 54.[7] As noted these log wages for youth do not differ between program and comparison villages for males or females as reported in the bottom row of Table 1, or within narrower age groups 15-16, 17-19, and 20-24 (not reported), even when controls are included for years of schooling completed and a quadratic in years of post-schooling potential experience (Cf. Mincer, 1974). However, Table 2 shows that log wages of female adults age 25 to 54 , who on

---

[6] The measure of children's schooling analyzed in Joshi and Schultz (2007) uses survey information provided by the parents on the completed years of schooling by their children, including those who were no longer resident in the parent's household. Thus, the reduced form estimates of the program's effect on years of schooling completed, normalized by means of a Z score based on one's birth cohort and gender, may provide a relatively reliable indicator of the schooling achievements of older children of surveyed parents in the program and comparison villages (See later Table 5, columns 4-7). Both age groups of sons are significantly more schooled in the program villages, whereas the program induced differences in schooling for daughters are substantial, but smaller than for sons, and not statistically significant, though they are significant in Table 1 where program differences are assessed conditional on fewer parental and village controls which seem to diminish the program associated gain in schooling for girls.

[7] When individuals report a wage rate in two occupations, the two wage rates are weighed by the share of months worked in each job.

average benefitted from having fewer unwanted births in the program villages, report 34 log points (40 percent) higher wages, whereas male adults log wages are insignificantly different between the program and comparison villages. These age-adjusted program/comparison differenced wage estimates suggest Malthusian population growth is not associated for adult male wages or the wages of youth of either sex. In contrast, adult females receive substantially higher wages in program villages. This could be explained by their reduced levels of unwanted childbearing that allowed them to reallocate their time to acquire productive experience and possibly to invest in physical capital that complements their labor and raises their reservation wages in home production and leisure activities.[8]

If an individual is employed in a paid job reporting monthly earnings, and the wage their receive on that job are determined by unobserved features of an individual's environment and endowments that also affect their productivity, the selected sample of individuals reporting monthly earnings may not provide an unbiased estimate of the earnings opportunities available to the entire age-sex group in the population. To improve on single-equation wage functions estimated by ordinary least squares, which assume the sample reporting monthly earnings is representative of the entire population, a framework is needed to account by gender for the participation of youth and adults in the wage labor force. A sample selection model is therefore specified below to correct for resulting variation in the composition and share of the population reporting monthly earnings, which is hypothesized to be potentially affected by the family planning program. Joint maximum likelihood (ML) estimates are then estimated for a probit model of employment in wage work and a log linear monthly wage equation to correct for the possible sample selection bias that could arise if the errors in the employment and wage equations are correlated , i.e. rho =/ 0.

Building on Heckman's (1974) insight, it is necessary to specify variables that raise the nonwage productivity (i.e. reservation wage) of an individual and thereby reduce the likelihood that an individual works in the market wage labor force.[9] However, it must be argued that these

---

[8] For example, NGO micro credit organizations in Bangladesh have often targeted poor women who lack collateral to offer for loans to establish themselves in self employment, e.g. for the purchase of livestock (e.g. ducks and goats) and materials for handicraft production. Approximately half of the program and half of the comparison villages in Matlab report in 1996 having a BRAC microcredit organization in the village. Reduced form regressions for fertility and other family outcomes include a control for the presence of such rural NGOs in the village, which are significantly associated with women participating more often in loan, savings, and work groups, having lower fertility (-.15), increased schooling of sons and daughters, but are not significantly associated with women's primary occupation earnings or total income (Joshi and Schultz, 2007, Tables 6 and 9).

[9] Fifty percent of the adult males report a wage, whereas 38 percent of adult females report a wage. For the youth age 15 to 24 the fraction earning a monthly wage is smaller, 18 percent for males and 8.6 percent for females. Thus, the correction for sample selection bias

identifying variables do not also modify the individual's market productivity or wage offer in the market labor force. If the household's ownership of land is exogenous to the village wage labor market, most of which land has been inherited by the surveyed families for generations, then households owning their own agricultural land (about 70 percent in 1996) might be expected to realize a higher marginal product on family labor working their own land, because of the lower cost of monitoring family labor than hired labor, and these landed households would thus be less likely to send household members to work in the paid labor force. Cultural restraints may limit daughters from working for pay away from the homestead or Bari. But these attributes are less likely to reduce daughters working in self employment in family enterprise or in housework, because they might impose a costly social stigma only if the young women worked away from their families, except perhaps in some high status occupations such as teaching and salaried work for the government or NGOs.[10] The value of cultivatable land owned by the household, divided by the number of adults who might work the land, is a second dimension of the household's factor endowment that is expected to increase family labor productivity and reduce the likelihood that family members would work off-farm for pay. These two variables expressing land ownership provide a reasonably exogeneous economic basis for identifying how male and female youth and adult workers are systematically selected into paid employment, and should help to correct for any sample selection bias embodied in standard single-equation estimates of the wage function.

Tables 3 presents log wage equation estimates for men and women age 15 to 24 for persons reporting monthly earnings. First, columns 1 and 3 report single equation (OLS) estimates as previously summarized that in addition now control for the conventional human capital variables of years of schooling, potential years of post-schooling experience, and this experience squared (divided by 100) (Mincer, 1974). Second, in column 2 and 4, joint maximum likelihood (ML) estimates of the sample selection correction model are reported, identified by the inclusion of variables indicating whether the household is "landed" or owns cultivatable land and the "value of this agricultural land" per adult (age 15 or more) in the wage

---

could be more important for youth, other things equal, but also possibly harder to estimate with precision, given the smaller proportion of youth reporting monthly earnings outside of their parent's homestead, especially for young women.

[10] The higher wage returns to women's schooling may be associated with them working as teachers, nurses, and staff in government and NGO institutions, such as in medical care. When the continuous variable for years of schooling is replaced in the wage function by three categories (1-3, 4-6, or 7 years or more), with none as the omitted category, only the wage difference for the 7 years or more of schooling is significant, and the same is true if the omitted category is 4-6 years of schooling. It appears that the relatively high return to women's schooling in Matlab arises mainly because of the salaried jobs occupied by relatively few women with at least some secondary schooling.

employment equation. The error in the wage employment equation is thus assumed to be normally distributed as in the probit specification. The "landed" and "household agricultural land value per adult" variables are both significant in reducing male participation in the paid labor force, as hypothesized, providing a credible economic basis for model identification when excluded from the wage equation. The family planning program village effect on male wages is again not significantly different from zero, corrected now for sample selection bias. The households which own agricultural land are also less likely to have young women work for wages outside of the homestead, though in the case of women, the household value of land per adult does not add to the explanation of the wage employment outcome.[11] The estimated effect of the program on young women's wages is also insignificant. According to this sample selection framework, there is again no evidence of Malthusian population pressure reducing the wages of youth relatively more in the comparison villages than in the program villages, either for men or women age 15 to 24. Private wage returns to schooling are estimated by the coefficient on the years of schooling completed by the worker in the log wage equation. Young men's wages are about 7.2 percent higher for those with an additional year of schooling, according to the OLS estimates, but when corrected for sample selection these returns double to nearly 15 percent, whereas for young women OLS estimates of returns to schooling decline slightly from 7.5 percent to 6.9 percent when corrected for sample selection, and are not statistically significant.

Table 4 ML presents estimates in columns 2 and 4 of the selection corrected wage equation for males adults age 25 to 54, which shows that males in landowning households are again less likely to work for pay outside of the household. Allowing for the covariance of the errors in the paid employment and wage equations in the ML selection model, male log monthly wages do not differ significantly between the program and comparison villages. However, both the single equation (OLS) and the joint sample selection model (ML) estimates imply for adult women that their wages are fully one-third higher in program villages, and these differences are statistically significant. This could be due to the her accumulation of productive experience other than child rearing, or savings in the form of assets that add to her productivity in nonwage activities in the program villages, raising the reservation value of a her time in housework, self employment, family enterprise, or simply leisure.

