Gender and Generational Consequences of a Health and Family Planning Program: A Quasi Experiment in Matlab, Bangladesh

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, improve their health, contribute to the health and education of their children, allow women to allocate more time to activities other than childcare, which adds to their market productivity, and to accumulate more household wealth to smooth and sustain their level of consumption into old age. Program evaluation studies are rarely able to assess long term lifecycle effects of such programs on those who are provided local access to subsidized services. In this paper, I explore, with the aid of a quasi social experiment in Matlab, Bangladesh of a relatively long duration or two decades, the association between a Maternal and Child Health and Family Planning (MCH-FP) Program on some of the program’s many objectives, which have different consequences by gender and generation, and may spill over beyond the explicit objectives of the program and may foster development. 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.

This paper extends a research project started several years ago with my colleague Shareen Joshi, that examines data from a much studied subdistrict of Bangladesh, Matlab, in which quasi experiment were conducted that allow one to estimate the long-term direct and indirect effects of an innovative 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 139 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) after 1966. The villages were grouped into six contiguous blocks (A, B, ..., F), and the first four blocks were singled out for the

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the intensive program treatment. The clustering of villages into this geographical design raises the question whether the assignment of villages between the program and comparison areas occurred independently of other factors that could affect family 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. 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 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) (Rahman et al. 1999). Older women may 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. This final limitation of the quasi experiment is the most difficult to assess from the available data, but a resurvey of the MHSS is being planned which could eventually clarify the consequences of selective migration and mortality that could differ between the program and comparison areas.

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

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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.

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 and interacted with program treatment in subsequent comparisons, to allow for possible heterogeneity in level of behavior and response to the program within these two ethnic groups (Joshi and Schultz, 2007).
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 often formalized after Samuelson (1958) in an overlapping generations (OLG) framework. Parents may also consider the opportunities for 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 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 these 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 inform one of indirect-effects of these 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 are typically correlated with other determinants of health status, as well as the time allocation of family members, and consequently access to non-experimental programs may not be an ideal or even a valid instrument for measuring 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 20th 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). There is scant empirical evidence of complementarity or substitutability at the family level.

Fertility Response to Exogenous Changes in Mortality
Biological and social scientists have often assumed that there would be a positive (homeostatic) response of fertility to variation in child mortality, with parents replacing children they lost or having extra children as insurance against their expected losses (Schultz, 1969, 1981). Cross-sectional data on fertility and child mortality at the family and aggregate level suggest there is a gross positive association, and even aggregate population time series tend to find the decline in child mortality commonly precedes the decline in fertility. But there are possibly offsetting factors. The “cost” of rearing a (surviving) child would decline, all else equal, with an exogenous decline in child mortality. If parent demand for surviving children increases as the price decreases, parents would then be motivated by this price effect to have more, not fewer, children (Schultz, 1981). However, child health and survival is endogenous, because it responds at the margin to individual behavior, family resources, health technology, social institutions, all of which can affect in unobserved ways fertility.

The consequences of inputs to health care tend to have persistent effects, suggesting they can be viewed as an investments in a (typically unobserved) stock of health human capital (Grossman, 1972). Schooling and health of parents are positively correlated with that of their children for biological as well as many possible behavioral reasons (Lleras-Muney, 2005). The resulting correlation of the health of children with their (parent’s) socioeconomic status may increase with the child’s age in some settings, referred to as a socioeconomic gradient in health inequality (Case, et al. 2005). This could be attributed to the reinforcing effects of health investments and health-related consumption associated with parent income and education, or the lack of equal access to institutionalized health care that might otherwise compensate for initially poor health endowments among children, or adverse shocks to their health, or their disadvantaged origins.

The decline in mortality that is associated with the onset of the demographic transition occurs for various reasons, some of which are outside the control of families. How fertility responds to such exogenous components of the variation in mortality is 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 their 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 should not 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 the 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 way to explain the causes of the rate of capital accumulation, savings and economic growth (Higgins and Williamson, 1997; Bloom and Williamson, 1998). Identifying exogenous changes in age composition on which to build causal analysis of demographic-economic relationships is no easier than to explain exogenous factors driving mortality and fertility during the demographic
transition in order to infer how surviving family size and population growth affects economic development.

