PAA Dallas 2010 Session 34 Preliminary Draft February 28, 2010
T. Paul Schultz
Yale University

Direct and Indirect Effects of a Health and Family Planning Quasi Experiment in Matlab, Bangladesh: Gender and Generational Consequences

1. Introduction

Welfare programs exert direct and indirect effects by gender and generation. They may target directly child health, education, family planning, and reproductive health, among other things, and affect other interdependent family outcomes of social importance. For example, improving understanding of and access to birth control may help women reduce their fertility, contribute to the health and education of their children, allow women to allocate more time to activities other than childcare, and accumulate more wealth. Program evaluation studies are rarely able to assess long term lifecycle effects of such programs on those provided local access to program services. In this paper I explore, with the aid of social quasi experiment in Matlab, Bangladesh of a relatively long duration, the effects of a Maternal and Child Health and Family Planning (MCH-FP) Program on some of the program's many objectives, which have gender and generational dimensions, and may have spillover effects beyond the core objectives of the program. Understanding how programs modify the magnitude and distribution of such transfers within the family may help design more effective and equitable programs to alleviate current and future poverty.

A quasi experiment in Matlab, Bangladesh provides the basis for estimating here the long-term direct and indirect effects of a welfare program, but the social experiment also has its limitations, of which five should be noted. One limitation of the Matlab experience is that it starts with family planning, and adds child and maternal health interventions thereafter, and is therefore not a single homogeneous program over time, but an evolving mixture of what were thought to be promising practices in the public health field. Second, of the 141 villages studied here, approximately half were provided an intensive outreach program starting in 1977, whereas all are monitored monthly by a Demographic Surveillance System (DSS) maintained by the International Centre for Diarrhoeal Disease Research, Bangladesh (ICDDR,B). However, the villages were grouped into six contiguous blocks (A, B, ..., F), and the first four blocks were singled out for the intensive program.[1] This clustering of villages into the geographical design of

* This research is supported by a grant from the MacArthur Foundation. Comments welcomed on this preliminary draft. Errors and opinions are only my own. <paul.schultz@yale.edu>.

[1] The extensive literature describing this innovative program does not discuss the motivation for the geographic clustering of treatment and control villages, and how it might have reduced information diffusion of program technologies between geographic areas.

the program intervention raises the question whether the assignment of villages between the program and comparison areas occurred independently of other factors that affect the family welfare outcomes and economic development. A third issue is the 19 year duration of the social experiment, from 1977 to 1996. To document the similarity of populations in the program and comparison villages before the program started, Joshi and Schultz (2007) examined a preprogram population census collected in 1974, in which child-woman ratios for villages approximate surviving fertility, and they are shown to not differ significantly between program and comparison villages, while the education of adults and children are also very similar.[2] Fourth, improvements in access to birth control and child and maternal health services can benefit men and women, sons and daughters differentially, and impact life cycle opportunities and consequent behavior in a variety of ways across these demographic groups. Although the direct and indirect effects on the family are revealed fully only when the children reach maturity and the parents in their old age realize fully the possible support of their children, many of these burdens and benefits of family transfers are expected to be evident after 19 years, as reflected in a NIH funded 1996 representative Matlab Health and Socioeconomic Survey (MHSS). Women will have reallocated their time released from child care due to having fewer births, and their surviving children, many born before the program started, will have completed their schooling and begun to engage in adult activities, indicative of their lifetime trajectory. Fifth, an analysis of a 19 year panel raises the likelihood that inter-village and inter-regional migration and mortality might differ between program and comparison areas and could bias estimates of program effects within the remaining families. Long-run intergenerational consequences of this program should therefore be ultimately adjusted using data on migration and mortality to correct for potential attrition or selection bias. As noted later, this final limitation of the quasi experiment is the most difficult to assess from the available data.

2. A Framework for Study of Life Cycle Choices Made by Parents

A couple who values their consumption today and their expected consumption opportunities in the future is likely to value having children today in part because those children are one way to insure the parent's consumption requirements in future periods, especially if the parents become disabled or find themselves in poor health. These child services would then represent for parents a partial substitute for their life cycle savings in the form of physical capital. This trade off is formalized by Samuelson (1958) in an overlapping generations (OLG) framework. Parents may also consider human capital investments in their children, such as health, schooling, and migration, which are costly but are expected to increase the children's productivity as adults, and may spillover to also improve parent consumption and utility in the future, e.g. Becker and Lewis (1974). Parents may then balance their expected returns, adjusted for risk, to these three lifecycle assets:(1) physical savings, (2) numbers of children, and (3) child quality, components

[2] The notable feature that differs between the program and comparison villages in 1974 (and thereafter) is the proportion Muslim/Hindu, and this characteristic is therefore included as a control variable in subsequent comparisons, to allow for possible heterogeneity in response to the program within these two ethnic groups (Joshi and Schultz, 2007).

of their portfolio of "social wealth". Home and market production technologies, and the preexisting aggregate supplies of the physical capital, population, and human capital should affect market returns to these three assets, other things being equal. To assess how these returns influence family behavior, a researcher wants to observe variation in these asset returns that is attributable to factors operating independently of the family's prior endowments, preferences, and choices. Unfortunately, such exogenous variations in these relevant returns are difficult to measure for each market area, village, or family. However, some constraints may be observed that are expected to impact systematically returns to these various types of wealth, such as the distance to and hence time costs to attend school or to obtain services at a local family planning clinic. If these community services or their shadow prices can be thought of as exogenous or independent of parent preferences or unobserved determinants of family behavior, these indicators of access to local service programs may help to estimate the effects of social welfare programs on the social wealth portfolio held by families. These shadow prices may affect directly parent demand for one class of wealth, and may also provide estimates of these indirect-effects of this prices on the demand for the other two assets, or cross-price effects. However, cross sectional and time series variation in asset returns driven by the placement and timing of social welfare programs and policies may be correlated with other determinants of health status, as well as the time allocation of family members, and consequently access to programs may not be an ideal or even valid instrument for only the variation in asset returns.