What I find surprising is that thirteen percent fewer adult women are in paid employment in the program villages than in the comparison villages (Table 4, column 4, panel 2) and according to Table 2 this is related to increased housework. The reduced supply of adult female labor to the inter-household wage labor market may contribute to raising the offered wages for adult women. Private wage returns on schooling increases from 5.2 percent to 6.0 percent for adult males, when the OLS estimates of the wage function are corrected for sample selection in the ML estimates. The comparable estimates of wage returns to schooling for adult women are

[11] The landed and value of land variables are, however, always jointly statistically significant at the 5 percent level, and over identification tests indicate both variables are, not surprisingly, identifying similar estimates of the effects of land on participation.

13.5 per cent in both the OLS and ML estimates, twice as large as for males. The higher proportionate wage returns to schooling for adult women than for adult men may explain the more rapid increase in female than male schooling in Matlab and in Bangladesh more widely, at both the primary and secondary school levels in the last two decade (Shafig, 2007; Asadullah and Chaudhury, 2008). The better educated adult men and women are somewhat more likely to participate in the paid labor force than their less educated peers, according to the ML estimates, but the estimated differences are not statistically significant.

In sum, the aggregate effects of population growth which Malthus assumed would diminish the marginal product of labor and depress wages are not evident in Matlab between program and comparison villages, possibly because the diminishing returns to labor are relatively modest in Matlab, or only two decades have elapsed, or unobserved migration arbitrages away any village differences in wages due to program-induced variation in population growth. Evidence of systematic migration from comparison to program villages is not observed in the movements of women or the children of women sampled in the MHSS. But there are indications that the probability of children and adults working for wages and reporting earnings per month are less common in villages with the program, perhaps because these households have fewer children demand more child labor per child on family farms and enterprises, and they may have also accumulated more lifetime assets due to their reduced fertility, and these household assets, such as agricultural land, orchards, and ponds could differentially raise the productivity of family labor in program villages. However, the portfolio of assets held by the household may also adjust to the program-induced reduction in fertility and compensate for the diminished supply of child labor, as explored further in the next section 8 of this paper. Thus, the aggregate Malthusian population growth effects on youth wages are not apparent in Matlab in 1996, but the allocation of family labor between wage work and home production may help to explain both the wage and employment patterns characterized in Tables 1 through 4.

5. Pathways from Family Planning to Women's Productivity or Human Capital

A family planning program reduces the cost to women of avoiding unwanted births and of controlling more precisely the timing of wanted births. With a program-induced reduction in births, women are able to allocate more efficiently their time from child care to accumulate vocational experience and training which is expected to raise their productivity in the market or home or in both sectors. With fewer and better-timed births, the health status of women is expected to improve and raise further their productivity, where health status, approximated here by her body mass index (BMI), which in this population is on average very low (i.e. 18.4 in the comparison villages in 1996) and positively significantly associated with her survival (Menken et al., 2003). Private returns to schooling of women are also hypothesized to increase, because of the program-induced control of their reproduction allows women to better allocate their time among work and training opportunities that is expected to complement their existing level of schooling. Thus, women's log wages are hypothesized to be higher in villages which are provided a more effective family planning program, and this program wage effect might be composed of a share (1) due to the woman's increased BMI (i.e. health status), (2) increased wage returns on their schooling, and (3) any remaining change in productive experience

associated with the program.[12]

First, BMI of women are compared in program versus comparison villages. This difference is estimated by Joshi and Schultz (2007) with many exogenous control variables, and women over age 25 appear to have BMIs about 1.0 units larger in the program than in the comparison villages, and these differences are statistically significant for each age group over 25. Women's log wages are reestimated as a function of residing in a program village, schooling, post-schooling experience as before (Table 4, col 4), with an additional control for BMI and an interaction between program and the returns to schooling, correcting for potential sample selection bias of those in wage employment. If BMI is not correlated with the error in the wage function, or BMI is not affected by omitted variables that also affect wages, a bloc-recursive specification of BMI in the first stage, and wages in a second stage is estimated, which implies that the one-third larger monthly earnings of women age 25 to 54 in program villages can be attributed mostly (62 percent) to the higher wage returns to women's schooling in program villages, and 11 percent attributed to increased BMI of women in program villages, and the remaining 27 percent of women's wage gains remain unaccounted for by this exercise. Lacking a credible identifying exclusion restriction which would affect BMI but not otherwise be associated with wages, it is not obvious to me how to estimate the effect of endogenous variation in BMI on wages.[13] It thus appears that much of the impact of the family planning program on women's wages is increasing the value of their human capital in the form of

[12] Early childhood health and nutritional conditions which may influence adult height are thought to be determined before the onset of the program for women over the age of 24 in 1996, and thus height of adult women can be treated as exogenous from the perspective of this FPCMH program evaluation. Although adult height is often found to be positively associated with wages in relatively large samples (Strauss and Thomas, 1998; Schultz, 2004), height was not a statistically significant variable when added as an exogenous determinant to the log wage equations estimated from the 1996 MHSS for either males or females within the age groups 25-54 (Tables 3 and 4) or 55 or more. For youth under the age of 25 height may still be increasing and the program could stimulate an earlier onset of the adolescent growth spurt, even if it did not affect the final adult height. The program might also impact the schooling of younger women, if their mothers were able to avoid having an additional child before the daughter completed her schooling, and this reduction in the mothers' childbearing thereby increased the daughter's years of schooling. Such a child schooling effect of the program could arise for the children of women about age 45 to 54 in 1996 and these children would then be about age 20-30 in 1996, included in the older children schooling regressions reported later in Table 5.

[13] Alternatively, if BMI is treated as endogenous to the wage determination process, BMI can be omitted from the wage equation, and a partial reduced form specification of the wage equation estimated that attributes the effect of the program transmitted through increased BMI to the residual program treatment wage effect, but continue to estimate the separate effect of the program on the private return to the schooling of women, which remains 60 percent of the total.

schooling returns and health status.[14]

6. Parent Life Cycle Substitution between Children and other Family Objectives

With the unusual social experiment in Matlab nearly two decades have elapsed by the time the 1996 MHSS is collected, providing a researcher with the opportunity to estimate reduced-form equations predicting a variety of long term family outcomes between program and comparison areas and thereby try to assess the pathways by which the program's has affected family welfare and socioeconomic development. The same controls are maintained as in the previous reduced-form study of the woman's fertility as now summarized in column 1 of Table 5.[15] The death rate of a woman's children before their fifth birthday is less predictable in the reduced-form specification (i.e. R^2 =.07) than is her fertility (R^2 = .57). Child mortality tends to be lower in program villages among women of all ages, but reaches statistical significance at the 5 percent level among women age 35-39, 45-49, and 50-54, and does not differ significantly by the child's gender. For example, among women age 45 to 54, child mortality is .056 lower in the program areas than in the control areas, as shown in Table 5 column 2, or a third less than the average child death rate of .15 in the comparison villages (Joshi and Schultz, 2007, Appendix Table A). This difference in child mortality may not be entirely attributed to the program-induced decline in fertility, because the program after 1982 sought directly to reduce infant and childhood illnesses through a variety of interventions such as tetanus toxiod inoculation of women, immunization of children for measles and other diseases, oral rehydration therapy for diarrhea, and growth monitoring.[16] But some part of the child mortality decline is undoubtedly due to the

---

[14] In the case of wages of males age 25-54, which did not differ between program and comparison villages, it may be noted that adding BMI to their wage function suggests a unit of BMI being associated with a significant gain in male log wages of about the same magnitude as for women , or about .05, but the program is not significantly associated with differences in male BMI or with a program-interaction affecting the returns to schooling in the male wage function, as they are in the case for adult women's wages.

[15] Controls for the woman's age, schooling, and religion are included as well as interacted with the program treatment, allowing for heterogeneity in response to the program, while additive controls are included in the form of a quadratic in husband's age, his years of schooling, household marital type, whether a control village shared a boundary with a program village and hence could have had greater opportunity to learn through social networks about the program services, and five characteristics of infrastructure in the village: the distance to the community family planning-health clinic, whether there is a secondary schools in the village or an adjacent village, a paved (Pucca) road, village motor boat transportation, and a BRAC microcredit program in the village.

[16] The program areas report significantly greater probabilities of having a woman's last child born in the last five years inoculated against the various childhood diseases, including polio, measles and DPT (Joshi and Schultz, 2007, Table 8).

greater control of unwanted fertility achieved by the program.