Advances at various times in medical technology and public health have spurred global public health interventions that have controlled the spread and improved 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 specific infectious and parasitic 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-death data are not particularly reliable in many countries, and are available for only a handful of low income countries by 1940, which are unrepresentative of the world (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. Some studies suggest declining child mortality is associated within a generation or two with declining fertility, and perhaps increasing child schooling. Recognizing that fertility and child schooling are jointly determined in part by parent coordinated choices, and child mortality is also affected by parent resource and time allocations, it becomes difficult to identify causal relationships among these three outcomes. What is needed is an independent source of variation in mortality or fertility, on which to build in a panel analysis of aggregates such as countries and thereby identify causal relationships, or a way to construct such identifying information at the individual level. The effects of food supplies on child mortality, and prices of contraception on fertility have been explored in earlier research, but these approaches remain somewhat unsatisfactory (Schultz, 1994, 1997). Disease-specific technical changes may still be helpful in accounting for exogenous 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 should not be surprising that they are associated with population growth but not with concurrent 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 tended to diminish in high income countries as have fertility differentials with respect to other socioeconomic characteristics, such as religion and race. 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 available after the Second World War this empirical pattern was evident (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 positive in sign (Schultz, 1981, 1997). 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 a robust inverse predictor of fertility.

But few hypotheses are advanced and tested to account for the socioeconomic pressures from the family’s environment that might initiate the closing of the gender gap in schooling, and 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 aggregate ratio of capital to output. The conclusion has been drawn that rising labor productivity depresses fertility, raises female schooling, increases female labor force participation, and stimulates economic growth. But typically gender specific schooling, wages, or ultimately empowerment of women in household production does not explicitly enter most of these models (e.g. Bongaarts, Mauldin and Phillips, 1990; Barro, 1997; Angeles, 2010).

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 (Schultz, 1981, 1997). Schooling will therefore be controlled in the subsequent regression for both wives and husbands, as indicators of their 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. Variation in fertility due to a quasi experimental program that reduces the overall psychic, time and monetary costs of birth control should induce an exogenous decline in fertility. 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.

3 Fertility is more readily attributed to mothers than to biological fathers. Representative samples tend to collect fertility information only from mothers and possibly currently coresident fathers or partners, or some information is reported by mothers on their previous unions. Most studies of the association between father’s endowments, behavior and fertility are thus based on selective samples of individuals. This gap in fertility data may partially justify the analysis of population aggregates, which are thought to span more adequately both sides of the “marriage market”.
Thus, the inverse relationship between women’s wage opportunities and fertility can be reinforced through feedbacks over the life cycle from declines in fertility to further increases in wages, even after controlling for the 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 while enrolled in school remains an important economic deterrent to poor and self employed parents enrolling 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 (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 birth rates 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 more pronounced effects, first on fertility, and then on maternal and child health, on women’s wage opportunities, 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 faltering. A form of reinforcing feedback may again occur, as improved child health further reduces fertility, because parents are then less motivated to sustain their high levels of fertility to compensate for actual and anticipated high levels of 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 terms of physical capital accumulation. The working assumption is that the MCH-FP does not directly affect physical asset returns, except by means of reductions in fertility and mortality.

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 described as economic development. In addition, decreasing fertility in the program villages may reduce the number of workers in this district with its inelastic supply of arable land, and thereby raise wages due to the reduced Malthusian pressures of population and the widely assumed diminishing returns to labor. It is not clear which of these substitution responses to exogenous declines in fertility within the intergenerational family are most significant, or how they might be compared in terms of advancing Matlab’s development.

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 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 several housing 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 17 percent lower in the program villages. Consulting the 1996 MHSS for strata 1 and 2 households, the child-woman ratio in the program villages are 16 percent lower than in the comparison villages, holding constant for the initial 1974 census levels, confirming that the program is continuing to reduce surviving fertility after some 19 years. The ratio of children age 5 to 9 to women age 15
to 49 was also indistinguishable in the program and comparison villages in 1974, and had not changed differentially 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 including fertility, being a Muslim is included among the control variables and interacted with the program treatment in some of the reported regression. Under the working assumption that any emerging differences in characteristics of the populations in the two regions are due to the MCH-FP program intervention, the next step is to estimate reduced-form type equations to account for lifecycle behavior and family transfers derived from the 1996 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 -0.500, 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, who were too old to have benefitted by the birth control provided by the program after 1977. The partial association with the program is essentially unaltered by this adjustment for age composition. Many economic models of fertility postulate that female schooling could affect the demand for children, because it would increase women’s productivity and the wages of women in the labor force, raising the opportunity cost of additional children, which would offset any “income effect” associated with their 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 notably 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 does not change substantially the partial effect of the program, which remains half a birth, -0.48.