Parents presumably view these three assets as substitutes for each other, and cross-price effects would then be positive, if income effects can be adequately controlled. Then, an exogenous decrease in returns for one asset, say children due to the decline in price of birth control, would encourage parents to invest in more human capital per child, and also possibly to save more in physical capital over their life cycle, holding constant for lifetime initial wealth, education, or inheritance. It is common to hypothesize today that human capital and physical capital are complements in the aggregate economy. The secular increase in wage returns to schooling in the 20^{th} Century can then be attributed to the deepening of physical capital, and potentially linked to the decline in fertility and slowing of population growth (e.g. Jorgenson, 1995: Gaylor and Weil, 2000; Acemoglu, 2002; Lucas, 2002; Goldin and Katz, 2009).

Fertility Response to Exogenous Changes in Mortality

Empirical research on these trade offs in parent portfolios could start by observing developments that seem likely to drive independently variation in the returns to these three life-cycle asset classes. The response of fertility to child and adult mortality has been postulated by biological and social scientists, and in cross sectional data fertility and child mortality tends to be positively related, and even over time they are often positively related. However, health and survival are responsive to individual behavior and family socioeconomic resources and constrained by social institutions. The consequences of investments in health appear persistent, suggesting a form of human capital affected by individual and parent choices (Grossman, 1972), and schooling and health outcomes of children and parents are also positively correlated, and this intergenerational relationship has become known as a socioeconomic gradient in health (Lleras-Muney, 2005; Case, et al, 2005).

The decline in mortality that is associated with the onset of the demographic transition occurs for various reasons, some of which may be outside the control of families. How fertility responds to such exogenous variation in mortality remain difficult to assess, because there is no consensus on what instruments are correlated with only these exogenous sources of variation in mortality or idiosyncratic health shocks. Changes in the age composition of aggregate populations can be related to the timing and pace of the demographic transition (Coale, 1982). However, these changes in age composition correspond to not only the exogenous determinants of the mortality regime, but also family and individual behavior, and of course most importantly the reduction in fertility. Consequently, the changes in age composition cannot be treated as if they were exogenous developments that might perturb the supply of savings and thereby impact economic growth independently of other family and institutional changes. To assess the impact of exogenous factors which might modify the age specific schedules of mortality and fertility requires an understanding of the behavioral determinants of these demographic outcomes and ultimately in measures of external shocks which have changed the frequency of births and deaths. To assume in cross country comparisons that changes in age composition occur independently of other socioeconomic developments is not an appealing approach to explain the rate of capital accumulation, savings and economic growth (Higgins and Williamson, 1997; Bloom and Williamson, 1998). To regard fertility and child and adult mortality as all exogenous has been questioned for some time, even if these demographic processes are replaced by changes in the age composition.

Advances at various times in medical technology and public health have spurred global public health interventions that have made strides in controlling the spread and improving the treatment of specific diseases. The timing of these advances in medical and public health technology in combination with the preexisting share of deaths in a country caused by various specific infectious diseases (i.e. before the demographic transition) may help to explain the timing of country-specific reductions in mortality (Acemoglu and Johnson, 2006). Yet disease-specific cause-of-deaths are not reliable for most poor countries, and are available for only a handful of low income countries in 1940 who may be unrepresentative (Preston, 1976). At the start of the demographic transition in low income countries, most of the initial reduction in mortality is due to declines in infant and child mortality. Many studies suggest declining child mortality contributes within a generation to declining fertility, and perhaps increasing child schooling. But relationships estimated with causal identification are rarely estimated among these variables at the family level. Whereas at the aggregate country level omitted variables affecting both mortality and fertility outcomes are likely to be a serious source of bias when attempting to estimate these relationships between fertility and mortality, even when fixed effects for each country allow for persistent factors and time periods are also allowed to vary (Schultz, 1981, 1997, 2009). There are still some suggestions that disease specific technical changes helps to account for increases in the expectation of life at birth from 1940 to 1980. Because these early declines in mortality are largely among infants and children, it is not surprising that they are associated with population growth but not with aggregate growth in income per capita (Acemoglu and Johnson, 2006).