As already noted, the women residing in program villages in 1996 appear to be healthier, measured by their body mass index (BMI) being 0.8 units higher than in the comparison villages for married women by age 25 to 29, and this significant health advantage increases steadily to 1.4 units among women at the end of their childbearing age 40 to 44 (Table 5, column 3). The average BMI of married women in the comparison villages of only 18, which suggests the serious level of female adult malnutrition in Matlab in 1996, at least according to WHO standards (Menken, et al. 2003).

Daughters of these women age 9-14 and 15-29 completed .35 and .22 standard deviations more years of schooling (measured as a Z score) for their age (and sex) in the program areas than in the comparison areas, whereas the sons obtained .54 and .43 standard deviations more schooling in these two age groups of children (Table 5, Columns 4-7). The estimated program effects on the son's schooling are statistically significant at the five percent level, whereas the schooling effects for daughters are not significant by conventional standards.[17] Even though the levels of schooling achieved by girls converged to that of boys in Matlab in the 1990s, as it did more widely in Bangladesh, the FPCMH program does not appear to have reinforce this gender convergence in schooling acheivements.[18] On the other hand, daughters age 1-14 are reported to have a significantly higher body mass index Z scores in the program villages, normalized for age and sex, whereas there is no significant difference in BMI Z scores for sons (Table 5, columns 8-9).[19]

Women's earnings in their primary occupation are higher in the program villages than elsewhere, but these regional differences appear to be significantly larger for better educated women, as indicated by a positive coefficient on the interaction of woman's schooling and program treatment in col. 10 of Table 5. According to these estimates, a woman living in a comparison village has earnings in 1995 which are 244 taka larger per month for each year of

---

[17] Enrollment rates did not differ between the program and comparison areas, as reported by Sinha's (2005), which suggests the survey measure of "school enrollment" may be a noisier measure of school investment than " years of schooling completed" by children in a cross section, especially if years of schooling is expressed as a normalized Z score within age and sex subgroups.

[18] However, it may be recalled from Table 1 which is based on all children age 15 -24, the program-comparison difference in girl's years of schooling is somewhat larger than for boys. I suspect this is due to the reduced form specification adopted in Table 5 attributing some part of the social programs effects to correlated conditions in the villages, even though initially the experimental design minimizes these differences.

[19] Chaudhuri (2008) reports evidence for samples of individual children under the age of ten that height-for-age is greater for boys and girls in the program villages vis a vis the comparison villages.

schooling she has completed, compared to the mean earnings in the comparison villages of 698 taka. In the program villages the earnings of a woman with one more year of schooling are 731 taka (244+487) larger, and the mean is also proportionately larger, 1374 taka.

Parents may view their children as a partial substitute for the accumulation of physical assets over their life cycle, to meet their consumption requirements in old age and as a form of insurance for care should their health fail. Family planning programs which help parents avoid unwanted births, as in Matlab, are likely to then lead parents to increase their lifecycle savings. The reduced form estimates for the value of household total assets, as reported in column 11 of Table 5, are consistent with this substitution between children and physical assets. But again, the interaction of women's schooling and program residence is positive and significant, suggesting that these program-associated increases in assets are absolutely larger in households in which women are better educated.

7. Women's Private Wage Returns to Family Planning

Why are the program financial effects on women's market productivity and household assets larger for better educated women, even though the program-induced reductions in births, child mortality, and increases in the women's BMI are of a similar magnitude for women of different educational levels (Table 5, columns 1 - 3)? One explanation could be that the woman's human capital gains from the program are proportional to the value of her time no longer invested in childcare but potentially reallocated to on-the-job training. Mincer (1974) proposed a semi-logarithmic functional form for the earnings-schooling relationship, which is widely applied, and although he derived it from a multiplicative framework of human capital investment of time in schooling, it has proven a robust simple approximation for data on male earnings for the US and many other countries than does an arithmetic function as implied in Table 5 (Cf. Heckman and Polachek (1974). The distribution of individual earnings (and household assets) tend to be skewed to the right, and consequently the standard assumption that errors in a regression are normally distributed is less tenable when the the dependent variables is skewed in this manner, whereas wages, earnings, income and assets are approximately normally distributed when transformed into logarithms as Mincer did in his preferred specification of the wage function. If the time a mother saves when she avoids having an "unwanted birth", due to a family planning program in her village, is approximately constant, regardless of the woman's education or potential post-schooling experience, then the program's impact on her productivity and lifetime assets is expected to be proportional to her opportunity wage. When the program's effect on log earnings and log household assets are estimated in this semi log functional form, the effects of the interaction between the woman's schooling and the Matlab program treatment ceases to be statistically significant, as in Table 4. One hypothesis is that unwanted births prevented by an exogenous improvement in family planning services should enter a woman's log earnings function in an approximately linear form, as completed years of schooling do in a conventional earnings equation, with of course the opposite signed effect. Because fertility is a parental choice to some degree, the challenge is to specify an instrument to predict exogenous variation in endogenous fertility and estimate the wage equation by instrumental variables. But in the Matlab social experiment the comparison of women's wages in Table 2, column 4, between program and comparison villages, provides an estimate of program's log earnings effect of a

third to two-fifths. Avoiding one unwanted births, which is approximately the program impact for women age 25 to 54 (Table 5 column 1) is equivalent to an investment in a woman's human capital for which the wage returns to her, over her remaining lifetime, is .34 log points per year, or comparable to the estimated wage return on schooling of about an additional 2.5 years. A robustness check is the confirmation that the return to the family planning program on the wages of youth or men age 25-54 (or older) is nil. Women's productivity alone is enhanced by the Matlab FPMCH program, and may be conceptualized as a gender specific investment in women's human capital.[20]

8. How Does Family Planning Affect The Portfolio of Household Assets ?

The 1996 MHSS reports extensively on wealth holdings, though it is more difficult to construct comprehensive indicators of household income from the survey. Individuals identify their own assets, but the ownership of most assets are attributed only at the household level. Table 6 summarizes by asset categories the author's calculations from various modules in the MHSS for strata 1 and 2 sample households (the representative sample), first for all married woman in column (1), which is the unit of observation used in Table 5, and then by the sample of households (including possibly more than one woman in a household) in column (2), and column (3) reports the percentage share of total household assets in column (2) accounted for by each asset category. The major assets are 1A-agricultural cultivated land, equal to 42 percent; 1B-ponds and orchards, 3.9 percent ; 2A-housing, 41 percent; 2B+2C- jewelry and financial assets, 2.9 percent; 2D-K consumer durables, 2.4 percent; 3-livestock, 2.0 percent; and 4-nonfarm business assets, 4.4 percent. Household assets in the program villages average 238,402 taka or 47,505 more than in the comparison villages, or 25 percent more ((program-comparison)/comparison), as shown at the bottom of columns 4, 5, 6 and 8 in Table 6. This program-comparison difference is statistically significant, i.e. the t statistic = 4.71 (Column 7). If the program and comparison region's households were essentially similar in 1977, and not influenced in their development thereafter, except by the provision of the FPCMH program's services, the 1996 survey data support the hypothesis that parents view their number of children as a substitutes for physical assets, presumably because they are alternative means for smoothing

[20] One way to think about the magnitude of the woman's wage return to the program is to note from Table 5, col. 1 that the program appears to have reduced the number of (unwanted) births by more than one for women age 25 to 54. If an extra child occupies its mother full time for the equivalent of three years that she could otherwise be productive and she invest her value of time in on-the-job training for these three years, the .34 log point wage effect of the program should be divided by the three years, and the annual return in Mincer's framework would be on the order of 14 percent. Of course the marginal birth avoided by the program might come at when the woman in Matlab was about age 30, which leaves her with only 30 or so years left to recover the investment. Conceptually to prevent an extra unwanted child who would otherwise dissipate his mother's human capital implies in the current context an internal private rate of return on the order of 8-10 percent. By this rough reckoning, of course, the private return does not recover the public costs of the program, but only the private investment of three years of the mother's time at age 30.

consumption over the life cycle. The differences in the portfolio of assets held by parents in program and comparison villages shed further light on which assets are viewed by parents as complementary with their child labor, and which assets are particularly valued as substitutes for the support and care parents expect to receive from their children in old age, as well as a source of child labor as adolescents.