Muslim fertility is on average about half a child more than Hindus, and a control for this ethnic characteristic is included in Column 4. Features of household that are plausibly related to fertility are also controlled, although people make choices about who resides together and household composition may therefore be affected by unobserved constraints that could also affect fertility, and thus be classified as in this situation as 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 -0.42 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 (BRAC) office that extends micro credit oriented to women and as well as encourages family planning, child health care and schooling. These village controls 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, or BRAC branches are systematically located in more disadvantaged villages.

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’s impact on fertility becomes significant only after a woman reaches about age 25. However, among women over age 55 in 1996, who were over the age of 37 when the program started, fertility was already relatively low by 1977, and therefore the program should have limited impact on completed fertility of these elderly women. For example, women 45 to 49 have .98 fewer births in the program villages than in the comparison villages other things being equal, 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 includes controls for only the arguably exogenous household characteristics. This final column (7) regression specification becomes the benchmark for the reduced-form estimates in the second panel of the regressions 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 panel reports the unconditional program “effect”, controlling for no other variables.

5. Program Association with Intergenerational and Gender Transfers and Outcomes

The columns in Table 2 summarize the estimated association between residence in a program village and the 1996 MHSS indicators of women’s health, participation in wage work, monthly wage in 1995 and its logarithm, a woman’s average child mortality rate by age 5, years of schooling completed children age 6 to 14 normalized as a Z score by gender, value of household assets per adult, and its logarithm, children ever born (as in Table 1 column 1 and 7) and number of children alive. The first row includes no controls, i.e. unconditional program effect, and the subsequent rows reports the preferred regression with controls for the age of women and their interaction with the program, etc.

The MHSS reports three indicators of the woman’s health: whether she categorizes herself as “currently healthy”, 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 nonetheless a preferred summary indicator of health in this population, because it is more objective and informative as a continuous variable (Joshi and
Schultz, 2007). The frequency of malnutrition among women in Matlab is high, making shifts in
the lower tail of the distribution of BMI a significant determinant of their 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
a sensitive 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), and this increase is associated with decreased probability of women
reporting BMI less than 18 and increased probability of reporting 20-25. No sample women
report a BMI in excess of 29. As with fertility reduction itself, it is hypothesized that the gains
to women’s nutrition and health associated with the program would 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 kernel density
distribution of BMI by age and histograms of BMI in Figures 1-4 illustrate the noted program
“effects” on BMI and their concentration by age among older women who have completed their
childbearing.

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 women and men age 15 to 24 (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 after the middle of the 20th Century (Mincer
1985). This does not appear to be the case in Matlab, however, where the participation in wage
work by women (column 2, Table 2) does not differ unconditionally (row 1) between program
and comparison villages, and wage work may even be lower in the program areas among women
50 to 54. It is also notable that better educated women in Matlab are less likely to participate in
wage 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 highly significant for women age 25 to 54, but not significant for men age 25 to 54, or for younger males or females (Schultz, 2009b). Women age 25 to 54 who confront higher wage offers in the program villages of Matlab appear less likely to work for wages and more likely to report working in the household. The log wage advantages of adult women in program villages are significantly larger for better educated women, suggesting that the wage returns to women’s schooling are enhanced by their improved access to birth control (Figure 5).

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 -0.0347 / 0.137. 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, however, 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 of all married women in the previous regressions given the restrictions to children of a specific age and sex. 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 for girls, 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 remain 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, and because 7 households report no assets, they are attributed a minimum value of one (thousand) to include them in the estimation sample. The program effects by age of mother are positive and significantly different from zero for all age groups except mothers age 45 to 49. Household assets per adult expressed in logarithms (column 9) are significant only for women age 35 to 44, an age when their reduced fertility would have begun to allow families to accumulate more assets. Household assets in the entire sample are increasing in age, presumably in part due to accumulation over the life cycle (not reported). Variation in household wealth is substantial at all ages, reflecting substantial
personal inequality, perhaps complicated by the importance of intergenerational households, and probably exacerbated by errors in reporting the value of assets. The coding of the units of land area owned and the valuations per unit of land area appear occasionally inconsistent with coding instructions, which led me to rely in those cases on the overall responses on total agricultural land valuations rather than the unit values. The survey appears to break new ground in its pursuit of many types of household and individual wealth, but further validation of the questionnaire design may be in order. Many categories of asset values other than agricultural land appear internally consistent and of plausible in magnitude for this population, which is predominantly self employed farm households. I would expect more work on the collection and interpretation of the household assets is desirable, and would seem more promising in the MHSS than adding up housing characteristics as is common with the Demographic Health Surveys.