Fertility Response to the Productivity and Schooling of Women and Men

Another widely observed correlate of fertility is female schooling, where better educated women tend to have fewer children, even though fertility differences by female education have diminished in high income countries as have other socioeconomic characteristics, such as religion and race in the United States. Mincer (1963) proposed the interpretation of this inverse relationship as the effect of the price of children on the number demanded, based on the observation that women supply in most societies the lion's share of the time allocated to child care. Consequently, when women's schooling increases, and their wage rates tend to rise, the opportunity cost of having an additional child increases, and fertility declines. Within industrially advanced OECD countries for which household surveys were readily available after the second world war this empirical pattern was common (Mincer, 1985, Schultz, 1981). Most aggregate models of growth neglect the gender distinction in schooling and wages in their accounting for demographic and economic change. For example, Becker and Barro (1988) or Gaylor and Weil (2000) focus on the reduction in fertility due to the increase in average wage (of men and women). Micro evidence from household surveys in low income countries, however, is consistent with Mincer's conjecture of a negative correlation between the mother's fertility and her schooling, as a measure of her wage opportunities, whereas the available data suggest that the (partial) correlation between the husband's schooling and fertility is either insignificant or even positive in sign (Schultz, 1981, 1997).[3] Cross country regressions also find female schooling is inversely related to fertility, whereas male schooling is less closely related to women's fertility, or when controlling for women's schooling the male schooling may be positively partially related to fertility. Fertility may be measured either as an age standardized total fertility rates per woman (a synthetic period rate) or as the number of children ever born per woman to a birth cohort of women (Schultz, 1981, 1994, 1997). Thus, increased female schooling attainment relative to male schooling is an inverse predictor of fertility. But few hypotheses are advanced and test to account for the pressures from the family's environment that might initiate the closing of the gender gap in schooling, the pace of this change across developing countries (Schultz, 1995). The focus on women's and men's market oriented human capital that Mincer linked to gender specific time allocation in the household and fertility has not found its way into most cross country studies of modern economic growth and the demographic transition. In this literature, mortality is generally assumed to be exogenous, adult average schooling is either assumed exogenous or driven by the ratio of capital to output, leading to the conclusion that rising labor productivity depresses fertility, raises somehow female schooling and their labor force participation, and increases economic growth, without reference to gender specific schooling, wages, or ultimately empowerment of women in household production (e.g. Bongaarts, Mauldin and Phillips, 1990; Barro, 1997; Angeles, 2010).

[3] Fertility is more readily attributed to mothers than to biological fathers. Representative samples thus collect information readily only on mothers and currently coresident fathers or partners, or information volunteered by mothers on their previous partners. Most studies of the association between father's endowments and behavior and fertility are thus based on selective samples of individuals. This blind spot in fertility data may provide one justification for the analysis of population aggregates, which are thought to span both sides of the "marriage market".

3. Family Consequences of the Child Maternal Health and Family Planning Program in Matlab, Bangladesh

Some household models of the demand for children predict that women's productivity is likely to curb the demand for births, whereas the productivity of men will have a less negative and perhaps positive effect on fertility, depending in part on the extent to which men's income is enhanced by their access to child labor in the family (Schultz, 1981, 1997). Schooling will therefore be controlled in the subsequent regression for both wives and husbands as indicators of productive potential as young adults. Vocational skills accumulated by women after schooling may be facilitated if they are able to control their fertility and have fewer and better timed births, if this variation in fertility is due to a quasi experimental program that reduces their overall psychic, time and monetary costs of birth control. The spacing and controlling of births may also improve woman's health, increase her access to nutrition with the increase in family's per capita resources, and thereby enhance further her labor productivity. Thus, the inverse relationship between fertility and women's wage opportunities can be reinforced through feedbacks over the life cycle, even after controlling for initial schooling of the woman.

Social scientists have frequently speculated that child quantity and quality, proxied by the schooling or the health of children, are to some degree substitutes for parents (Becker and Lewis, 1974). The most common way to test this hypothesis that they are substitutes, even though both are endogenous choice variables in the family, is to observe how the quasi experiment of twins affects the educational attainment of siblings (Rosenzweig and Wolpin, 1980, Rosenzweig and Zhang, 2008). Although the method for testing for this trade-off differs slightly between studies, those in low income countries tend to confirm substitution, probably because a child's opportunity cost of time in school remains an important deterrent to parents sending their children to school(Schultz, 2008, 2009a).

In the first four years of the MCH-FP project in Matlab the community health workers were involved mainly in promoting family planning services (Fauveau, 1994: p.92). Home visits by the health workers with all married women of childbearing age every two weeks were designed to provide information and birth control supplies. The use of modern contraception increased more rapidly in the program villages than in the comparison villages and fertility declined more rapidly (Phillips, et al. 1982; Koenig, et al., 1987). The question investigated in this paper is whether this quasi-experimental decline in fertility in the program villages is also associated with increasing women's wage opportunities conditional on their schooling, especially for women at an age when they have begun to restrict their fertility and the program is expected to have had its most pronounced effects, first on fertility, and then on maternal and child health, and finally on the family's investment in child schooling, and accumulation of physical assets.

Any effect of the program increasing child health and survival could also be interpreted as consistent with parents treating child health and number of children as substitutes. In this case, however, the MCH-FP program also has many missions that involve directly improving the health and survival of children, as well as encouraging birth control, including inoculations of women with tetanus toxoid, early adoption of measles and other childhood vaccinations, the distribution of oral rehydration salts to treat childhood diarrhea, and physical growth monitoring of young children with compensatory diet supplementation where growth appeared to be retarded. A form of reinforcing feedback may again occur, as improved child health further reduces fertility as parents are less motivated to raise their fertility to compensate for anticipated child mortality.

A third form of parent social capital is physical capital accumulation, which is extensively surveyed in the MHSS in 1996 and the respondents are asked to estimate the current value of their many assets. Agricultural business assets, including predominantly agricultural land, represents 46 percent of the average household assets per adult, whereas housing and consumer durables represents another 43 percent, leaving relatively small amounts held as financial assets, jewelry, livestock and nonfarm business assets (Schultz, 2009b). It has been conjectured that children are substitutes for life cycle savings in the form of physical and financial capital, but there are few empirical studies of this relationship, and none I know of which tries to deal with the joint determination of fertility and life cycle savings, or the endogeneity of fertility. I propose here to rely on the MCH-FP program to identify exogenous variation fertility, and thereby evaluate the induced response to the program in physical capital accumulation.