One area of household production where child labor is thought to be relatively important is in attending to livestock. Total livestock assets are 23 percent *lower* in program village households than in comparison village households, with a significant t = 4.60, even though the value of sheep and goats is slightly larger in program households and thus offsets to some degree the reduced value of cows and buffalos in program areas. A second activity in which children assist parents is fishing, and the value of boats is 36 percent lower in program than in comparison villages.[21] The predominant role for family labor in agriculture is in the cultivation of annual crops in this delta region, and the value of household assets held in the form of agricultural cultivated land is 8 percent larger in program villages relative to comparison villages, but this small difference is not significant, in contrast to the increase of one quarter noted earlier in total household wealth.[22] However, households in program villages hold 44 percent more assets in the form of housing, and 33 percent more assets in the form of consumer durables than do households in comparison villages (Table 6, row D-K, column 8). These large increases in consumer assets may be due to above average income elasticities of household demand for the consumption of these services of housing and consumer durables, and perhaps the advancement of women's earnings in program areas for which they may provide substitute services as well as augment welfare in retirement and as a means of precautionary savings.[23] In

---

[21] However, because fishing is predominantly an occupation of Hindus, and the fraction of Hindus is lower in the program villages than in the comparison villages in 1977 and 1996, this religious difference could account for the difference in fishing assets. The 1977 and 1982 Census asks how many boats the household owns, and the difference in number of boats between program and comparison areas was smaller in these earlier years (1974, 1982) than the value of boats difference in 1996.

[22] It was assumed earlier that the marginal product of child labor increases with the household's value of agricultural land, and to the extent that the program contributes exogenously to accumulation of agricultural land, as a form of life cycle savings substituting for children, this additional land would also reduce the cost of additional children and encourage greater fertility.

[23] The value of TVs in the household is 2.5 times larger in program households than in comparison households. One might infer from these asset differences across villages that buildings and shops in non farm business assets and ponds and orchards in farm business assets are assets classes which did not strongly complement child labor, given their substantial positive associations with program treatment, 55 and 66 percent, respectively (Table 6). Another dimension of household assets is having a tube well within the family homestead or Bari, which is increasing in this period more in program villages than in comparison villages, raising family

the case of financial savings and jewelry, these more liquid assets are 56 percent larger in the program than in the comparison households, consistent with these assets also being a substitute for children over the life cycle, and a form of retirement and precautionary savings. Estimating reduced-form effects of the program, as in Table 5 for household value of assets summed across all categories reported in Table 6, confirm that the aggregate effect of the program is approximately proportional, and consequently reasonably transformed to logarithms, consistent with the proportional effects of family planning on women's earnings and income, in which case the interaction effect between women's incomes and education (in Table 5 col 11) is no longer statistically significant.

In sum, a case study of the long-run consequences of family planning-induced reductions in fertility in Matlab is not a basis for generalizations about other parts of the low income world. But it suggests that in this poor rural South Asian region of Bangladesh, where women are culturally restricted in their movement outside of their homestead, a concerted outreach program delivering birth control information and supplies every two weeks to married women in their homes achieved a significant decline in fertility and sustained lower (by 16 percent) levels of fertility for two decades. This was accomplished during a period when fertility was falling rapidly for other reasons, and fertility declined by 38 percent in the comparison villages (in the MHSS 1996 Survey) from about 6 to 3.5 children per woman, where there existed only the standard government operated family planning clinics at the community level (Fauveau, 1994). This policy-induced reduction in fertility and allied improvement in child and maternal health are also associated with sons receiving significantly more schooling, daughters having a better nutritional status as measured by their BMI, and for women having proportionately higher earnings in the paid labor market and living in households with proportionately greater assets. Households in program villages reported a fourth more assets per adult, and held a smaller shares of household asset in forms which complement child labor, such as livestock and fishing or land for agricultural cultivation, and held a larger share of those assets which are thought to be better substitutes for child support in the parent's old age, such as housing, consumer durables, financial savings, jewelry, orchards and ponds, and most non farm business assets.

An implication of the Malthusian model of population pressure depressing wages would imply that the wage rates of youth age 15 to 24 should be higher in program villages where population growth and the size of surviving family size is 15 to 20 percent lower by 1996. But there was no evidence of higher youth monthly earnings in the program villages, even when maximum likelihood estimates of employment in wage jobs and log wage equations are jointly estimated to correct for potential sample selection bias. Monthly earnings of adult males, age 25

---

welfare and presumably improving health and hygiene. The convenience of these water sources adjacent to the household also saves the time of women and children, who are traditionally responsible for fetching water (Joshi and Schultz, 2007, Table 7). Unfortunately, the introduction of tube wells, though they undoubtedly contributed to reducing pathogens in water supplies and thus to the decline in child mortality and morbidity in this period, also tapped shallow aquifers in the Matlab region that have recently been shown to contain toxic level of arsenic.

to 54, are also no different between the program and comparison villages. Patterns of in and out migration from the two adjacent areas is also similar for children residing in program and comparison villages in Matlab in 1996. However, adult women age 25 to 54 in program areas are less likely to work in wage employment, and when they do they receive wages which are fully one-third larger (Table 4) related mostly to higher returns which women receive from their schooling in program villages increased BMI-health status . This regularity is not readily explained in the Malthusian framework, but is consistent with the hypothesis that avoiding unwanted births allowed women to improve their health, increase their returns from their predetermined levels of schooling, and enhance their productive training, and accumulate more experience, which adds to the value of their human capital, and raises their reservation wage determining whether they enter the wage labor market.

Whether these estimates of the effects of family planning and child and maternal health policy are relevant for other parts of the world remain an open issue, because other social experiments or long term statistical matching evaluation studies of population programs have not, to my knowledge, been conducted or suitably analyzed.[24] Are the consequences of the Matlab program on fertility, child survival, and child schooling due to special features of gender relations in these poor Muslim rural areas, or would such a program as implemented in Matlab have a similar effect on fertility and family outcomes in other equally poor rural areas of the developing world, especially where gender inequality is comparable?

9. Conclusions and Directions for Research

The long run consequences for women, children, and men of the voluntary decline in fertility facilitated by public programs and policies that reduce the monetary and psychic costs of birth control have not been adequately evaluated. One research strategy to explore this question is to specify instrumental variables that are causally responsible for a decline (or increase) in fertility where the source of this variation can be viewed as outside the control of the household, i.e. exogenous to lifecycle allocations, and otherwise uncorrelated with the long term outcomes of the family, such as the experimental introduction of a family planning program in half of the villages of Matlab. An alternative research strategy is to specify an instrument for fertility which represents a "natural experiment", such as having twins, which may under some conditions simulate the consequences of a shock to fertility that may arguably be independent of parent preferences, family endowments, and prices that might otherwise modify family opportunities and behavior (Schultz, 2008). The effect of twins on fertility and subsequent family outcomes may be viewed as a estimate of the long term effect of a fertility decline induced by a family

[24] A literature has studied the family consequences of legalizing abortion in the United States, which concludes that legalization by state and time period reduced birth rates, especially among poorer groups in the population, and there were improvements in average child health and schooling. And after 20 years, a reduction in crime associated with youth can be detected and linked to the earlier reforms reducing unwanted childbearing (Gruber, et al.,1999; Donohue and Levitt, 2001). Other studies have tried to isolate the policy induced effect of increasing women's schooling on fertility, child health and schooling (Currie and Moretti, 2003, Black et al., 2005a, 2005b; Osili and Long, 2007).

planning program, with of course the sign reversed. But even in this case, the biological quality of twins is not equal to singleton births, and the timing of fertility is altered as well by twins, leaving those who are credit constrained at a particular disadvantage in making compensating investments in their children due to having twins.