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 greater detail the consequences of the MCH-FP program affecting Matlab families over time. 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, and the irregular age pattern of program effects, it may be prudent to await further study of the components of assets, some of which may be more reliable than others. Finally, one can hope that the new resurvey of the Matlab MHSS sample, which I understand has been funded by NIH, will help define more precisely these longer run consequences of a remarkable social experiment and deal more explicitly with the determinants of migration (do the relatively rich or poor leave Matlab in greater numbers in the program and comparison areas), and what consequences does this differential out-migration have on those left behind in the program and comparison villages?

I have not used the covariance in residuals across life cycle outcomes for families which one might expect to be related, if for no other reason than being codetermined with an overall budget constraint. One simple approach would be to a jointly estimate a set of behavioral outcomes that are conditioned on a common set of variables, where one expects the unexplained disturbances across equations for these several outcomes could be driven by common unobservables. One such unobservable might be couple fecundity or biological reproductive capacity of a couple. 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 over the life cycle in terms of adjustment of other behaviors and outcomes? How do programs such as MCH-FP in Matlab mitigate these shocks? 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 ($r = .361$) than with any of the other dependent variables. 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 and family planning program interventions as essentially a means to slow population growth and alleviate Malthusian population pressure at an aggregate level. At least as important are the consequences of an effective programs for women’s health and productivity, the improvements in child health and survival, and the schooling attained by the next generation. At least this conclusion appears to be consistent with the empirical evidence from Matlab.

References:


35, International Centre for Diarrhoeal Disease Research, Bangladesh, Dhaka.


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.


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


<table>
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<tr>
<th>Explanatory Variables</th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
<th>(6)</th>
<th>(7)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Program Village Effects (without controls and for all women)</td>
<td>-0.500 (5.04)</td>
<td>-0.495 (6.53)</td>
<td>-0.482 (6.82)</td>
<td>-0.424 (6.53)</td>
<td>-0.366 (4.07)</td>
<td>0.505</td>
<td></td>
</tr>
<tr>
<td>2. Program Village Effect for Specific Age</td>
<td>*Age 15 - 24</td>
<td>-0.0024 (.02)</td>
<td>-0.102 (1.34)</td>
<td>0.048&lt;sup&gt;a&lt;/sup&gt;</td>
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<td></td>
<td></td>
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<tr>
<td></td>
<td>*Age 25 - 29</td>
<td>-0.250 (2.04)</td>
<td>-0.363 (3.79)</td>
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<tr>
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<td>*Age 30 - 34</td>
<td>-0.592 (4.28)</td>
<td>-0.695 (5.41)</td>
<td>0.078</td>
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<td>*Age 35 - 39</td>
<td>-0.492 (2.90)</td>
<td>-0.625 (3.78)</td>
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<td>*Age 40 - 44</td>
<td>-0.803 (3.93)</td>
<td>-0.995 (5.43)</td>
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<td></td>
<td>*Age 45 - 49</td>
<td>-0.976 (3.81)</td>
<td>-1.07 (4.28)</td>
<td>0.045</td>
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<td>*Age 50 - 54</td>
<td>-0.592 (3.00)</td>
<td>-0.691 (3.43)</td>
<td>0.047</td>
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<tr>
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<td>*Age 55+</td>
<td>0.141 (0.95)</td>
<td>0.059 (0.52)</td>
<td>0.107</td>
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<td>Woman’s Years Schooling</td>
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<td>-0.0702 (6.63)</td>
<td>-0.0679 (6.39)</td>
<td>-0.0688 (6.37)</td>
<td>-0.0816 (7.76)</td>
<td>2.09 (2.87)</td>
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<tr>
<td>Husband’s Years Schooling</td>
<td>0.0203 (2.16)</td>
<td>-0.0054 (.54)</td>
<td>-0.0066 (.66)</td>
<td>-0.0051 (.50)</td>
<td>0.0218 (2.31)</td>
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<tr>
<td>Missing Husband Schooling</td>
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<td>0 (.00)</td>
<td>0.0066 (.06)</td>
<td>-0.0008 (.01)</td>
<td>0.0127 (1.33)</td>
<td>0.07</td>
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<td>Age controls (7)&lt;sup&gt;b&lt;/sup&gt;</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td>Household Composition, Husband Age, Muslim Controls (7)&lt;sup&gt;c&lt;/sup&gt;</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Village Infrastructure Controls (5)&lt;sup&gt;e&lt;/sup&gt;</td>
<td>N N N N Y Y N</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td>Constant</td>
<td>5.24 (72)</td>
<td>1.25 (23.6)</td>
<td>1.48 (22)</td>
<td>1.09 (6.71)</td>
<td>1.10 (5.44)</td>
<td>0.888 (4.15)</td>
<td>1.28 (18.6)</td>
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<td>0.563</td>
<td>0.568</td>
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</table>

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

<sup>a</sup> Strata 1 and 2 samples from MHSS.