If the MCH-FP program in Matlab decreases completed fertility, as is widely concluded from registration data from the first few years of the program (Phillips et al, 1982; Fauveau, 1994), it may have subsequently increased women's health and productivity, increased child health and schooling, and augmented physical capital formation, as I have speculated above. Thus, there are many potential channels through which such a community health and family planning program may influence life cycle behavior and outcomes. Many of these substitutions and adjustments in family accumulation and investment behavior may contribute to what is typically associated with economic development, in addition to the effect that decreasing fertility may have on the number of workers in this district with its extremely inelastic supply of arable land, due to the Malthusian aggregate effect of diminishing returns to labor. It is not clear which of these substitution responses to exogenous declines in fertility within the intergenerational family are significant, or how they might be compared in terms of advancing development priorities in Matlab.

4. Unconditional Difference between Program and Comparison Populations

If the population characteristics and socioeconomic conditions in the 71 villages which were provided the MCH-FP program in 1977 were statistically no different from the comparison 70 villages, and exogenous shocks experienced by the two areas were similar for the subsequent 19 years before the Matlab Health and Socioeconomic Survey (MHSS) was collected in 1996, differences between the two areas in indicators of lifecycle behavior and family transfers after 1977 could be attributed to the program intervention. Joshi and Schultz (2007) report that in a preprogram population census collected in 1974, the ratio of children under age 5 to women age 15 to 49, one indicator of surviving fertility rates, is not statistically different between the program and comparison areas. Other indicators of family resources and behavior also do not appear to differ at the village level in the rudimentary 1974 census , such as years of schooling completed by adults age 15 and older, and schooling of children age 6 to 14. The 1974 census does not report values of earnings, or assets, but available household characteristics do not differ. In a 1982 census the land owned by households and the fraction landless, critical indicators of wealth, are reported and they do not differ significantly at the village level between the two regions, whereas surviving fertility measured by the child-woman ratio in 1982 is significantly 18 percent lower in the program villages, and remained 16 percent lower 14 years thereafter in 1996. The ratio of children age 5 to 9 to women age 15 to 49 was also the same in 1974, and had not declined from 1974 to 1982, but had decreased 23 percent by the 1996 MHSS. One notable difference between the village averages in the program and comparison area is the share Muslim, which is 80 percent in the program areas and 88 percent in the comparison areas in 1974. Since this ethnic difference is related to many socioeconomic behaviors and outcomes, being a Muslim is included among the control variables in some of the regression reported. Under the working assumption that any emerging differences in characteristics of the populations in the two regions are due to the MCH-FP program, the next step is to estimate reduced-form type equations to account for lifecycle behavior and family transfers derived from the MHSS.

The first column in Table 1 shows the unconditional difference in the number of children born per ever married woman between the program areas and the comparison areas in the 1996 MHSS which is -.500, where the overall average fertility is reported at the bottom of the table 2 as 4.98 births. The second regression adds control variables for seven five-year age groups of women, from age 15 to 24, to 50 to 54 , and women age 55 and over. The partial association with the program is essentially unaltered by this adjustment for age composition. Economic models of fertility postulate that female schooling could affect the demand for children, because it would increase their productivity and the wages of women in the labor force, raising the opportunity cost of additional children, which would offset the income effects associated with her increased productivity. A woman's schooling may also increase her knowledge of birth control and modify her attitudes toward this birth control, which might make her more likely to adopt birth control, holding constant for her demand for births. Husband's schooling, on the other hands, is expected to simply increase household potential income and thereby add most likely to the demand for children, without raising the opportunity cost of children. The implicit assumption is that husbands spend less of their time caring for children and managing their nutrition and health than do their wives. As expected column (3) in Table 1 shows that a year of additional schooling for the mother is associated with .083 fewer children, whereas an additional year of husband schooling is partially related to .020 more births. However, controlling for these small, but significant, effects of parent schooling on fertility do not change substantially the partial effect of the program, which remains essentially half a birth, -.48.

Muslim fertility is on average about half a child more than Hindus, and a control for this ethnic characteristic is included in Column 4 along with features of household composition that are plausibly related to fertility. But people make choices about who resides together and household composition may be affected by unobserved constraints that could also affect fertility, and thus are endogenous. For example, the gap between the age of the husband and wife at marriage is controlled by including a quadratic in the husband's age, whether she is household head and widowed, or she is a household head and her husband is a migrant and probably remitting to her income, or she resides without her husband and is not the head of her own household, a lower status arrangement overall. Including these household composition characteristics reduces further the program's partial effect on fertility to -.42 children. Column (5) adds to the regression five characteristics of the village in which the woman resides that could influence (1) public transportation, or (2) distance to family planning and clinical health care, (3) to a secondary school in the village or a contiguous village, (4) to a village motor boat which provides a key form of transportation in the rainy season, and (5) a Bangladesh Rural Association Cooperative office that extends micro credit oriented to women and as well as encouraging family planning, child health care and schooling. These village control further reduce the partial regression coefficient on the program in the village, but may over adjust if household composition and village infrastructure variables are also impacted by the MCH-FP program in the village.

Finally, column (6) includes interactions between the program access variable and the woman's age, motivated by biological and behavioral considerations. Birth control appears to be adopted primarily in the later stages of a woman's life cycle when she has the number of births she wants (Koenig et al.,1989), and therefore the program impact on fertility is significant only after a woman reaches age 25. However, among women over age 55 in 1996 who were over the age of 37 when the program started, would have very few additional births even in this high fertility area, and the program had no significant effect on completed fertility of these older women. For example, women 45 to 49 have .98 fewer children in the program villages than in the comparison villages, whereas for women 50 to 54 residing in a program village is associated with .59 fewer births on average. The last regression reported in column (7) of Table 1 is a preferred specification that removes the controls for the potentially endogenous household composition variables and the village infrastructure variables. This final column (7) regression specification becomes the benchmark for the reduced-form estimates in the second regression in Table 2 that controls for the age of the woman, age-program interactions, and the schooling she has obtained and the schooling of her husband, whereas the first row reports the unconditional program effect.

5. Program Association with Intergenerational and Gender Transfers and Outcomes

The first row of Table 2 reports the unconditional regression coefficient for the program on four indicators of the woman health and productivity, three indicators of the children's human capital, and the arithmetic and log transformation of the household's physical capital per adult. The hypothesis is that the program facilitates women's control of the timing of their reproduction and production of family health which allows them to invest more of their time and resources in acquiring vocational skills that raise their productivity.

The MHSS reports three indicators of the woman's health: whether she categorizes herself as "currently healthy", a summary index of functional limitations in performing activities of daily living, and a nutritional Body Mass Index (BMI) defined as weight (in Kg.) divided by height (in Meters) squared. Only BMI of these three health indicators is significantly associated with village access to the MCH-FP program, but BMI is a justified summary objective indicator of health in this population (Joshi and Schultz, 2007). The frequency of malnutrition among women in Matlab is very high making shifts in the lower tail of the distribution of BMI important for health. About half of the adult female population is malnourished by WHO standards; the average BMI for women in the comparison villages in 1996 is 18.4. Menken, et al. (2003) estimate the hazard of dying for women in Matlab from 1975 to 1996, and finds reproductive age women (16-54) are 17 percent less likely to die if their BMI is one unit higher. A woman's BMI is therefore interpreted here as an informative indicator of the program's impact on women's health and longevity. Women's BMI is unconditionally .58 units higher in villages with the program, and this coefficient is estimated precisely (t = 18.6). As with fertility reduction itself, it may be hypothesized that the gains to women's nutrition and health associated with the program would also be concentrated among those middle aged and older women who are most likely to have reduced their fertility due to the program intervention. The pattern of first differenced changes in BMI by age estimated in the second regression in the first column in Table 2 implies the program impact on BMI increases to .93 units for women age 40-45. It may be noted that the woman's BMI is also significantly larger for better educated women, and for women with better educated husbands.

The program associated improvement in women's BMI is expected to increase women's health and productivity. Productivity is only observed, however, for women who engage in paid work in 1995, and this occurs for only 31 percent of the MHSS sample (i.e. 1639/5307). Among women reporting earnings per month worked, this average "wage" is 2512 Taka higher in program than in comparison villages, first row column 3 in Table 2. These wages are significantly higher for women between the ages of 35 and 49, an age when their earlier adoption of birth control in the program villages would have facilitated their investment of more time in vocational training, adding to their human capital, productivity and wages. Repeating this wage regression in the more conventional semi-logarithmic specification (Mincer, 1974), the program is associated in column 4 with women's log wages being .47 higher overall (60 percent). In the semi logarithmic specification by age, the program is associated with log wages being .31 to .54 larger, from age 30 to 34 to 45 to 49, respectively. These are very large wage gains which are not evident for males age 25 to 54, or younger women and men (Schultz, 2009b).

It is observed in high income developed countries that as fertility decreases married women tend to increase their participation in paid work, at least from the middle of the 20th Century (Mincer 1985). This does not appear to be the case in Matlab, however, where the participation in paid work by women ("part" in column 2, Table 2) does not generally differ between program and comparison villages, and among those women age 50 to 54 may even be lower in the program areas. It is also notable that better educated women in Matlab are less likely to participate in paid work, although their monthly wages tend to be about 16 percent (log specification) higher for each additional year of schooling. Elsewhere, I have estimated a structural model to correct for potential sample selection bias in the subsample of wage earners, by excluding from the wage equation two measures of household productive agricultural assets, namely, whether the household is landless, and the value of any agricultural land. The selection-corrected wage effects of the program remain .30 on log wages and significant for women age 25 to 54, but not significant for men age 25 to 54, or for young males or females (Schultz, 2009). Women age 25 to 54 who confront higher wage offers in the program villages of Matlab are however less likely to work for wages.

The association between the program and the human capital of children is first documented in terms of the decline in the death rate children experience before their fifth birthday (mean .137, column 5, Table 2). The unconditional association is for the program to reduce the child death rate by about a fourth, or -.0347 / .137. In this case, the interactions of the child survival effect with mother's age are statistically significant for mothers between the age of 30 and 39, and 45 and 55 and over. As expected the schooling of mother and father is partially associated with lower child mortality, and the impact of mother's schooling is larger than that of the father's schooling. Little of the variance in child mortality is explained by this simple reduced form regression (.069), in contrast with that for fertility (.545), or even women's BMI (.114).

The years of schooling completed by children age 6 to 14 by sex are normalized within the sample as a Z score. In other words, the child's education is expressed as deviation from the sample mean for a child of that age and sex and divided by the standard deviation of that variable in the sample (column 6-7. Table 2). The sample sizes are only a third of the total given the restrictions to children of a specific age and sex, and if the woman has more than one child of the same sex between the ages of 6 and 14, they are averaged. The program is associated with a .17 standard deviation larger overall schooling score, and with a .23 standard deviation larger schooling score for boys. In the second reduced-form specification, allowing for program-age interactions, these interactions are not significant for girls, but are significant for boys at the 10 percent level for mothers age 30 to 49. The schooling of the mother and father are significantly associated with the schooling of their daughters and sons, as would be expected.

The household assets per adult (column 8, Table 2) are expressed in thousands of Taka, and appear to be 62 (thousand) larger in program villages than in comparison villages in 1996, and this difference is .16 when assets are expressed in logarithms with the 7 households reporting no assets attributed a minimum of one (thousand). The program effects by age of mother are positive and significantly different from zero for all aged groups except mothers age 45 to 49. In logarithms the regressions suggest significance in program effects occur only within the group of women age 35 to 44, when we might have expected reduced fertility would have begun to allow families to accumulate more assets. The differences in household assets in the entire sample are strongly increasing in age over the life cycle (not reported), and the individual variation is substantial, reflecting either substantial personal inequality or errors in reporting, and more likely both. The coding of land areas owned and the valuations per unit of land area owned appear to diverge from that described in the coding instructions, which makes one cautious on assigning too much confidence in the survey household asset figures, especially given the importance of agricultural land in the total assets held by the predominantly self employed farm households residing in Matlab.

6. Conclusions

With only one program treatment, and one time period for measuring health, earnings and assets in the 1996 MHSS, it is not clear how to describe in more detail the various consequences of the

MCH-FP program might have affected families in Matlab. BMI and wages of women age 25 to 54 increase markedly 15-20 years after the program started, and child mortality declines substantially. What fraction of these changes is due to distinct efforts to disseminate birth control or child and maternal health interventions remains unclear. The increases in schooling of the children are substantial, and favor somewhat boys to girls, but the child mortality is more difficult to disaggregate by sex and age given the low explanatory power of the rudimentary empirical fit of child death rates. Household assets per adult are larger in program areas in 1996, but given the variability in assets, the irregular age pattern of program effects, and the declining share of assets attributable to the program, it is appropriate to encourage further study of the components of assets, some of which may be better measured than others. Finally, one can hope that the new resurvey of the Matlab sample which is to be funded by NIH will help define more precisely these longer run consequences of a remarkable social experiment.

One approach to a jointly determined set of behavioral outcomes that are conditioned on a common set of variables (often referred to as Seemingly Unrelated Regressions (SURE)), where one expects the unexplained disturbances across deterministic equations for these several outcomes could be driven by common unobservables. One such unobservable is couple fecundity. To consider the covariances among the empirical residuals in reduced form regression estimates in Table 2, it may be informative to ask how important are shocks to the demographic transitions experienced at the family level, and how are they resolved. How do programs such as MCH-FP in Matlab mitigate these repercussion? An unexplained shock of one extra child (residual from regression for children ever born) is correlated more strongly with the residual from the child death rate (.361) than any of the other. Many questions to explore, but the relative magnitude of the life cycle and intergenerational effects in the MCH-FP program suggest that it would be myopic to treat such rural health program interventions as primarily a means to slow population growth and alleviate population pressure. At least as important are the consequences for women’s health and productivity, the improvements in child health and survival, and the schooling attained by the next generation.

References:

Angeles, Luis, 2010, "Demographic transition: analyzing the effects of mortality on fertility", Journal of Population Economics, 23(1): 99-120.

Acemoglu, Daron, 2002, "Technical change, Inequality and the Labor Market", Journal of Economic Literature, 40(1): 7-72.

Acemoglu, Daron and S. Johnson, 2006, " Disease and Development: The effects of life expectancy on economic growth", Journal of Political Economy, 115(6):925-985.

Barro, Robert J., 1997, Determinants of Economic Growth: A Cross Country Empirical Study, MIT Press, Cambridge MA.

Becker, Gary S. And R. J. Barro, 1988, "A reformulation of the economic theory of fertility", Quarterly Journal of Economics, 103(1): 1-25.

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

Bloom, David and J. Williamson, 1998, "Demographic Transition and economic miracles in emerging Asia", World Bank Economic Review, 12(3): 419-56.

Bongaarts, J., P. Mauldin, and J. Phillips, 1990, "The demographic impact of family planning programs", Studies in Family Planning , 21: 299-310.

Case, Anne, A. Fertig, and C. Paxson, 2005, "The lasting impact of childhood health and circumstance", Journal of Health Economics, 24: 365-389.

Coale, Ansley J., 1972, Growth and Structure of Human Populations,: A Mathematical Investigation, Princeton NJ: Princeton University Press.

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

Gaylor O. and D. Weil, 2000, "Population, Technology and Growth: from Malthusian stagnation to the demographic transition and beyond", American Economic Review, 90(4): 806-828.

Goldin, Claudia and L. F. Katz, 2008, The Race between Education and Technology , Harvard University Press, Cambridge MA.

Grossman, Michael, 1972, The Demand for Health, New York: Columbia University Press, NBER Occasional Paper 119.

Higgins, M. And J. G. Williamson, 1997, "Age Structure Dynamics in Asia and Dependence on Foreign Capital", Population and Development Review, 23(2): 261-294.

International Centre for Diarrhoeal Disease Research, Bangladesh (ICDDR,B), 2004, Health and Demographic Surveillance System- Matlab, vol 35, Registration of Health and Demographic Events, 2002, Scientific Report No. 91- September 2004. Dhaka, Bangladesh.

Jorgenson, Dale W., 1995, Productivity, Vol.1: Postwar U.S. Economic Growth, Cambridge, MA: MIT Press.

Joshi, Shareen, and T. P. Schultz, 2007, "Family planning as an investment in development: Evaluation of a program's consequences in Matlab, Bangladesh", Economic Growth Center discussion paper 951, Yale University, New Haven CT.

Koenig, M.A., J. F. Phillips, R.S. Simmons, M.A. Khan, 1987, "Trends in family size preferences and contraceptive use in Matlab, Bangladesh", Studies in Family Planning, 18(3): 117-127.

Koenig, M.A., V. Fauveau, A.I. Chowdhury, J. Chakraborty, and M.A. Khan, 1988, "Maternal Mortality in Matlab, Bangladesh: 1976-85", Studies in Family Planning, 19(2)): 69-80.

Lleras-Muney, Adrianna, 2005, " The relationship between education and adult health in the United States", Review of Economic Studies, 72: 189-221.

Lucas, Robert E. Jr. 2002, Lectures on Economic Growth, Cambridge MA: Harvard University Press.

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

Menken, Jane and J. F. Phillips, 1990, "Population Change in a rural area of Bangladesh, 1967-87", Annals of the American Academy of Political and Social Science, 510: 87-101.

Mincer, Jacob, 1963, "Market prices, opportunity costs, and income effects" in Measurement in Economics, Edited by C. Christ, et al., Stanford CA: Stanford University Press.

Mincer, Jacob, 1974, Schooling, Experience and Earnings, New York: Columbia University Press,

Mincer, Jacob (ed.), 1985, "Trends in Women's work, Education and Family Building", Journal of Labor Economics, 3(1, part 2): S1-S396.

Muhuri, Pradip, 1995, "Health Programs, Maternal Education and Differential Child Mortality in Matlab, Bangladesh", December, ICDDR.B. Dhaka, Bangladesh.

Phillips, J.F., W. Stinson, S. Bhatia, M. Rahman and J. Chakraborty, 1982, "The Demographic impact of Family Planning-Health Services Project in Matlab, Bangladesh," Studies in Family

Planning, 13(5): 131-140.

Rahman O., 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).

Rosenzweig, Mark R. and K. I. Wolpin, 1980, “Testing the quantity-Quality Fertility Model”, Econometrica, 48(1): 227-240.

Rosenzweig, Mark R,. and J. Zhang, 2008, “Do population control policies induce more human capital investments? Twins, birthweight and China’s one-child policy” Review of Economic Studies,

Preston, Samuel H., 1976, Mortality Patterns in National Populations, New York: Academic Press.

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

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

Schultz, T. Paul, 1994, “Human capital, family planning and their effects on Population growth”, American Economic Review, 83: 255-260.

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

Schultz, T. Paul, 1997, “The Demand for Children in Low Income countries, “ Handbook of Population and Family Economics, Vol 1A, (eds.) M.R. Rosenzweig and O. Stark, Amsterdam: North Holland Pub Co.

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, Chap. 52, Amsterdam: North Holland, Elsevier Pub.

Schultz, T. Paul, 2009a, “Population and Health Policies”, Economic Growth Center Discussion paper No. 974, Yale University, New Haven CT.

Schultz, T. Paul, 2009b, “How Does Family Planning Promote Development?: Evidence from a social Experiment in Matlab, Bangladesh, 1977-1996", unpublished papers, Yale University.

van Ginneken, J., R. Bairagi, A. De Francisco, A. R. Sarder, and P. Vaughan, 1998, Health and Demographic Surveillance in Matlab: Past, Present and Future, International Centre for Diarrhoeal Disease Research, Bangladesh, (ICDDR,B) Dhaka, Bangladesh. Special Pub. No. 72.

Table 1

Children Ever Born for Married Women in Matlab Health and Socioeconomic Survey, 1996[a]

Explanatory Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	Means (Standard
1. Program Village Effects (without controls and for all women)	-0.500 (5.04)	-0.495 (6.53)	-0.482 (6.82)	-0.424 (6.53)	-0.366 (4.07)			0.505
2. Program Village Effect for Specific Age *Age 15 - 24						-0.0024 (.02)	-0.102 (1.34)	0.048[b]
*Age 25 - 29						-0.250 (2.04)	-0.363 (3.79)	0.062
*Age 30 - 34						-0.592 (4.28)	-0.695 (5.41)	0.078
*Age 35 - 39						-0.492 (2.90)	-0.625 (3.78)	0.066
*Age 40 - 44						-.803 (3.93)	-.995 (5.43)	0.051
*Age 45 - 49						-0.976 (3.81)	-1.07 4.28	0.045
*Age 50 - 54						-0.592 (3.00)	-0.691 (3.43)	0.047
*Age 55 +						0.141 (0.95)	0.059 (0.52)	0.107
Woman's Years Schooling			-0.0829 (7.75)	-0.0702 (6.63)	-0.0679 (6.39)	-0.0688 (6.37)	-0.0816 (7.76)	2.09 (2.87)
Husband's Years Schooling			0.0203 (2.16)	-0.0054 (.54)	-0.0066 (.66)	-0.0051 (.50)	0.0218 (2.31)	3.02 (3.84)
Missing Husband Schooling			0.123 (1.27)	0 (.00)	0.0066 (.06)	-0.0008 (.01)	0.0127 (1.33)	0.07
Age controls (7)[c]	N	Y	Y	Y	Y	Y	Y	
Household Composition, Husband Age, Muslim Controls (7)[d]	N	N	N	Y	Y	Y	N	
Village Infrastructure Controls (5)[e]	N	N	N	N	Y	Y	N	
Constant	5.24 (72)	1.25 (23.6)	1.48 (22)	1.09 (6.71)	1.10 (5.44)	0.888 (4.15)	1.28 (18.6)	4.98 (2.90)
R^2	0.0074	0.537	0.540	0.562	0.563	0.568	0.545	
Sample Size 5307								

Variable descriptions reported in Joshi and Schultz 2007 (Table 3).

[a] Strata 1 and 2 samples from MHSS.

[b] Binary dummy variable for which standard deviation is √m*(1-m), where m = mean.

[c] 8 Age dummies as with program*age interaction. Reference group exluded is age under 25, captured by constant in reg (2) to (7).

[d] 7 Controls for muslim, husband age quadratic, husband age missing, married or unmarried female head, husband absent, and not female head.

[e] 5 villages have paved road, distance to sub hospital, secondary school, village motor boat, and BRAC in village.

Table 2
Program Local Treatment Effect, and Conditional on Age of Woman and Couple's Schooling in 1996

Dependent Variable	Woman Effects				Children Effects			Household Assets Per Adult (in thousands)		Children Ever Born	Children Alive
	BMI	Wage Work	Monthly Wage		Death Rate 5	Schooling Z-Score					
			Taka	Log		Girls	Boys	Taka	Log		
Program Village (no controls all women)	.578 (18.3)	-.033 (.99)	2512 (1.89)	.473 (3.01)	-.0247 (5.11)	.169 (2.20)	.225 (3.22)	62 (3.05)	0.156 (1.67)	-0.500 (5.04)	-0.252 (3.21)
*Age 15 - 24	0.032 (.17)	-0.051 (1.39)	2793 (1.56)	0.401 (1.40)	-0.029 (1.42)			42.7 (1.95)	.0564 (.46)	-.102 (.60)	-.508 (.89)
*Age 25 - 29	0.455 (2.28)	0.011 (.24)	-2734 (.99)	0.220 (1.02)	0.017 (1.25)	0.346 (1.91)	-0.291 (1.34)	73.5 (3.15)	.144 (1.08)	-.363 (2.37)	-.362 (4.23)
*Age 30 - 34	0.528 (2.94)	-0.086 (1.53)	2847 (1.58)	0.308 (1.83)	-0.025 (2.35)	0.008 (.08)	0.168 (1.84)	51.7 (2.65)	.0335 (.30)	-.695 (4.96)	-.502 (4.89)
*Age 35 - 39	0.675 (2.77)	-0.006 (.12)	2482 (1.88)	0.389 (2.10)	-0.033 (3.24)	0.114 (1.35)	0.068 (1.74)	53.8 (2.19)	.234 (2.31)	-.625 (4.14)	-.356 (2.59)
*Age 40 - 44	.927 (3.15)	-.048 (.82)	5836 (2.43)	1.01 (4.18)	-.0087 (.65)	.133 (1.24)	.316 (3.39)	37.7 (1.59)	.210 (1.67)	-.995 (5.75)	-.820 (4.68)
*Age 45 - 49	0.674 (2.24)	-0.049 (.81)	4543 (2.14)	0.538 (2.05)	-0.041 (3.25)	0.261 (1.51)	0.34 (2.61)	-6056 (.20)	.009 (.06)	-1.07 (5.95)	-.552 (2.80)
*Age 50 - 54	0.499 (1.89)	-0.096 (2.09)	779 (.72)	0.334 (1.15)	-0.041 (2.80)	0.038 (.19)	-0.074 (.44)	73.7 (2.41)	.114 (.88)	-.691 (3.94)	-.150 (.78)
*Age 55 +	0.405 (2.50)	-0.123 (.50)	1174 (1.50)	0.488 (2.40)	-0.023 (1.94)	-0.675 (1.57)	0.294 (.80)	67.4 (2.37)	.046 (.44)	.059 (.52)	.239 (1.71)
Woman's Years Schooling	.0734 (2.43)	-.0084 (2.10)	1627 (3.29)	.155 (4.74)	-.0034 (2.70)	.113 (11.5)	.0960 (8.17)	22.4 (7.06)	.121 (11.9)	-.0816 (5.68)	-.060 (6.52)
Husband's Years Schooling	.0975 (6.23)	.0008 (.35)	-54.1 (.51)	-.0168 (1.34)	-.0024 (2.64)	.055 (6.53)	.0534 (6.71)	13.5 (8.15)	.0867 (11.3)	.0218 (2.05)	.044 (5.38)
Missing Husband Schooling	.0816 (.63)	.007 (.25)	-3929 (3.22)	-.229 (1.49)	-.015 (1.44)	.050 (.56)	.0473 (.49)	-26.6 (2.06)	-.187 (2.55)	.127 (1.08)	.228 (2.57)
Age Controls (7) 25 or more	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Constant (age 15 - 24)	18.3 (100)	.230 (7.71)	-2675 (1.57)	5.83 (29)	.124 (8.26)	.362 (1.02)	-.266 (1.93)	-19.2 (1.07)	3.24 (34.4)	1.28 (10.2)	.958 (15.7)
R^2	.114	.063	.046	.121	.069	.277	.237	.113	.180	.545	.450
Sample Size	4640	5307	1639	1639	5055	1334	1417	5307	5307	5307	5307
Dependent Variable Mean (standard deviation)	18.66 (2.57)	.309 (.462)	1038 (8290)	2.01 (3.11)	.137 (.183)	-.0174 (.971)	-.0187 (.951)	175 (327)	4.19 (1.51)	4.98 (2.90)	3.95 (2.22)

See notes to Table 1.