The implications of alternative economic opportunities and constraints on the determination of fertility have been studied but largely guided by the simple unified models of household production and consumption (Becker, 1981; Schultz 1981, 1997). However, husbands and wives may have different preferences over fertility and women's work outside of the family, and bargain over fertility, the allocation of household resources, and their labor supplies (McElroy and Horney, 1981; Chiappori, 1992; Haddad, et al. 1997; Quisumbing and Maluccio, 2003, Thomas, 1990, 1994). Several directions for research on these issues are promising and deserve attention. Associated with the decline in fertility, women supply more of their lifetime labor to the household production other than child care and to the market labor force (Schultz, 1990, 2008). Available measures of women's work in the home, in unpaid family work, in self employment, as well as in the wage employment, are not always comparable across countries, or even over time within countries, especially in low-income agricultural settings (Durand, 1975; Schultz, 1981, 1990). As fertility declines in many countries in South and West Asia, the prevailing culture may not encourage women in rural areas to reallocate their time to work in occupations outside of their home. In these circumstances, how do women realize their productive potential and capture the opportunity value of their time? If women are constrained to allocate their time among traditional home making activities or household production, as they reduce their allocation of time to rearing children, how large is the efficiency loss, and how does the different working environment for women affect their bargaining power over resources in the household? Can women in Matlab readily enter paid employment and earn the higher wages observed in program villages if they exceed their marginal product in the home, due to a public program that assists them to avoid unwanted births? How might public programs assist women in reallocating their time to realize these increased productive opportunities in program villages?

One way to assess whether women benefit disproportionately from engaging in work outside of their home is to analyze how households allocate their resources to "private goods" that benefit only certain individuals in the household. Variation in private good consumption can help to identify the implicit "sharing rule" guiding a rational (Pareto efficient) household's joint labor supply and consumption choices (Chiappori, 1992; Browning and Chiappori, 1998; Haddad et al, 1997; Schultz , 2001). This requires the specification of a "private good" that provides utility only to the woman (or man) in the household. It has been argued that leisure, if it could be unambiguously measured for a mother, might represent such a private good (Schultz, 1990). A more readily measured private good would be investment in women's own human capital, such as for health human capital (e.g. BMI > 19, Cf. Fogel, 2004), schooling, vocational skills, or on-the-job experience, although even in these cases altruism between spouses could complicate the interpretation of own human capital as a "private good". For children a private good could be any of several forms of their human capital, but then it must be assumed that one spouse values these forms of child human capital more than the other spouse, to back out implications of the collective household model and explore the determinants of the sharing or

bargaining rule. Education could be measured as years of schooling completed relative to the average of a child's birth cohort (i.e. a Z score normalized measure of schooling) and is associated with gains in wage opportunities for females and for males (Schultz, 1995).

It remains unclear whether the magnitude and persistence of the effects of the family planning program in Matlab on fertility are due to the frequency of the field worker's home visits, or the low incomes and education of the population, or the local Muslim/Hindu customs which restrict the geographic movement of women, and limit their independence to seek out birth control and use it regularly. Regional variation in expansions of family planning programs in a number of countries suggest there may be only a brief period when the program's initial intensity contributes to a substantial and significant decline in births rates (Freedman and Takeshita, 1969; Schultz, 1973, 1992; Gertler and Molyneaux, 1994; Frankenberg, et al. , 2003; Miller, 2004). This would imply the demand for contraceptive use and resulting fertility is relatively inelastic with respect to family planning price subsidies for contraception or access to complementary services. This does not appear to have been the case in Matlab, and it is important to know why the Matlab experiment is different. More analysis of the sources of the decline in cohort fertility would be useful before it will be possible to conclude what share of the international decline in fertility is attributable to past and current organized family planning activity. What have these policy interventions contributed to the decline in world fertility and to the associated increase in women's wage opportunities, as observed in Matlab, to changes in women's time allocation and market labor supply, to increased private household savings rates, to the changes in the relative importance of various assets in their households, and the benefits of increased survival, health and nutrition, and schooling of the next generation of children.

References:

Acemoglu, Daron, 1998, "Who do new technologies complement skills? Directed technical change and wage inequality", Quarterly Journal of Economics, 113: 1055-1090.

Asadullah, Mohammad Niaz, and N. Chaudhury, 2008, "Madrasas and NGOs: Complements or Substitutes? Non-State Providers and Growth in Female Education in Bangladesh", Policy Research Working Paper 4511, South Asia Region, Human Development Unit, Washington D.C. :The World Bank.

Becker Gary S. and H. G. Lewis, 1974, "Interaction between quantity and quality of children", in (ed.) T. W. Schultz, Economics of the Family, Chicago: University of Chicago Press.

Becker, Gary S., 1981, A Treatise on the Family, Cambridge MA: Harvard University Press.

Black, Sandra E., P. Devereux and K. Salvanes, 2005a, "Why the apple doesn't fall far: understanding intergenerational transmission of human capital", American Economic Review, 95(1): 437-449.

Black, Sandra E., P. Devereux, and K. Salvanes, 2005b,"The more the merrier? The effect of family composition on children's education", Quarterly Journal of Economics, 120(2): 669-700.

Blake, Judith, 1989, Family Size and Achievement, Berkeley and Los Angeles: University of California Press.

Bleakley, Hoyt, 2007, "Disease and development: evidence from hookworm eradication in the American South", Quarterly Journal of Economics, 122(1): 72-117.

Blunch, Niels-Hugo, 2007, "Changing norms about gender inequality in education: Evidence from Bangladesh" , World Bank working paper. Ssrn.com/abstract=1030697.

Browning, M. and P.-A. Chiappori, 1998, " Efficient intrahousehold allocations: a generalized characterization and empirical test", Econometrica, 66(6): 1241-1156.

Canals-Cerda, Jose and Cristobal Ridao-Cano, 2005, "The Dynamics of School and work in rural Bangladesh", working paper Department of Economic University of Colorado at Bolder.

Chandrasekaran, C. and A. I. Hermalin (eds.), 1976, Measuring the Effect of Family Planning Programs on Fertility, Belgium: Ordina Editions for IUSSP.

Chaudhuri, Anoshua, 2008," Revisiting the impact of a reproductive helath intervention on children's height-for-age with evidence from rural Bangladesh", Economic Development and Cultural Change, 56(3): 619-656

Chiappori, P.-A., 1992, "Collective labor supply and welfare", Journal of Political Economy , 100(3): 437-467.

Coale, Ansley J., and E. Hoover, 1958, Population Growth and Economic Development in Low Income Countries, Princeton NJ: Princeton University Press.

Currie, Janet and E. Moretti, 2003, "Mother's education and the intergenerational transmission of human capital", Quarterly Journal of Economics, 118(4): 1495-1532.

Donohue, John J. And S. D. Levitt, 2001, "Legalized abortion and crime", Quarterly Journal of

Economics, 116(2): 379-420.

Duflo, Ester, R. Glennerster and M. Kremer, 2008, "Using randomization in development economics research: a toolkit", in Handbook of Development Economics vol 4, (eds.) T. P. Schultz and J. Strauss, Amsterdam: Elsevier Pub. Co. (Forthcoming).

Durand, John, 1975, The labor force in economic development, Princeton NJ: Princeton University Press.

Edmonds, Eric, 2008, "Child labor" in Handbook of Development Economics, Vol 4, (eds.) T. P. Schultz and J. Strauss, Amsterdam: Elsevier Pub. Co.

Fauveau, Vincent (ed.), 1994, Women, Children and Health. ICDDR,B special publication No. 35, International Centre for Diarrhoeal Disease Research, Bangladesh, Dhaka.

Field, Erica and A. Arbus, 2005, "Early marriage and female education in Bangladesh", Harvard University <efield@latte.harvard.edu>.

Fogel, Robert W., 2004, The Escape from Hunger and Premature Death, 1700-2100, Cambridge: Cambridge University Press.

Frankenberg, Elizabeth, B. Sikoki, W. Suriastini, and D. Thomas, 2003, "Contraceptive use in a changing service environment: Evidence from Indonesia during the economic crisis", Studies in Family Planning, 34(2): 103-116.

Frankenberg, Elizabeth and D. Thomas, 2001."Women's health and pregnancy outcomes: Do services make a difference?", Demography, 38(2): 253-265.

Freedman, Ronald and J. Y. Takeshita, 1969, Family Planning in Taiwan: an experiment in social change, Princeton NJ: Princeton University Press.

Gertler, Paul J. And J. W. Molyneaux, 1994, "How economic development and family planning programs combined to reduce Indonesian fertility", Demography, 31(1): 33-63 .