<sup>b</sup> Binary dummy variable for which standard deviation is √m*(1-m), where m = mean.

<sup>c</sup> Age dummies as with program*age interaction. Reference group excluded is age under 25, captured by constant in reg (2) to (7).

<sup>d</sup> 7 Controls for muslim, husband age quadratic, husband age missing, married or unmarried female head, husband absent, and not female head.

<sup>e</sup> 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

<table>
<thead>
<tr>
<th>Dependent Variable</th>
<th>Woman Effects</th>
<th>Children Effects</th>
<th>Household Assets Per Adult (in thousands)</th>
<th>Children Ever Born</th>
<th>Children Alive</th>
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<tbody>
<tr>
<td></td>
<td>BMI</td>
<td>Wage Work</td>
<td>Monthly Wage Log</td>
<td>Death Rate 5</td>
<td>Girls</td>
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<tr>
<td>Program Village (no controls all women)</td>
<td>.578 (.183)</td>
<td>-.033 (.99)</td>
<td>2512 (.89)</td>
<td>.473 (3.01)</td>
<td>-.0247 (5.11)</td>
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<tr>
<td>*Age 15 - 24</td>
<td>0.032 (.17)</td>
<td>-.051 (.39)</td>
<td>2793 (.56)</td>
<td>.401 (1.40)</td>
<td>-.0292 (1.42)</td>
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<td>*Age 25 - 29</td>
<td>0.455 (2.28)</td>
<td>.011 (.24)</td>
<td>-.2734 (1.99)</td>
<td>.220 (1.02)</td>
<td>0.017 (1.25)</td>
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<tr>
<td>*Age 30 - 34</td>
<td>0.528 (2.94)</td>
<td>-.086 (1.53)</td>
<td>2847 (1.58)</td>
<td>.308 (1.83)</td>
<td>-.025 (2.35)</td>
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<tr>
<td>*Age 35 - 39</td>
<td>0.675 (2.77)</td>
<td>-.006 (1.2)</td>
<td>2482 (.88)</td>
<td>.389 (2.10)</td>
<td>-.033 (3.24)</td>
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<td>*Age 40 - 44</td>
<td>.927 (3.15)</td>
<td>-.048 (.82)</td>
<td>5836 (2.43)</td>
<td>1.01 (4.18)</td>
<td>-.0087 (.65)</td>
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<td>*Age 45 - 49</td>
<td>0.674 (2.24)</td>
<td>-.049 (.81)</td>
<td>4543 (2.14)</td>
<td>.538 (2.05)</td>
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<td>*Age 50 - 54</td>
<td>0.499 (1.89)</td>
<td>-.096 (2.09)</td>
<td>779 (.72)</td>
<td>.334 (1.15)</td>
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<td>0.405 (2.50)</td>
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<td>1174 (1.50)</td>
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<td>1627 (3.29)</td>
<td>.155 (4.74)</td>
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<td>Husband’s Years Schooling</td>
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<td>.0008 (3.5)</td>
<td>-.541 (51)</td>
<td>-.0168 (1.34)</td>
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<tr>
<td>Missing Husband Schooling</td>
<td>.0816 (.63)</td>
<td>.007 (2.5)</td>
<td>-.3929 (3.22)</td>
<td>-.229 (1.49)</td>
<td>-.015 (1.44)</td>
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<td>Y</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
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<tr>
<td>Constant (age 15 - 24)</td>
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<td>.230 (7.11)</td>
<td>-.2675 (1.57)</td>
<td>5.83 (29)</td>
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<td>R²</td>
<td>.114</td>
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<td>18.66 (2.57)</td>
<td>.309 (4.62)</td>
<td>1038 (8290)</td>
<td>2.01 (3.11)</td>
<td>.137 (.183)</td>
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See notes to Table 1.
Figure 1
Distribution of Women by BMI
Figure 2
BMI density by age group
Figure 3
Histogram for BMI
Figure 4
BMI histogram by age group

[Graphs showing BMI distribution by age group and treatment control]
Figure 5
Program Association with Women’s Monthly Wages in 1995