Gluckman, Peter and M. Hanson, 2005, The Fetal Matrix: Evolution, Development and Disease, Cambridge UK: Cambridge University Press.

Gruber, Jonathun, P.B. Levine and D. Staiger, 1999, Abortion legalization and child living circumstances: who is the marginal child", Quarterly Journal of Economics, 114(1): 263-291.

Haddad, L., J. Hoddinott and H. Alderman (eds.), 1997, Intra-household resource allocation in developing countries, Baltimore MD: Johns Hopkins University Press.

Hanson, G., 2003, "What has happened to wages in Mexico since NAFTA?", NBER working

paper No 9563, National Bureau of Economic Research, Cambridge MA.

Heckman James J., 1974, "Sample bias as a specification error", Econometrica, 47(1): 153-62.

Heckman, James J. and S. Polachek, 1974,"Empirical evidence on the functional form of the earnings-schooling relationship", Journal of the American Statistical Association, 69:350-354

Joshi, Shareen and T. P. Schultz, 2007, "Family Planning an Investment in Development: Evaluation of a Program's Consequences in Matlab, Bangladesh", Economic Growth Center Discussion Paper No. 951, Yale University, New Haven CT.

Killingsworth, Mark, 1983, Labor Supply, Cambridge: Cambridge University Press.

Kremer, Michael and E. Miguel, 2007, " The Illusion of Sustainability", Quarterly Journal of Economics, 122(3): 1007-1066.

Khan, Rubayat, O. Rahman, and A.K. Azad, 2007, "Are daughters a better investments?" Independent University, Bangladesh.

Kuznets, Simon, 1966, Modern Economic Growth: Rate, Structure and Spread, New Haven CT.: Yale University Press.

Menken, Jane, L. Duffy and R. Kuhn, 2003," Childbearing and Women's survival in rural Bangladesh", Population and Development Review 29(3): 405-426.

Miller, Grant, 2004, "Contraception as development? New evidence from family planning in Colombia", Harvard University, Cambridge MA, website graduate student papers.

Mincer, Jacob, 1974, Schooling experience and earnings, New York: Colombia University Press.

McElroy, Marjorie and M.J. Horney, 1981,"Nash-bargained household decisions", International Economics Review, 22(2): 333-350.

Modigliani, Franco, 1970, "The life cycle hypothesis of savings and the inter-country differences in savings ratio", in Induction, Growth and Trade: Essays in Honor of Sir Roy Harrod, (eds.) W. A. Eltis, M .F.G. Scott, and J. N. Wolfe, Oxford: Oxford University Press.

Modigliani, Franco and R. Brumburg, 1954," Utility Analysis and the consumption function", in Post Keynesian Economics, (ed) K. K. Kurihara, New Brunswick NJ: Rutgers University Press, pp. 388- 436.

Munshi, Kaivan, and J. Myaux, 2006, "Social norms and the fertility transition", Journal of Development Economics, 80: 1-38.

National Academy of Sciences, 1971, Rapid Population Growth, Baltimore MD: Johns Hopkins University Press.

Osili, Una O. And B.T. Long, 2007, "Does female schooling reduce fertility? Evidence from Nigeria", Journal of Development Economics, (forthcoming).

Parker, Susan W., L. Rubalcava, and C. Teruel, 2008, "Evaluating conditional schooling and health programs" in Handbook of Development Economics, vol 4, (eds.) T. P. Schultz and J. Strauss, Amsterdam: Elsevier.

Phillips, James F., W. Stinson, S. Bhatia, M. Rahman, and J. Chakraborty, 1988, " The demographic impact of family planning-health services project in Matlab, Bangladesh, Studies in Family Planning, 13(5): 131-140.

Quisumbing, Agnes R. And J.A. Maluccio, 2003, "Resources at marriage and intrahousehold allocation: evidence from Bangladesh, Ethiopia, Indonesia and south Africa", Oxford Bulletin of Economics and Statistics, 65(3): 283-323.

Rahman, Omar, J. Menken, A. Foster, and P. Gertler, 1999, Matlab [Bangladesh] Health and Socioeconomic Survey (MHSS), 1996, Inter-university consortium for political and social research, Ann Arbor, MI (ICPSR 2705)

Razzaque, Abdur, N. Lutfun, A.M. Sarder, J. K. Van Ginneken, and M. A. K. Shaikh, International Centre for Diarrhoeal Disease Research, Bangladesh (ICDDR,B) , 1998, Demographic Surveillance System-Matlab, vol, 29, 1996 Socio-Economic Census, Scientific Report No. 83, Dhaka, Bangladesh.

Rosenzweig, Mark and T. P. Schultz, 1982, "Child mortality and fertility in Colombia", Health Policy and Education, 2: 305-348.

Samuelson, P.A., 1958," An exact consumption loan model of interest with or without the contrivance of money", Journal of Political Economy, 66(6): 467-482.

Schuler, Sidley R. , L.M. Bates, Md. K. Islam, 2001, "The persistence of a service delivery 'culture': Findings from a qualitative study in Bangladesh", International Family Planning Perspectives, 27(4): 194-200.

Schuler, Sidney R., L. M. Bates, F. Islam, and Md. K. Islam, 2006, "The timing of marriage and childbearing among rural families in Bangladesh: Choosing between competing risks", Social Science & Medicine, 62: 2826-2837.

Schultz, T. Paul, 1973, "Explanations of birth rate changes over space and time: a study of Taiwan", Journal of Political Economy, 81(2, pt. II): S238-S274.

Schultz, T. Paul, 1981, Population Economics, Reading MA: Addison Wesley Pub.

Schultz, T. Paul, 1982, "Notes on the estimation of migration decision functions" in Migration and the labor market in developing countries, (ed.) R. Sabot, Boulder CO: Westview Press.

Schultz, T. Paul, 1990, "Women's changing participation in the labor force", Economic Development and Cultural Change, 38(93): 451-488.

Schultz, T. Paul, 1992, "Assessing Family Planning Cost-Effectiveness", in Family Planning Programmes and Fertility, J.F. Phillips and J.A. Press, New York: Oxford University Press, pp. 78-105.

Schultz, T. Paul (ed.), 1995, Investment in Women's Human Capital, Chicago: University of Chicago Press.

Schultz, T. Paul , 1997, "Demand for children in low-income countries", in Handbook of Population and Family Economics, vol 1A. (Eds.) M. R. Rosenzweig and O. Stark, Amsterdam: .North Holland Pub. Co.

Schultz, T. Paul, 2001, "Women's roles in the agricultural household: bargaining and human capital investments", in Handbook of Agricultural and Resource Economics,(eds.) B. Gardner and G. Rausser, Amsterdam: Elsevier Pub. Co.

Schultz, T. Paul, 2004, " Wage rentals for reproducible human capital: evidence from two West African countries, Economics of Human Biology, 1 (3): 331-366.

Schultz, T. Paul, 2008, "Population policies, fertility, women's human capital and child quality" in Handbook of Development Economics, vol 4, (eds.) T.P. Schultz and J. Strauss, Amsterdam: Elsevier Pub Co.

Sinha, Nistha, 2005, "Fertility, child work, and schooling consequences of family planning program", Economic Development and Cultural Change, 54(1): 97-128.

Shafig, M. Najeeb, 2007, "Household Schooling and child labor decisions in rural Bangladesh", working paper, ssrn.com/abstract=967899.

Strauss, J. And D. Thomas, 1995, "Human Resources: Empirical Modeling of Household and Family Decisions", in Handbook of Development Economics, Vol. 3A, (eds.) J. Behrman and T.N. Srinivasan, Amsterdam: Elsevier, Chapter 34.

Thomas, Duncan, 1990, "intra-household resource allocation: an inferential approach", Journal of Human Resources, 25(4): 635-664.

Thomas, Duncan, 1994, "Like father, like son: like mother, like daughter", Journal of Human

Resources, 29(4): 950-989.

United Nations, 1985, Studies to Enhance the Evaluation of Family Planning Programmes, New York: United Nations.

United Nations, 2003, World Population Prospects: the 2002 Revision, vol I, Department of Economic and Social Affairs, Population Division, New York.

Welch, Finis, 1979, "Effect of cohort size on earnings: the baby book babies' financial bust", Journal of Political Economy, 87(5, part II): S65-S97.

Zajonc, R. B., 1976, "Family configuration and intelligence", Science, 192 (4236) : 227-236.

Table 1: Program Effects on Characteristics of Youth Age 15 to 24*

Type of Occupation or Characteristic	Male Sample Size	Male Program Effect	Female Sample Size	Female Program Effect
1. Work for Pay	1159	-.073 (2.56)	1190	-.021 (.93)
2. Self Employment	1159	.065 (2.81)	1190	-.014 (1.62)
3. House Work	1159	.018 (1.72)	1190	.019 (.77)
4. Other (1.0-1-2-3)	1159	-.011 (.39)	1190	.016 (.56)
5. Student Enrolled	2514	.033 (1.73)	2222	.029 (1.54)
6. Years of Schooling	2222	.400 (2.65)	2514	.510 (3.38)
7. Ln Monthly Earnings	453	.013 (.14)	190	.283 (1.39)

* Beneath regression coefficient in parentheses is the absolute value of its roust t statistic. Adjusted only for age by controlling in the regression for its linear effect. Because the program appears to have reduced fertility and contributed to the increase in child schooling and also thereby affected post school potential experience, it is inappropriate to control for schooling or experience when estimating the total effect of the program on type of occupation or outcomes.

Table 2: Program Effects on Characteristics of Adults Age 25 to 54, by Sex

Type of Occupation or Characteristic	Male Sample Size	Male Program Effect	Female Sample Size	Female Program Effect
1. Work for Pay	2545	-.0049 (.28)	3632	-.0692 (4.19)
2. Self Employment	2545	.0174 (1.01)	3632	-.0009 (.15)
3. House Work	2545	.0018 (.73)	3632	.0678 (4.50)
4. Other (1.0 -1-2-3)	2545	-.143 (2.40)	3632	.0024 (.19)
5. Student (#33)	3525	-.0045 (.92)	4092	.0010 (.35)
6. Years of Schooling	3525	.584 (4.63)	4092	.285 (3.76)
7. Ln Monthly Earnings	1776	-.0626 (1.48)	1599	.340 (4.86)

* Beneath regression coefficient in parentheses is the absolute value of its robust t statistic. Regression also includes for this age group a quadratic in post schooling potential experience and schooling, except for predicting schooling, which is estimated without a control for schooling.

Table 3: Matlab, Bangladesh 1996 Estimates of Wage and Wage Employment Functions for Youth age 15-24, by Gender: Alternative Estimates

(Beneath regression coefficients in parentheses are the absolute values of associated robust t statistics)

	Dependent and Explanatory Variables	Male OLS	Male ML Selection Corrected	Female OLS	Female ML Selection Corrected
1.	Log Monthly Earnings	(1)	(2)	(3)	(4)
	Program Village	.0558 (.59)	.154 (1.38)	.267 (1.32)	.0948 (.37)
	Years of Schooling	.0718 (3.30)	.149 (5.74)	.0751 (1.58)	.0693 (1.16)
	Years of Post-School Potential Experience	.178 (2.77)	-.121 (1.60)	-.0048 (.04)	.268 (1.93)
	Experiences Squared ($x10^{-2}$)	-.256 (.94)	.941 (2.85)	.042 (.09)	-.221 (.36)
	Constant	4.91 (12.0)	8.00 (15.4)	3.77 (4.94)	-3.70 (3.24)
2.	Selection into Sample with Monthly Earnings (expressed as derivatives at sample means)				
	Program Village		-.0876 (1.40)		-.0774 (.98)
	Years of Schooling		-.0494 (.046)		.0231 (1.24)
	Years of Post-School Potential Experience		.247 (7.12)		.142 (3.48)
	Experience Squared ($x10^{-2}$)		-1.00 (7.12)		-.238 (1.28)
	Agricultural Land Owner (0/1)		-.192 (3.31)		-.132 (2.32)
	Value of Agricultural Land (1000s of takas per Adult)		-.0016 (1.78)		-.00061 (.65)
	Constant		-1.66 (7.89)		-2.38 (8.97)
	Rho (Standard. Error)		-.903 (.026)		-.983 (.008)
	n	452	452 / 2504	190	190 / 2212
	P > F or Chi-Squared Wald test of eqns. Fit	.0000	.0000	.093	.0000

Table 4: Matlab, Bangladesh 1996 Estimates of Wage and Wage Employment Functions for Adults age 25-54, by Gender: Alternative Estimates
(Beneath regression coefficients in parentheses are the absolute values of associated robust t statistics)

Dependent and Explanatory Variables		Male OLS	Male ML Selection Corrected	Female OLS	Female ML Selection Corrected
1.	Log Monthly Earnings	(1)	(2)	(3)	(4)
	Program Village	-.0442 (1.17)	-.0291 (.61)	.334 (4.80)	.343 (4.67)
	Years of Schooling	.0518 (9.71)	.0602 (9.76)	.135 (9.41)	.135 (9.39)
	Years of Post-School Potential Experience	.0162 (1.29)	-.0790 (5.44)	.0145 (.59)	.0051 (.15)
	Experiences Squared ($x10^{-2}$)	-.027 (1.32)	.104 (4.35)	-.0080 (.04)	.0067 (.13)
	Constant	6.90 (36.4)	9.10 (39.4)	3.34 (8.70)	3.58 (5.11)
2.	Selection into Sample with Monthly Earnings (expressed as derivatives at sample means)				
	Program Village		-.0471 (1.12)		-.129 (3.25)
	Years of Schooling		.0066 (1.15)		.0101 (1.21)
	Years of Post-School Potential Experience		.126 (11.4)		.123 (9.71)
	Experience Squared ($x10^{-2}$)		-.165 (8.70)		-.191 (9.44)
	Agricultural Land Owner (0/1)		-.294 (6.88)		-.0738 (1.50)
	Value of Agricultural Land (1000s of takas per Adult)		-.0059 (1.13)		-.0006 (1.16)
	Constant		-1.82 (11.1)		-1.95 (9.96)
	Rho (Standard error)		-.848 (.019)		-.0770 (.190)
	Sample Size	1832	1832 / 3686	1627	1627 / 4254
	P > F or Chi-Squared test of eqns. Fit	.0000	.0000	.0000	.0000

Table 5: Reduced Form Estimates of the Matlab Program's Treatment Effect on Fertility and the Family Outcomes *

Selected Explanatory Variables:	Children Ever Born	Fraction Children Died by Age five	Women's Body Mass Index		Children's Years of Schooling Z Score				Children's Body Mass Index Z Score		Women's Primary Job Income in 1995	Household Assets Total ($X10_3$)
					Age 9 - 14		Age 15 - 29		Age 1 - 14			
	(1)	(2)	(3)		Daughter (4)	Son (5)	Daughter (6)	Son (7)	Daughter (8)	Son (9)	(10)	(11)
Treatment * Age Under 25	- .517 (.213)	- .038 (.032)	.380 (.385)								- 1966 (1730)	- 50.4 (49.1)
Treatment * Age 25 to 29	- .681 (.208)	.010 (0.24)	.839 (.379)								- 2824 (1701)	- 4.74 (57.1)
Treatment * Age 30 to 34	- 1.07 (.232)	- .038 (.025)	.945 (.346)								- 713 (1008)	- 14.3 (57.1)
Treatment * Age 35 to 39	- 1.02 (.245)	- .049 (.025)	1.14 (.347)								540 (1121)	- 11.2 (55.1)
Treatment * Age 40 to 44	- 1.26 (.270)	- .025 (.027)	1.40 (.385)		.352[a] (.257)	.541 (.194)	.221 (.211)	.430 (.185)	.424 (.185)	- .047 (.259)	1046 (1160)	-20.8 (48.2)
Treatment * Age 45 to 49	- 1.51 (.296)	- .056 (.025)	1.19 (.358)								356 (1175)	- 55.1 (50.7)
Treatment * Age 50 to 54	- 1.11 (.259)	- .056 (.026)	1.02 (.390)								- 825 (1018)	34.4 (47.7)
Treatment * Age 55 to 59	- .303 (.308)	-.038 (.028)	.957 (.425)								- 522 (1039)	27.4 (66.7)
Treatment * Age 60 to 64	- .404 (832)	- .007 (.029)	.716 (.405)								- 251 (925)	57.9 (67.8)
Treatment * Age 65 or more	- .255 (.324)	- .051 (.027)	.999 (.383)								- 524 (898)	23.5 (59.6)

Selected Explanatory Variables:	Children Ever Born	Fraction Children Died by Age five	Women's Body Mass Index		Children's Years of Schooling Z Score				Children's Body Mass Index Z Score		Women's Primary Job Income in 1995	Household Assets Total ($X10_3$)
					Age 9 - 14		Age 15 - 29		Age 1 - 14			
	(1)	(2)	(3)		Daughter (4)	Son (5)	Daughter (6)	Son (7)	Daughter (8)	Son (9)	(10)	(11)
	(1)	(2)	(3)									
Treatment * Women's Schooling	.0017 (.018)	.001 (.002)	.049 (.051)		.018 (.017)	.005 (.016)	.026 (.014)	- .011 (.015)	.013 (.016)	.028 (.018)	487 (283)	21.8 (5.30)
Treatment * Muslim	.310 (.177)	.023 (.019)	- .426 (.285)		- .277 (.232)	- .283 (.182)	- .404 (.193)	.469 (.160)	- .246 (.155)	.148 (.256)	- 746 (742)	- 13.2 (34.4)
Women's Years Schooling	- .064 (.014)	-.004 (.002)	0.49 (021)		.093 (.014)	.088 (.015)	.098 (.013)	.092 (.013)	.005 (.015)	- .022 (.014)	244 (126)	9.73 (4.02)
Muslim	.252 (.149)	-.020 (.017)	.102 (.189)		.409 (199)	.062 (.146)	.475 (.168)	.456 .140)	.066 (.132)	- .203 (.235)	- 389 (530)	34.8 (27.8)
Village adjacent to Program Village*												
Age 15 to 34	- .223 (.121)	.020 (.011)	.192 (.238)								- 811 (860)	4.34 (24.5)
Age 35 to 54	-.390 (.160)	.003 (.013)	.323 (.299)		.064[a] (.078)	.071 (.107)	.003 (.083)	- .010 (.077)	.208 (.091)	.123 (.104)	- 909 (372)	- 9.22 (23.7)
Age 55 or more	-.216 (.190)	.015 (.022)	.153 (.309)								-746 (357)	- 18.1 (33.7)
Husband's Years of Schooling	- .005 (.010)	-.002 (.001)	.095 (.015)		.093 (.014)	.088 (.015)	.078 (.007)	.071 (.008)	.003 (.009)	.007 (.007)	- 11.2 (33.2)	12.9 (1.66)
Sample Size	5379	5127	4703		1338	1416	1717	2235	1716	1741	5307	5307
R^2	.571	.072	.123		.305	.263	.312	.259	.031	.048	.048	.131

Notes:

* Robust standard errors reported in parentheses beneath regression coefficients. Other variables included in regression but not reported here are women's age dummies, husbands age and age squared, female heads of household married, female heads of household widowed or divorced, female not head and husband absent, variable for missing age or education of husband, five village infrastructure characteristics: Pucca road, distance to sub– hospital/clinic, secondary school in village or next village, BRAC office in village, village has motor boat.

a : Treatment interaction with age collapsed to only a single treatment for all women with children averaged in specified age groups and controls included for child's age average.

. Source: Columns 1-9 from Tables 4, 5, 9 in Joshi and Schultz (2007), Column 10, and 11 from new specification

Table 6: Average Value of Assets of Households in Matlab 1996 MHSS by Average in Program and Comparison Villages and Their Differences

Categories of Household Assets			Married Women Sample Means (1)	Household Sample Total Means (2)	Percent of Total Household Wealth (3)	Program Treated Villages Means (4)	Comparison Villages Means (5)	Treatment Differences Program-Comparison (6)	*t* Statistic of Program Effect (7)	Treatment Difference (6) ÷ Comparison Mean (5)* (8)
1.		Farm Business Assets	113,001	99,260	46.2	104,819	93,612	11,207	2.45	.12*
	A	Agricultural Land	102,716	90,271	42.0	93,739	86,748	6,991	1.64*	.081
	B	Ponds and Orchards	9,393	8,301	3.9	10,334	6,236	4,098	5.94	.66*
	C	Equipment	645	512	0.2	601	422	179	1.48*	.42
	D	Plows	22	18	0.0	17	18	-.63	-0.28*	-.04
	E	Other Farm Bus. Assets	225	158	0.1	128	188	-.60	-0.69*	-.32
2.		Housing, Liquid Assets and Consumer Durables	114,341	99,387	46.3	117,261	81,225	36,036	5.73	.44*
	A	Housing or Homestead	101,309	87,954	40.9	103,741	71,914	31,827	5.40	.44*
	B	Jewelry	3,759	3,084	1.4	3,533	2,629	904	4.40	.34*
	C	Savings Financial Assets	3,407	3,108	1.4	4,005	2,196	1,809	2.53	.82*
		Liquid Assets (B + C)	7,166	6,192	2.9	7,538	4,825	2,713	3.38	.56*
	D	TV	340	307	0.1	476	136	340	5.74	2.50*
	E	Radio	3.26	280	0.1	310	249	61.1	2.30	.25*
	F	Clock/Watch	484	399	0.2	416	382	34.4	1.28*	.09
	G	Fan - Electric	180	163	0.1	242	82.6	160	5.68	1.94*
	H	Cycle	80	86	0.0	1.24	47.1	77.3	2.70	1.64*
	I	Furniture	3,205	2,879	1.3	3,115	2,639	476	2.93	.18*
	J	Quilt	1,106	973	0.5	1,086	858	227	4.83	.26*

Categories of Household Assets			Married Women Sample Means (1)	Household Sample Total Means (2)	Percent of Total Household Wealth (3)	Program Treated Villages Means (4)	Comparison Villages Means (5)	Treatment Differences Program-Comparison (6)	*t* Statistic of Program Effect (7)	Treatment Difference (6) ÷ Comparison Mean (5)* (8)
2	K	Other Consumer Goods	143	153	0.1	213	92	120	2.67*	.56*
		Total Consumer Durables (D - K)	5,865	5,240	2.4	5,982	4,486	1,496	5.07*	.33*
3.		Livestock Total	4,825	4,258	2.0	3,718	4,807	-1,089	- 4.60*	- .23*
	A	Cows and Buffalos	4,091	3,570	1.7	3,023	4,126	- 1,103	- 4.78*	- .27*
	B	Goats and Sheep	303	288	0.1	303	271	32.3	1.70	.12*
	C	Fowl	411	383	0.2	378	388	- 9.83	- 0.75	- .03
	D	Other Livestock	20	18	0.0	14	22	- 8.84	- 3.20*	- .40*
4.		Non-Farm Business Assets Total	14,210	11,933	5.6	12,603	11,252	1,351	0.41	.12
	A	Buildings and Shops	11,121	9,434	4.4	11,437	7,399	4,038	1.82	.55
	B	Rickshaw	95	101	0.1	100	102	- 1.74	- 0.07	- .02
	C	Boats	720	651	0.3	510	795	- 286	- 3.20*	- .36*
	D	Carts	14	14	0.0	11	176	- 6.51	- 0.88	- .37
	E	Fishing Nets	279	253	0.1	240	267	- 27.1	- 0.51	- .10
	F	Spinning Looms	0.2	0.2	0.0	0.2	.4	- .43	- 0.97	- 1.0
	G	Other	1,979	1,478	0.7	305	2,671	- 2,366	- 1.06	- .89
Total Assets			246,377	214,838	100	238,402	190,897	47,505	4.71*	.25*
Sample Size			6,375	4,522	4,522	2,279	2,243	4,522	4,522	–

* significantly different from zero at 5% confidence level according to *t* test : absolute value t <1.69.

Figure 1. Number of Children Ever Born per Ever Married Woman by Five-Year Age Groups in Matlab Health and Socioeconomic Survey 1996, by resident in Program and Comparison Villages

<u>Unconditional Effects of the Program</u>: