

The Price of Fertility: Marriage Markets and Family Planning in Bangladesh*

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Abstract

This paper considers the impact of family planning on dowry transfers. We construct a model of the marriage market in which prospective mates anticipate the outcome of intrahousehold bargaining over fertility. We show that as the price of contraception falls, brides must compensate men with higher dowries in order to attract them into marriage. We test the model using data from a successful 1970s family planning experiment in Bangladesh, which lowered average fertility by 0.65 children. We find that the program increased bride-to-groom dowry transfer amounts by at least eighty percent. The marriage market's response to a family planning program may dampen the welfare benefits of family planning for women.

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1 Introduction

When a daughter in South Asia marries, her parents transfer up to several multiples of annual household income to her in-laws as dowry. This paper studies how these dowry transfers are affected by the number of children a bride is expected to bear. Husbands tend to desire greater fertility than wives in poor countries, where the costs of childbearing for women are particularly high (Bankole and Singh, 1998). Thus, when exposed to a family planning program, we might expect that women would be led to compensate grooms for the anticipated fall in their fertility.

In this paper, we develop a theoretical model of a marriage market in which prospective mates anticipate the outcome of future intrahousehold bargaining over fertility, and show that a fall in the price of contraception for some women makes them less desirable to grooms. We then use dowry data to show that a successful 1970s family planning experiment in Bangladesh led women to compensate grooms with higher dowries in order to attract them into marriage. We find that dowries increased by at least eighty percent as a result of the family planning program; our point estimates are statistically and economically significant.

This study lies in the intersection of two literatures. First, several scholars have examined the impact of the marriage market (through changes in the sex ratio) on household outcomes (Chiappori et al., 2002, for example). A subset of these papers consider effects on fertility (Angrist, 2002; Francis, 2006). Ours is the first paper (that we are aware of) to look at the reverse effect: the impact of an anticipated change in fertility on marital transfers between forward-looking participants in the marriage market.¹

Second, economists have, in the last fifteen years, begun paying serious attention to dowry as an institution in its own right, building upon the insights of Becker (1981). Prominent papers in this vein include Rao (1993); Anderson (2003) and Botticini and Siow (2003); in

¹Goldin and Katz (2002) and Bailey (2006) study how the availability of the pill shaped marriage outcomes, but their mechanism operates through an increase in age at marriage, rather than the direct and immediate forward-looking behavior we study here.

addition, a few recent working papers consider dowry in the region of Bangladesh that we study (Esteve-Volart, 2004; Mobarak et al., 2006; Do et al., 2006). Ours is the first paper in this field to link dowry and fertility. This link is a natural one—many anthropologists have emphasized that fertility lies at the core of marriage as an institution, and that in particular men’s desired fertility is key to understanding marital transfers (Srinivas, 1984; Bell and Song, 1994; Borgerhoff Mulder, 1989). Indeed, some of the earliest mentions of dowry in recorded history draw an explicit connection to fertility.²

This paper offers the first formal model of a marriage market with dowry transfers to consider future household bargaining over fertility. While a number of studies examine intrahousehold bargaining in *existing* marriages, only recently have scholars tackled the problem of how future bargaining affects matching in the marriage market (Chiappori et al., 2005; Choo et al., 2006; Iyigun and Walsh, forthcoming 2007). At the same time, we build on existing work on bargaining over fertility (Eswaran, 2002; Rasul, 2005; Seebens, 2005) by embedding the anticipated outcome in a marriage market. Our model is closer to Iyigun and Walsh (forthcoming 2006) but we depart by generating a hedonic dowry function that maps each prospective bride-groom pair to a dowry transfer.

The key prediction of the model is the following: we develop conditions under which when fertility is initially high, a fall in the price of contraception causes men to demand higher dowries in order to enter the marriage market. Similarly, as fertility falls, this “dowry premium” falls. The intuition for the result is straightforward: at high fertility levels, the substitution effect of the fall in the price of contraception may dominate the income effect, so that the household bargained fertility outcome makes the husband worse off.

The linchpin of our explanation for the program’s effect on dowries is that husbands

²The betrothal ceremony in ancient Greece, which represented the legally binding moment in a marriage, consisted only of a simple contract between a father and his future son-in-law: “Father: I give you this woman for the procreation [literally, ‘ploughing’] of legitimate children. Young man: I take her. Father: And three talents as dowry. Young man: Fine” (Katz, 1998).

desire greater fertility than wives.³ We give evidence from studies by demographers and anthropologists that support this stylized claim in the context of developing countries and Bangladesh in particular, and discuss some common explanations of the discrepancy in husbands' and wives' desired family size.

The empirical analysis exploits the experimental design of the Matlab Family Planning program in rural Bangladesh, which began in 1977. While over 200 studies have examined the fertility effects of the Matlab program, ours is the first paper to examine the marriage market effects of the program—or, to our knowledge, the marriage market effects of any family planning program. The setting is in many ways ideal for our study. Before the program, contraception was virtually unknown to the population of Matlab, and fertility rates in Bangladesh were among the highest in the world (Phillips et al., 1982). The Matlab program generated an immediate and substantial rise in contraceptive use in the treatment villages, causing an immediate and lasting reduction in fertility of approximately .65 fewer children per couple. Finally, the marriage market in Bangladesh is marked by observable dowry transfers, enabling a natural quantitative measure of the impact of family planning on the marriage market.

The key experimental source of variation is the exogenous shock to the price of contraception for households in treatment villages. This price shock is known to couples at marriage, and enters the marriage market as a shift in the conditional distribution of dowry transfers. To document this shift, we employ a difference-in-differences strategy that compares real dowry payments before and after the onset of family planning across treatment and control villages. Our results indicate large, positive effects of the family planning program on dowries. In reduced form, controlling for demographic variables and observable characteristics of the bride and groom and their families, we find that the program increased dowry prevalence—i.e., the payment of a non-zero dowry—by approximately fifteen percent, and

³More precisely, in the model, men have a higher marginal rate of substitution of quantity of children for consumption goods.

increased dowry amounts by at least eighty percent. Directly investigating the theorized mechanism of reduced fertility, we use an instrumental variables approach, instrumenting fertility in marriages after the program onset with a household's residence in a treatment village. While this result is more difficult to interpret, in that fertility is observed *ex post*, we find that for the average reduction of .65 births (the observed program effect), the *ex ante* dowry amount was on average approximately 63% larger.

We verify the robustness of the main empirical findings in a number of ways. First, we show that the results are robust to including a variety of controls. Second, while we argue that dowry amounts are most likely not censored, we employ a Tobit estimator to address the possibility of censoring. Third, we test for, and reject, sorting on observables as a possible counter-hypothesis. Finally, we develop a placebo test that runs our difference-in-differences estimator using fake years of onset; only in the true year of program onset (1977) do we find a statistically significant effect on dowry amount.

Our paper contributes to a growing literature in development economics that looks at the interplay between traditional social institutions and new technologies. For example, Conley and Udry (2005) consider how traditional networks mediate the diffusion of agricultural technology. Closer to our concerns, Munshi and Myaux (forthcoming) consider the same region of Bangladesh as we do, and study the diffusion of contraception takeup within and between religious groups. Ours is the first study in this vein to examine marital transfers.

Regarding family planning, we do not view our findings as tempering enthusiasm for the Matlab program, in light of its substantial long-run welfare improvements for women and children (Joshi and Schultz, 2006). However, our study does indicate that women (or more precisely, their families) to some extent paid for these improvements up front—a wholly unintended consequence of the program. By taking into account the underlying social institutions in which family planning programs operate, such unintended consequences could perhaps be mitigated.

2 Marital Payments and Fertility Preferences

2.1 Historical Context: Dowry in Bangladesh

In the model that follows, we assume that dowry is a transfer from the bride’s family to the groom’s family, rather than a portion of the bride’s marital assets. To understand this assumption, some context may be useful. The term “dowry” historically refers to two distinct types of marital transfers. The first, a pre-mortem bequest to daughters, has roots in South Asia dating to the earliest textual descriptions of marriage almost two millennia ago (Oldenburg, 2002). These bequest dowries have been observed in many other parts of the world, from Europe (Kaplan, ed, 1985) to Latin America (Nazzari, 1991) to East Asia (Zhang and Chan, 1999). Most scholars place the origin of bequest dowry in women’s poor property rights over inheritance in virilocal societies, such that a bequest to a daughter must take place at her marriage rather than upon her parents’ death (Goody, 1973, for example).⁴

The second type of dowry, the type we study in this paper, is also known as a groom-price, and is a marital payment to the groom’s family. The groom-price or price dowry emerged in India beginning in the late nineteenth century (Tambiah, 1973; Srinivas, 1984; Banerjee, 1999). In Bangladesh, price dowry is a more recent phenomenon, dating to the 1940s (Lindenbaum, 1981; Hartmann and Boyce, 1983). A potential concern with our model is that the data do not specify whether dowry serves as a groom-price or as a pre-mortem bequest—if dowries are bequests, an arguably more apt model would follow along the lines of Zhang and Chan (1999) or Brown (2003).⁵ This said, a variety of evidence supports our view that dowry should be modeled as a groom-price. Anthropological studies based on long-term fieldwork universally document the demise of bequest dowry and the rise of price dowry in Bangladesh by the early 1970s (Ahmed, 1987; Ahmed and Naher, eds, 1987; Lindenbaum,

⁴Botticini and Siow (2003) posit a novel alternative explanation: virilocality spurs parents to give a pre-mortem bequest to their daughters in order to incentivize their sons, left alone on the familial estate.

⁵We are aware of no large-sample survey in South Asia that asks respondents about the recipient of the dowry—the reason is that groom-prices are technically prohibited in India, Pakistan, and Bangladesh.

1981; Hartmann and Boyce, 1983).⁶ Indeed, this new form of dowry was often called by the English word “demand” rather than the traditional terms for marriage transactions. Furthermore, the decline of bequest dowry and predominance of price dowry is a phenomenon that is common to other parts of South Asia, a fact which has led other economists studying dowries to model them as groom-prices (Rao, 1993; Sen, 1998; Mukherjee, 2003; Dasgupta and Mukherjee, 2003; Dalmia, 2004; Mukherjee and Mondal, 2006).⁷

A final stylized fact about dowries in the period and region we study is that payment is made in full at or before marriage, rather than in installments over several years. This fact is important because a system of installment dowry payments would vitiate the non-contractibility over fertility that drives our theoretical model. Installment contracts over fertility have been documented in sub-Saharan Africa (Gonzalez-Brenes, 2005), but we find no evidence of such arrangements in Bangladesh in the period we study. Interestingly, installment dowry or “dowry renegotiation” seems to have proliferated in Bangladesh starting in the early 1990s, although is not as common as in southern India (Bloch and Rao, 2002).⁸

2.2 Fertility Preferences of Husbands and Wives

Demographers have long argued that husbands’ desired fertility is greater than wives’ in developing countries. A number of surveys ask husbands and wives to report their desired fertility directly: “[m]ost of the information gathered from fertility surveys suggests that women consistently desire smaller families than their husbands” (Eberstadt, 1981, pg. 58). Recently, Bankole and Singh (1998) use Demographic and Health Survey data from eighteen

⁶Arunachalam and Logan (2006) generate predictions from the economic theories of price dowry and bequest dowry to structure an exogenous switching regression model, using the same dataset we use here. They corroborate the historical and anthropological claim that bequest dowries declined in prevalence and price dowries became more common over time.

⁷Anderson (2004) offers a model to explain why dowries have transformed from bequest to price with modernization, focusing on changes in relative heterogeneity of male and female characteristics.

⁸Suran et al. (2004) survey women in a different part of rural Bangladesh in 2003, and find that approximately nine percent of marriages involve a fraction of dowry being paid after marriage.

developing countries to show that husbands tend to want larger families than wives and to want the next child sooner.⁹ Individual country studies also point to this pattern—a few examples include Short and Kiros (2002) for Ethiopia; Mahmood and Ringheim (1997) for Pakistan; Kimuna and Adamchak (2001) for Kenya; and Stycos (1952) for Puerto Rico. Interestingly, surveys of secondary school children in Costa Rica, Colombia, and Peru (Stycos, 1999b) and India (Stycos, 1999a) indicate that the discrepancy in desired family size may form well before marriage.

We do not have large-sample evidence comparing husbands' and wives' desired fertility preferences from Bangladesh at the time of the onset of the Matlab program. However, qualitative and small-sample survey evidence supports the pattern described above, that husbands desired more children than wives. Dyson and Moore (1983) place Bangladesh within the fertility pattern characteristics of north India, whereby “[within marriage] women are subjected to relatively strong pronatalist pressures, [and] they are faced with particularly severe restrictions on their ability to control their fertility” (pg. 48). The only quantitative evidence we are aware of, a small sample study (51 men and 51 women) in a Bangladesh village around 1976, found that wives' ideal family size was 6.4 while husband's was 7.0 (Bulatao, 1979). Finally, when we describe the Matlab program below, we offer qualitative evidence indicating that husbands desired greater fertility than wives, and that this fact resulted in women being ostracized and punished for the use or even possession of contraceptives.

Until recently, demographers tended to take husbands' greater desired fertility preferences as manifesting in a rather rudimentary fashion. As a recent survey points out: “Demography has regarded men as economically important but as typically uninvolved in fertility except to impregnate women and to stand in the way of their contraceptive use” (Greene and Biddlecom, 2000, pg. 83). Within the last decade, demographers and economists have urged

⁹Bankole and Singh (1998) is partly a response to Mason and Taj (1987), who use aggregate data on men and women rather than husbands and wives to cast doubt on desired family size differences by gender. Bankole and Singh essentially argue that aggregating by gender opens the latter study to composition bias.

the development of models incorporating conflicting fertility preferences to generate cleaner predictions regarding fertility behavior (Voas, 2003; Bergstrom, 2003). Economists have taken steps in this direction (Eswaran, 2002; Rasul, 2005; Seebens, 2005), but some prefer models incorporating differential costs of fertility so as not to assume differential fertility preferences between husbands and wives (Iyigun and Walsh, forthcoming 2006). Our paper aims to shed light on this question by investigating an observable prediction of the claim of differential fertility preferences: that prospective grooms require compensation to marry women who face a lower price of fertility control.

2.2.1 Reasons for the Difference in Fertility Preferences

Why do husbands in developing countries desire greater fertility than their wives? One reason is straightforward: women disproportionately bear costs of bearing and raising children (Eswaran, 2002). After a certain number of children, the costs to a wife of an additional child may outweigh the benefits, while the marginal benefit to the husband may still be positive. Maternal mortality rates in developing countries are an order of magnitude higher in poor countries relative to the developed world, raising the biological costs to mothers of childbirth. Indeed, the Matlab region of Bangladesh reported some of the highest maternal mortality rates in the world (Koenig et al., 1988); during 1967-1970 estimates range from 570 to 770 deaths per 100,000 births, the majority of which stemmed from direct obstetric causes (Chen et al., 1974).¹⁰ Maternal morbidity (injury and illness from childbirth) occurs much more frequently; as of the early 1990s incidence of acute maternal morbidity was reported at 67 episodes per maternal death (Goodburn et al., 1995).

Another explanation derives from male property rights over children's labor. Insofar as fertility is motivated by children's productivity (due to child labor) or old age security concerns (due to adult children's remittances), wives will tend to favor smaller families when

¹⁰By way of comparison, the maternal mortality rate in the United States during 1974-1978 was around 12 per 100,000 (Smith et al., 1984).

economic returns largely accrue to husbands. Folbre (1983) argues that in contexts where the patriarch controls the income of children as well as the reproductive labor of his wife, he will prefer a larger number of children than his wife.

A third possible reason is much more general, and is rooted in evolutionary biology. Since Darwin, a long line of evolutionary biologists have pointed to differential selection pressures operating on fertility preferences of males and females. The classic argument in this vein is Trivers (1972): biological reproductive differences (sperm are metabolically cheap, while eggs are dear) drive optimal mating strategies, which in turn drive optimal parental investment strategies, so that males are biologically selected to favor high fertility while females are biologically selected to favor fewer, high-quality offspring. Borgerhoff Mulder (1989) develops this argument to explain why strongly-built women draw higher bridewealth among the Kipsigis of Kenya: their expected fertility is greater. Although the *net* marital transfer is reversed in South Asia, the claim that men pay for fertility is consistent with our finding that women of lower expected fertility pay a compensation in the marriage market.

3 A Model of Marriage Payments and Fertility Choice

Our model consists of two environments: a marriage market and an intrahousehold fertility bargain. First, individuals match in a competitive marriage market. The equilibrium dowry function maps the characteristics of each possible bride-groom pairing to a dowry amount, taking the results from the future intrahousehold bargain in that pairing as given. Second, married couples bargain in the household to determine the quantity of children and consumption of a household public good. In this way, the anticipated results from the second-stage bargain determine the dowry function in the first-stage marriage market.

The theoretical approach draws from three classes of models: “classical” models of contraception and fertility (Becker and Lewis, 1973; Willis, 1973); models of intrahousehold

bargaining (McElroy and Horney, 1981); and hedonic models of dowry (Rao, 1993).

In the last 25 years, classical models of fertility choice have come under attack for eliding the dynamic and sequential decision-making that characterizes contraceptive utilization and fertility outcomes. As critics have pointed out, the Becker-Lewis framework is a “once-and-for-all utility-maximizing decision made in full detail at the beginning of the marriage” (Coelen and McIntyre, 1978, pg. 1093). We return to the classical framework for a simple reason: “once-and-for-all” anticipation of future decisions is precisely that which enters the marriage market (determining matching of individuals as well as marital payments) at the time of marriage. That is, we re-cast the Becker-Lewis framework as the ex ante prediction of fertility choice at the time of marriage.

In modeling the fertility decision, we depart from classical fertility models in two ways. First, we incorporate conflicting fertility preferences by gender. This is a necessary component of the model, in that only by positing such conflict can we generate predictions about marriage market effects of future fertility outcomes. Second, we draw from bargaining models of intrahousehold choice. The bargaining approach captures the intuition behind the conflicting fertility preferences at the core of the model. In addition, part of our theoretical contribution is to highlight a consequence of Nash bargaining that a fall in the price of a good desired by both parties can make one side worse off.

Finally, we embed fertility choice in a model of the marriage market, wherein individuals anticipate the solution of the fertility bargain given by any prospective match. Here, we follow Rao (1993) in generating a hedonic function that yields a dowry amount necessary in equilibrium to sustain each bride-groom match. Assembling the complete model, we generate predictions for the dowry effect of changes in parameters that affect fertility choice, including the price of contraception and the relative bargaining power of wives to husbands.

3.1 Setup of the Model

The key idea in the model is that dowries incorporate an ex ante compensating differential for noncontractible ex post fertility bargains. To the extent that a family planning program alters the distribution of ex post utility, it affects the dowry paid ex ante.

We model the rural marriage market as a large, competitive market for couple characteristics. We assume an equal number of men and women. The market is two-sided: each prospective groom has a vector of traits M , which includes characteristics of his family. A prospective bride and her family have a vector of traits W . In addition, brides have a vector of fertility-relevant traits W_f . Unlike marriage markets in other settings, a dowry D may be transferred at marriage from the bride's parents to the groom's parents. Following the strategy adopted from Rosen (1974) by Rao (1993), we write the dowry as a function that maps a given joint vector (M, W, W_f) into a net transfer D paid by the woman's family. Dowry can act to substitute for characteristics, in that female traits that men desire lower the dowry paid, while male traits that women desire increase it.

The market imperfection in the model is that fertility is non-contractible. Women are unable to commit to bearing a certain number of children over the course of the marriage, and dowry cannot be conditioned on fertility.¹¹ Instead, fertility is negotiated within marriage. We model the intrahousehold fertility decision as a Nash bargain over the quantity of children and household joint consumption (McElroy and Horney, 1981; Lundberg and Pollak, 1993). Recent work in household bargaining theorizes changes in prices as operating on the weights in a family welfare function (Browning and Chiappori, 1998, for example). One advantage of using instead the Nash bargaining approach is that we can represent the solution as a constrained maximization problem, allowing us to draw extensively from standard results from classical demand theory.

¹¹The setup has some similarities with the incomplete contracts literature (Grossman and Hart, 1986) in that the ex-ante efficient allocation depends on the outcomes of the ex-post bargain.

A couple takes natural fertility, \bar{n} , as exogenous—this is the number of children they would have in the absence of contraception. The couple chooses a level of contraception, x , which, following Michael and Willis (1973) is measured in the number of children avoided, so that $n \equiv \bar{n} - x$ is the number of children a couple has. Children are both costly and provide utility. The couple also chooses the level of household consumption that is valued by both husband and wife, which we model as a family public good, g .¹²

In the first stage, marriages are arranged by parents, in that each set of parents chooses their child’s spouse. Arranged marriage is almost universal in South Asia—in our data, approximately 98% of marriages are arranged by parents. We abstract from any intergenerational bargaining that may transpire due to parents’ and children’s different valuation of spousal traits.

Throughout, we denote the bride and her parents by f , and the groom and his parents by m . Parents of brides and grooms have utility:

$$\begin{aligned} \text{Bride’s parents’ utility:} \quad & v^f(M, c, n, g; W, W_f) = v^f(M, c, u^f(n, g); W, W_f) \\ \text{Groom’s parents’ utility:} \quad & v^m(W, W_f, c, n, g; M) = v^m(W, W_f, c, u^m(n, g); M) \end{aligned}$$

The bride’s parents’ utility, v^f , is comprised of their own consumption, c ; their daughter’s utility, u^f ; and utility derived directly from the match of the groom with traits M with their daughter (whose traits W and W_f they take as given). The bride’s utility, u^f , is given from the second stage intrahousehold bargain, and is a function of the number of children that the bride and groom will choose to have, n , and a public good consumed within marriage, g . We assume rational expectations so that, in equilibrium, n and g are known in the first stage; n

¹²We do not explore the relationship and tradeoff entailed between child quality and child quantity (Becker and Lewis, 1973), but an extension to the model with child quality is given in the appendix. Adding the nonlinear budget constraint implied by complementarity between child quality and child quantity requires an additional assumption about this complementarity, but does not otherwise weaken the model’s main insights.

and g are also sufficient to peg the bride’s utility in the second stage. The bride’s utility is increasing, twice continuously differentiable, with positive cross-partials and concave in both arguments. The groom’s parents’ utility, v^m , is specified similarly, where u^m is the utility of the groom.

3.2 Stage 2: Fertility Choice within Marriage

We first consider the outcome of the bride and groom’s intrahousehold bargaining problem. The fertility choice is over x , the number of children that are avoided by using contraception. Substituting $\bar{n} - x$ for n into u^f and u^m , we write bride and groom’s utility as:

$$\begin{aligned} \text{Bride's utility:} \quad u^f(n, g) &= u^f(\bar{n} - x, g) \\ \text{Groom's utility:} \quad u^m(n, g) &= u^m(\bar{n} - x, g) \end{aligned}$$

The household chooses the quantity of children and consumption as the result of generalized Nash bargaining, subject to a household budget constraint. This is solved by maximizing the Nash product, or the “utility-gain product function” (McElroy and Horney, 1981), which we call u^h :

$$\begin{aligned} \max_{x, g} \quad u^h(\bar{n} - x, g) &= (u^f(\bar{n} - x, g) - z_f)^w (u^m(\bar{n} - x, g) - z_m)^{1-w} \\ \text{s.t.} \quad &g + \Pi(\bar{n} - x) + p_x x = I \end{aligned} \tag{1}$$

The outside options for husbands and wives within marriage are z_m and z_f respectively, and represent the reservation position within marriage (Lundberg and Pollak, 1993). We assume no divorce, an assumption that is realistic in rural Bangladesh—in the 1970s fewer than 1% of women and fewer than 0.01% of men were reported as divorced in Comilla, the

region of Bangladesh from which our data derives (Esteve-Volart, 2004). The wife's bargaining power is given by w ; Π is the price of raising a child; p_x is the price of contraception; I is household income; and the price of the consumption good, g , is normalized to 1.

Assumption 1: $\frac{u_n^m}{u_g^m} > \frac{u_n^f}{u_g^f}$

This assumption is central to our predictions: the husband's marginal rate of substitution of quantity of children for consumption is greater than that of the wife.

Assumption 2:

- a. $x \in [0, \bar{n}]$
- b. $p_x < \Pi$
- c. u^f and u^m satisfy the Inada conditions

These assumptions guarantee a positive, interior solution. Assumption 2a restricts the number of children to be non-negative and weakly less than \bar{n} ; assumption 2b states that contraception is cheaper than the price of child-rearing, ruling out an immediate choice of $x = 0$; and assumption 2c rules out the case $x = \bar{n}$.

Proposition 1: If fertility is sufficiently high, then a fall in the price of contraception decreases the utility of the husband. That is, if the optimal child quantity n^* is greater than some level \hat{n} : $\frac{du^m}{dp_x} > 0$.

Proofs are given in the appendix. The intuition behind Proposition 1 is straightforward: if the household already has many children, the marginal utility from each additional child is small. Then, the substitution effect of the price decrease outweighs the income effect; the household's reduction in child quantity is sufficient to make the husband worse off. The specific condition stating \hat{n} is given in the appendix.

Figure 1 gives the rough intuition behind the result. A fall in the price of contraception pushes the budget constraint out, enabling the household to enjoy a new allocation. Treating

the utility-gain product function of the household as though it were a utility function, we can trace out household indifference curves. The price decrease shifts the household from I_1^h to I_2^h , a superior indifference curve. However, as drawn in the figure, the husband's utility is actually lower at the new allocation, which lies below his original indifference curve I_1^m . A fall in the price of a good, even one that is enjoyed by both parties, can make one party worse off.

Proposition 2: A rise in the wife's bargaining power, w , reduces the utility of the husband: $\frac{u^m}{dw} < 0$.

Here the intuition is even more straightforward: the greater the divergence between the husband's preferred choice of n and g and the household's bargained outcome, the worse off the husband will be in the bargain.

3.3 Stage 1: Marriage Market

Parents choose a spouse for their child in the marriage market, taking their child's second stage utility from each potential match as given.

Assumption 3: Π and I are the same for all couples.

This assumption allows us to focus on the effects of changes in wife's bargaining power, w , and the price of contraception, p_x , as a result of the family planning program.

Parents of a groom with traits M secure a dowry D in the marriage market, so that their utility from a given match is:

$$v^m(W, W_f, c, n, g; M) = v^m(W, W_f, D(\bar{n} - x, g, W, W_f; M), u^m(n, g); M)$$

Similarly, parents of a bride with traits W, W_f pay dowry D in the marriage market. Their utility from a given match is:

$$v^f(M, c, n, g; W, W_f) = v^f(M, -D(\bar{n} - x, g, M; W, W_f), u^f(n, g); W, W_f)$$

We are implicitly assuming that dowries are the only source of consumption—adding other sources of income would not qualitatively change our results. Here, $n = \bar{n} - x(p_x, w, \Pi, I)$ and $g = g(p_x, w, \Pi, I)$ is the solution to the household's fertility bargain.

In equilibrium, each set of parents maximizes over their own consumption and the traits of their child's partner, taking their child's characteristics and the equilibrium dowry function as given. We assume that the only fertility relevant traits that differ among women are the price of contraception and their bargaining power in intrahousehold bargain, so that $W_f = (p_x, w)$. We can rewrite equilibrium utilities as:

$$\begin{aligned} v^m(M) &= \max_{W_f, W} v^m(W, W_f, D(\bar{n} - x, g, W, W_f; M), u^m(n, g); M) \\ v^f(W, W_f) &= \max_M v^f(M, -D(\bar{n} - x, g, M; W, W_f), u^f(n, g); W, W_f) \end{aligned}$$

This yields first order conditions:

$$\begin{aligned} \nabla_{W_f} D &= -\frac{v_{u^m}^m(M)}{v_c^m(M)} \nabla_{W_f} u^m = \frac{v_{u^m}^m(M)}{v_c^m(M)} (-u_{p_x}^m, -u_w^m) \\ \nabla_W D &= -\frac{\nabla_W v^m}{v_c^m(M)} \\ \nabla_M D &= \frac{\nabla_M v^f}{v_c^f(W)} \end{aligned} \tag{2}$$

The first order conditions readily give us the next proposition, which is the key comparative static that we take to the data.

Proposition 3: Holding the dowry function fixed, if fertility is sufficiently high, a fall in the price of contraception increases the dowry paid. Also, an increase in bargaining power

of the wife in the fertility bargain will increase the dowry paid.

Figure 2 graphically demonstrates the main prediction of the model. On the vertical axis we plot $\frac{dD}{dp_x}$, the response of dowry to an infinitesimal change in the price of contraception. The curve shows how this dowry effect moves with the fertility rate. Above some fertility level \hat{n} , a fall in the price of contraception increases the dowry women must pay. Holding husband's utility fixed, the amount that the dowry will increase shrinks as fertility falls.

3.4 Estimation Equation: Reduced Form

Using the first order conditions in (2), we can linearize the function $D(W_f, W, M)$ around the joint vector of sample means, which we denote $(\bar{W}_f, \bar{W}, \bar{M})$:

$$D(\bar{W}_f + \Delta W_f, \bar{W} + \Delta W, \bar{M} + \Delta M) \approx D(\bar{W}_f, \bar{W}, \bar{M}) + \nabla_{W_f} D(\bar{W}_f, \bar{W}, \bar{M}) \Delta W_f + \nabla_W D(\bar{W}_f, \bar{W}, \bar{M}) \Delta W + \nabla_M D(\bar{W}_f, \bar{W}, \bar{M}) \Delta M$$

We can easily write this as a regression equation:

$$\Delta D(\bar{W}_f, \bar{W}, \bar{M}) = \alpha + \nabla_{W_f} D(\bar{W}_f, \bar{W}, \bar{M}) \Delta W_f + \nabla_W D(\bar{W}_f, \bar{W}, \bar{M}) \Delta W + \nabla_M D(\bar{W}_f, \bar{W}, \bar{M}) \Delta M + \varepsilon$$

where α is a constant and ε is an error term. Since $W_f = (p_x, w)$, we can write:

$$\Delta D(\bar{W}_f, \bar{W}, \bar{M}) = \alpha + D_{p_x}(\bar{W}_f, \bar{W}, \bar{M}) \Delta p_x + D_w(\bar{W}_f, \bar{W}, \bar{M}) \Delta w + \nabla_W D(\bar{W}_f, \bar{W}, \bar{M}) \Delta W + \nabla_M D(\bar{W}_f, \bar{W}, \bar{M}) \Delta M + \varepsilon$$

The estimation equation thereby collapses the program effect on the price of contraception

and on the wife's bargaining power in reduced form:

$$\begin{aligned} \Delta D(\overline{W}_f, \overline{W}, \overline{M}) = & \alpha + \underbrace{D_{p_x}(\overline{W}_f, \overline{W}, \overline{M})\Delta p_x + D_w(\overline{W}_f, \overline{W}, \overline{M})\Delta w}_{\text{Program Effect}} + \\ & \nabla_W D(\overline{W}_f, \overline{W}, \overline{M})\Delta W + \nabla_M D(\overline{W}_f, \overline{W}, \overline{M})\Delta M + \varepsilon \end{aligned} \quad (3)$$

Here, our linearized reduced form estimation equation is given by:

$$D = \alpha + \beta T + \Phi_W W + \Phi_M M + \varepsilon$$

where D is the dowry amount; W is the vector of characteristics of the bride and her family; and M is the vector of characteristics of the groom and his family. The program's effect on W_f is captured by T , a dummy for treatment.

3.5 Estimation Equation: Instrumental Variables Model

If we hold married couple joint consumption fixed across households, we can use (3) to derive an expression for the effect on dowry of a change in quantity of children, by ignoring W_f and considering only direct effect of a change in $\bar{n} - x^*$:

$$\begin{aligned} \Delta D(\bar{n} - x^*, \overline{W}, \overline{M}) = & \delta + D_{\bar{n}-x^*}(\bar{n} - x^*, \overline{W}, \overline{M})\Delta(\bar{n} - x^*) + \\ & \nabla_W D(\bar{n} - x^*, \overline{W}, \overline{M})\Delta W + \nabla_M D(\bar{n} - x^*, \overline{W}, \overline{M})\Delta M + \nu \end{aligned}$$

In the estimation, we only observe fertility ex post—we do not observe the program's effect on p_x and w . The model, however, demonstrates that excludability is violated, since joint consumption will also be affected by the fall in the price of contraception. However, since increased joint consumption reduces the dowry paid, the direction of the bias in the

instrumental variables estimate is illuminated by the model. Insofar as one of the Matlab program's effects was to increase consumption, as indicated by (Joshi and Schultz, 2006), restricting our attention to fertility produces estimates of the effect of fertility on dowries that are biased downward. That is, the model predicts that unobserved variation in household joint consumption is negatively correlated with fertility and also negatively correlated with dowry amounts, so that the estimated instrumental variables coefficient on fertility will be attenuated. This gives a lower bound on the magnitude of the true program effect on dowry.

Here, our linearized first stage equation is given by:

$$\bar{n} - x^* = \delta + \gamma T + \nu$$

Here, as before, T is a dummy indicating treatment, and $\bar{n} - x^*$ is the optimal fertility of each couple.

4 Data and Econometric Specification

4.1 The Matlab Family Planning Program

The genesis of the family planning project in the rural Matlab district of Bangladesh was in the mid 1960s, when Matlab was a part of Pakistan. A clinic was first located in Matlab in 1963, which served all 250,000 households in 234 villages in the region. By the 1970s, despite the availability of clinic-based family planning services for over a decade, fewer than five percent of rural women were using any form of modern contraception. This fact was troubling to family planning and public health specialists, since survey evidence suggested that of women of childbearing age, more than half did not want any more children. It was decided that instead of making women come to the family planning, the family planning would go to the women in a door-to-door effort to distribute contraceptives.

To address these problems, the Matlab program began in October 1977. Seventy villages were selected to receive the program, with seventy-one villages left as control. The selection criteria for each village was based on contiguousness, to minimize spillover, rather than any intrinsic feature of the villages in the treatment and control areas (see Figure 1, a map of the Matlab area, in which the treatment villages are shaded). Several studies, most conclusively Joshi and Schultz (2006), have established that covariates were largely balanced at baseline.¹³

A central center and four sub centers were constructed, and eighty female village workers (to begin with) were given intensive training in family planning counseling, including a three week orientation, four week pre-service orientation, and once a week in-service training. These women would become the face of the Matlab program. The overarching goal was to focus on family planning at first, but to eventually phase health-related interventions into the study, including child diarrhea prevention and health services for new and expectant mothers. These new services were added in stages beginning in 1982 (Phillips et al., 1984).¹⁴

The geographic layout of Matlab has given researchers reasonable grounds to assert that “the area tends to insulate treatments from one another and from the outside world” (Phillips et al., 1982, pg. 131). For many years, the area was not accessible by roads and other modern forms of transportation. Additionally, rather than integrating into the larger economic changes sweeping that part of Asia at the time (and potentially having a confounding influence on the experiment), Phillips et al. (1982, pg. 132) report that “the changes that have occurred are therefore not of a sort that demographers regard as prerequisites or corequisites of demographic transition.”

The Matlab study is the most well-known family planning intervention in the population literature. Freedman (1997, pg. 2) describes the project as “the only reasonably valid ex-

¹³One exception is that the treatment villages contained a slightly larger population of Hindus (roughly 14% in the treatment villages as compared to 5% in the control)—to minimize contamination from this fact, and also because the anthropological evidence indicates that Hindus largely used dowry as bequest, we consider only Muslims in the analysis.

¹⁴To focus strictly on the family planning aspect of the intervention, we restrict the estimation sample to marriages before 1982.

periment that deals with program effects on fertility preferences”—and studies of the effects of family planning in other settings generally begin with a discussion of the Matlab results (Miller, 2005, for example). Not only did contraception rates increase, but Bhatia et al. (1980) found that those who began using contraception were much more likely to remain on contraception for a longer period of time. The effects on fertility were almost immediate—in our data, we see a large drop in the general fertility rate starting in 1979, when the program began in October 1977. In addition, the program has been widely found to produce long-term effects on women’s economic and health outcomes (Joshi and Schultz, 2006, for example).

4.2 Qualitative Evidence

Considerable evidence indicates that women in the treatment villages were subjected to punishment and ostracism. Interviews with women in the treatment villages indicate that “many husbands, in the tradition of patriarchy, initially complained about their wives accepting contraception” (Duza and Nag, 1993, pg. 79). Women who sought to use contraception did so “at considerable personal risk of embarrassment, shame, or rejection by her husband and his family” (Cleland et al., 1994). Husbands reportedly punished even the possession of contraceptives (Aziz and Mahoney, 1985). Munshi and Myaux (forthcoming) argue that these factors slowed the uptake of contraceptive technology in Matlab. Adopting contraception challenged the reigning social norm wherein fertility was a wife’s primary “socially recognized” contribution to a family.¹⁵

In the Matlab region, women reported that they bore not only a greater burden of costs of reproduction, but also a greater burden of the costs of raising a family. One young women from Matlab reported that: “In many cases, the husband says to his wife: ‘Look, you can’t

¹⁵As a recent study puts it: “[For women] the objectives of marriage are to procreate and build a family, to fulfil the sexual needs of both the man and the woman, to determine the inheritor and to make life fixed and regular” (Chowdhury, 2004, pgs. 247-248).

use family planning methods: let there be ten babies—if that’s what it’s going to be.’ But the wife thinks otherwise Men don’t bother about the number of children. While women do, because they are the ones who actually look after the families. The burden of the family is really borne by women” (Simmons, 1996, pg. 253).

4.3 Data

We estimate the model using data from 1996 Matlab Health and Socioeconomic Survey (MHSS).¹⁶ We have 1051 Muslim women in this dataset for whom we have information on year of marriage, whether dowry was paid, the dowry amount, and village of residence. Of these, 103 report dowry for previous marriages and are excluded from consideration in the regressions with husband characteristics. In addition, many husbands were difficult to locate for the survey, so that the specifications which control for husband characteristics uses a sample of 714 women for whom we have information on whether year of marriage, whether dowry was paid, the dowry amount, residence in treatment village, and the other bride and groom side characteristics used in the regressions. To deflate dowries, we use the price of rice, as in Khan and Hossain (1989) and Amin and Cain (1998) (see Data Appendix).

Table 1 reports summary statistics, broken down by treatment and control villages. With the exception of wife’s body mass index (BMI), covariates are not statistically significantly different between treatment and control.¹⁷ The only variables that are statistically significantly different are dowry variables (in marriages after the onset of the program) and births. Before the family planning program, average dowries represent roughly sixty percent of a couple’s annual income.¹⁸ Average dowries as a fraction of income are smaller than those

¹⁶Detailed discussion of the dataset and variable construction is in the Data Appendix.

¹⁷A possible explanation for the slightly larger BMI in the treatment villages is that BMI is measured in 1996; maternal health programs had been available since 1982 in the treatment villages.

¹⁸In 1976, the average daily wage in rice farming for a 20-25 year old man was 6.5 takas (Cain, 1977). The probability of being employed in a given day is low; we take an overestimate of 350 days worked to give an annual income of 2275 takas. Women draw very little in the market; using the 1996 proportion of female to male income as an upper bound, we add five percent to give an annual household income of roughly 2400

reported in India in other studies, which range up to several multiples of annual household income (Rao, forthcoming).

4.4 Empirical Strategy

We now turn to the econometric specifications used to estimate the model.

4.4.1 Reduced Form

Our primary specification of interest examines the overall impact of the family planning program on dowries. We use a difference-in-differences strategy that compares dowries between the treatment and control areas, before and after the program began. We report two treatment effects in the reduced form: dowry participation, and dowry amount. The former seeks to answer whether the effect on dowries occurred only at the extensive margin, while the latter is the main result of the paper.

To eliminate contamination of the model by bequest dowries, in the primary specifications we trim the data to four years before the onset of the program in 1977. We also exclude Hindu marriages, in order to eliminate another major source of bequest dowries. We also trim the data to four years after the onset of the program, to eliminate another possible source of contamination: the establishment of a major maternal and child health intervention in the treatment area starting in 1982. By using the trimmed sample, we can most closely estimate the effects of the fertility effects of the family planning program.

For dowry amount, we estimate equation (3) given by the theoretical model. The specific

takas. The average dowry in 1976 is 1440 takas, giving us the estimate of 60% of annual household income. If we restrict attention to positive dowries, the average dowry is 3450 takas, yielding an estimate of 140% of annual household income.

difference-in-differences regression takes the form:

$$\begin{aligned} \text{Dowry} = & \alpha + \beta_1 \text{Treatment} \times \text{Post} + \beta_2 \text{Treatment} + \beta_3 \text{Post} + \\ & \beta_4 \text{Treatment} \times \text{Transition} + \beta_5 \text{Transition} + \Phi_W W + \Phi_M M + \Phi_X X + \epsilon \end{aligned} \quad (4)$$

For dowry participation—whether a dowry is given—we estimate a probit of the form:

$$\begin{aligned} \text{Any Dowry} = & \alpha + \beta_1 \text{Treatment} \times \text{Post} + \beta_2 \text{Treatment} + \beta_3 \text{Post} + \\ & \beta_4 \text{Treatment} \times \text{Transition} + \beta_5 \text{Transition} + \Phi_W W + \Phi_M M + \Phi_X X + \epsilon \end{aligned} \quad (5)$$

The unit of observation is a marriage. “Any Dowry” is a dummy variable taking value 1 if a dowry was given in the marriage. “Treatment” is a dummy referring to residence in a treatment village at the time of the survey; “Post” is a dummy that takes value 1 if the year of marriage is 1978 or later; and “Transition” is a dummy taking 1 if the year of marriage is 1977. We use the separate “Transition” dummy since the program began during 1977, but we do not have month of marriage for most couples, in order to avoid falsely attributing a treatment effect to transition year marriages. As controls we include vectors of wife characteristics W , husband characteristics M , and demographic trends X which include the age-adjusted sex ratio (Rao, 1993).

In this framework, the coefficients of interest are β_1 and β_4 . Estimates of these coefficients represent the difference-in-differences estimates of the program’s impact on dowry. This is the primary estimate of interest in the paper.

4.4.2 Fertility and Dowry

Directly analyzing the mechanism proposed in the paper poses several challenges. First, dowries are transferred at marriage, while fertility is observed ex post, so that regressing dowry amounts on observed fertility captures the noise with which couples anticipate intra-

household bargains. Second, and more importantly, fertility may be correlated with many characteristics that affect the dowry amount. Third, the simple difference-in-differences identification strategy used to estimate the effect of the program in reduced form will not capture the fertility effect on dowry, precisely because the program’s effect on fertility is indistinguishable between women who were married before and after the program began. Indeed, plotting fertility by year of marriage (not displayed) shows no break in 1977, because all treatment village women who married around the program years were treated.

We approach the problem by using the specification:

$$\text{Dowry} = \delta + \gamma_1 \text{Births} \times \text{Post} + \gamma_2 \text{Births} + \gamma_3 \text{Post} + \Gamma_W W + \Gamma_M M + \Gamma_X X + \nu \quad (6)$$

To measure fertility, we follow Joshi and Schultz (2006) in using the number of live births to each couple. Here, we instrument the interaction term $\text{Births} \times \text{Post}$ using $\text{Treatment} \times \text{Post}$. The coefficient of interest is γ_1 , which captures how fertility affects dowry amount for women married after the program versus women married before the program.

5 Results

The central empirical results can be seen visually. Figure 3 shows the general fertility rate (births per 1000 women age 15-44) in treatment and control villages. The general fertility rate in both areas is approximately constant at around 250 births until about 1970, when it begins to trend downward. The year 1977, when the program began in October, is marked by the vertical line. In 1979, a gap between the areas emerges of approximately 30 fewer births in the treatment villages, and continues through to the end of the period. Figure 4 shows the average log dowry amounts in treatment and control villages plotted by year of marriage. Immediately upon the onset of the program, dowry amounts in the treatment

villages (relative to control) rise by approximately 100%. The gap between treatment and control begins to close around the mid-1980s.

There are a few points worth highlighting. First, while the change in dowry amounts is immediate upon the onset of the program, while the effect on fertility takes several months to be realized. This is consistent with our model as capturing the marriage market effects of anticipated changes in fertility. Second, the difference in dowry amounts between treatment and control villages increases at once, consistent with our comparative static in Proposition 1 that a discrete fall in the price of controlling fertility raises dowry amounts. Third, the difference in dowry amounts between treatment and control villages declines as fertility falls, consistent with the result in Proposition 1, that the dowry effect of the program will decline as fertility falls.¹⁹

5.1 Reduced Form: Difference-in-differences Program Effect

Table 2 shows OLS regression results, with the differences-in-differences effect of the program on dowry amounts shown in the first two rows. Columns (1) to (3) use real dowry (in rice kg) as the dependent variable, while columns (4) to (6) use the log of real dowry (in rice kg), with a start of 1 added to all amounts. The coefficient of interest is reported in first row. In Columns (1) and (4), no covariates are included; in columns (2) and (5), only the reported covariates are included; and columns (3) and (6), our preferred estimates, report results with year of marriage dummies included. From the first three columns, we see that the difference-in-differences estimate (the coefficient on $\text{Treatment} \times \text{Post}$) ranges from 212.16 kg to 237.30 kg; using the sample mean of the pre-1977 dowries this represents an 80% to 90% increase in dowry amount. Columns (4) to (6) use log amounts, although the fact that

¹⁹Another possible explanation for the decline in the dowry effect is the proliferation of intensive maternal health services in the treatment villages. Medical services were phased in beginning in 1982, and grew to include, for example, tetanus vaccination for all women (Phillips et al., 1984). In terms of the model, improvements in maternal health improve the bride's characteristics W , so that the total dowry effect may be ambiguous. It is for this reason that we restrict the estimation sample to marriages before 1982.

we must add 1 to the dowry amounts prevents an exact interpretation in terms of elasticity. Ignoring this fact, the coefficients would translate to a 152% increase in dowry amounts.²⁰

In contrast to the coefficient on Treatment×Post, the coefficient on Treatment×Transition is only significant in the specification without controls. Once other characteristics that affect the dowry are added, the point estimate falls and the estimate loses statistical significance.

In Table 3, we examine the extent to which the program operated on the extensive margin of dowry-giving. The marginal effects from a probit model are reported. We see a moderate increase in the likelihood of giving a dowry as a result of the program (the coefficient on Treatment×Post is 15-16%). Again, the estimate remains statistically significant even as other controls and year of marriage dummies are added, while the point estimate on Treatment×Transition shrinks and loses statistical significance once covariates are added to the specification.

To sum, we see a fifteen percent increase in dowry giving as a result of the program, and at least an eighty percent increase in average dowry amounts.²¹

²⁰Since the dowry amounts model uses a semilog specification where the variables of interest are dummies (Kennedy, 1981), the estimate of the percentage increase of real dowry amounts as a result of the program becomes:

$$g^* = \exp(\hat{\beta} - \frac{1}{2}\hat{V}(\hat{\beta})) - 1$$

²¹Are our effects too large to be reasonable? Since ours is the first paper to document the marriage market effects of a family planning program, we cannot easily benchmark our findings, but estimates of the cost of child-rearing from another part of rural Bangladesh permit a rough statement about whether our findings are of a reasonable size. We find an increase in dowry amounts of at least eighty percent as a result of the program, which from the sample mean represents approximately half of one year’s market household income. Based on estimates conducted in another part of Bangladesh, this is smaller than the expected cost of raising a child over fifteen years. Using time use and earnings data from rural Bangladesh in 1984, Khan et al. (1993) show that non-market wage estimates (predominantly attributed to women) are fairly high, so that our dowry effect therefore represents approximately 25% of one year’s total (market and non-market) household income. From the same study, the costs of child-rearing in rural Bangladesh are about 5% of annual (market and non-market) household income each year. In the absence of income growth, we can roughly calculate that a household bears approximately 65% of one year’s income to raise a child for 15 years, minus the economy of scale effect, which Khan et al. (1993) estimate at approximately 20% at the margin, giving a total figure of 55% of one year’s household income. We find a 14% decline in fertility as a result of the program (as do Joshi and Schultz (2006)), which represents about .65 children. In terms of the cost of child-rearing, the program reduces children by approximately 35% of one year’s (market and nonmarket) household income—or 70% of one year’s market household income. Thus the dowry effect is easily dominated by the amount a couple would have been willing to pay to raise the children foregone as a

5.2 Are Dowry Amounts Left-Censored?

We would argue that dowry amounts are most likely not left-censored. That is, a “zero” for dowry amount is most likely a meaningful zero—the match is sustained without a dowry being transferred. While we do not have brideprice amounts in our data, evidence from other studies in rural Bangladesh indicates that brideprices disappeared by the 1950s, well before our survey period (Amin and Cain, 1998; Lindenbaum, 1981).

This said, we assess the robustness of our results to the possibility of censoring by using a Tobit model. The estimates in Table 4 indicate much larger program effects than the OLS estimates—in the most complete specification, the estimate is almost double that of the OLS estimate. Since the qualitative evidence does not justify the Tobit assumptions, we do not put much weight in these estimates, except to note that they do not reject our findings.

5.3 IV Model: Fertility Decline Drives Dowry Increase

We use a two-stage least squares model to test our purported mechanism: that the program increases dowry amounts by lowering fertility, where fertility is instrumented using residence in a treatment village. Table 5 reports the results of the instrumental variables model. Column (1) reports the second stage; the coefficient on $\text{births} \times \text{post}$ represents an approximate doubling in dowry amount for each fewer birth. Column (2) reports the same result using log dowry; here, the effect is a 112% increase for each fewer birth. The estimate of the fertility effect of the program has been widely estimated at reducing births by .65 by couple (Joshi and Schultz, 2006); at this level, the total instrumental variables estimate is approximately 63% (or 73% using the log dowry estimates) increase in dowry attributable to the average reduction in births. Column (3) reports the first stage.

result of the program.

5.4 Alternative Hypotheses

A natural concern is that the sharp rise in dowry may have been driven by sorting. For example, it may be that the Matlab program shaped the nature of matching in some unobservable way that raised average dowries in the treatment villages. While we cannot test this hypothesis directly, we can check for sorting on observables as a result of the program. Table 6 displays the estimated coefficients from a series of separate regressions. In each regression, a covariate is treated as the dependent variable, and the difference-in-differences estimate of the program’s “effect” on this covariate is estimated. Other than the dowry results, which correspond with the reported coefficient in Column 1 of Table 1, only with wife’s BMI do we see a statistically significant change after the program across treatment and control villages. The fact that the change is positive makes it an unlikely candidate for explaining the *rise* in dowry amounts.

Another possible concern is that the research design may be contaminated in some other way—and that we are spuriously attributing to the Matlab program a dowry effect. As a test of the research design, we duplicate (4) using “fake program years” from 1951 to 1990. For each fake year of marriage, we restrict to marriages within four years before and afterward, and examine the estimated coefficients β_1 and β_4 . This placebo test is aimed at checking that we have not picked up a spurious rise in dowries. Figure 5 shows the results: the only statistically significant difference-in-differences estimate is the one associated with the true program year, 1977.

6 Conclusions

Consistent with a model in which men demand larger dowries from brides with lower anticipated fertility, we found large and positive effects of a family planning program on dowry transfers in Bangladesh. Our results speak to two literatures which have, up to this point,

remained separate. With regard to the growing literature on dowries—particularly the literature regarding dowry inflation in South Asia—we offer a distinct explanation for the rise in dowry-giving and dowry amounts: falling fertility. Our model furthermore predicts that the fertility effect on dowry amounts is initially large and then falls as overall fertility drops. Insofar as our findings generalize to other parts of South Asia, *ceteris paribus* we would predict a decline in dowry-giving as the income effect of the declining price of fertility control dominates the substitution effect.

With regard to the efficacy of family planning programs, our findings indicate that the marriage market responded to attempts to shape fertility outcomes. The Matlab program was responsible for important long-run improvements in women’s health and economic outcomes (Chaudhuri, 2003; Joshi and Schultz, 2006). However, our study does indicate that women (or more precisely, their families) to some extent paid for these improvements up front—a wholly unintended consequence of the program. The effect is analogous to other public policy measures in a variety of settings where only one side of the market is “treated.” Economists have found that the beneficial effects of interventions may be mitigated, if, for example, sex workers are educated about health risks from non-condom use but clients are not, the effect of public health interventions may be to simply raise the compensating differential to risky sex (Gertler et al., 2005). In our context, targeting men’s fertility preferences may be an effective method of improving the efficacy of family planning in poor countries.

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Table 1: Summary Statistics

Variable	Treatment	Control	Difference (Treatment-Control)
Year of marriage	77.12	77.26	-0.14
Wife's age at marriage	15.37	15.39	-0.03
Husband's age at marriage	24.39	24.32	0.06
Wife's BMI	19.6	18.91	0.69***
Husband's BMI	18.81	18.76	0.05
Wife did not attend school (=1)	0.55	0.54	0.01
Wife attended some primary school (=1)	0.34	0.38	-0.04
Wife attended some secondary school (=1)	0.11	0.09	0.03
Husband did not attend school (=1)	0.58	0.58	0.00
Husband attended some primary school (=1)	0.19	0.22	-0.02
Husband attended some secondary school (=1)	0.23	0.20	0.03
Wife's mother's school (yrs)	0.76	0.79	-0.04
Wife's father school (yrs)	2.41	2.37	0.04
Husband's mother's school (yrs)	0.20	0.17	0.03
Husband's father's school (yrs)	1.22	1.12	0.1
Wife's parents' land value (1996 takas)	76078.90	60188.19	15890.71
Husband's parents' land value (1996 takas)	108034.6	90262.11	17772.46
Wife was previously married (=1)	0.18	0.18	-0.01
Husband is polygynous (=1)	0.03	0.02	0.01
Dowry given at marriage (pre-1977) (=1)	0.31	0.32	-0.01
Dowry given at marriage (post-1977) (=1)	0.62	0.49	0.14***
Nominal dowry in takas (pre-1977)	1033.43	1170.76	-137.33
Nominal dowry in takas (post-1977)	2794.68	1689.75	1104.93***
Real dowry in rice kg (pre-1977)	264.07	271.46	-7.39
Real dowry in rice kg (post-1977)	487.38	282.6	204.77***
Births	3.93	4.55	-0.62***

Note: Statistical significance: * 10% ; ** 5% ; *** 1%.

Table 2: Difference-in-Differences Effect on Dowry Amount

	Dowry (1)	Dowry (2)	Dowry (3)	log(Dowry+1) (4)	log(Dowry+1) (5)	log(Dowry+1) (6)
Treatment×Post	212.16 (90.79)**	230.21 (102.99)**	237.30 (102.64)**	0.98 (0.37)***	1.05 (0.44)**	1.09 (0.44)**
Treatment×Transition	293.60 (130.14)**	164.96 (152.70)	183.51 (151.94)	1.25 (0.62)**	0.79 (0.7)	0.84 (0.7)
Treatment	-7.39 (59.09)	-1.05 (67.43)	-14.01 (65.73)	-.07 (0.34)	-.07 (0.39)	-.12 (0.39)
Post	11.15 (44.11)	330.00 (163.18)**		0.94 (0.27)***	-.02 (0.57)	
Transition	-59.34 (70.84)	167.39 (102.59)		-.11 (0.43)	-.26 (0.54)	
Year of marriage (19–)		-52.41 (27.11)*	2.28 (13.69)		0.25 (0.1)***	0.18 (0.07)**
Wife’s age at marriage		-33.55 (7.40)***	-29.14 (6.38)***		-.21 (0.04)***	-.21 (0.04)***
Husband’s age at marriage		1.06 (2.51)	1.30 (2.66)		0.002 (0.02)	0.004 (0.02)
Eligible sex ratio (males/females)		61.28 (217.74)	265.99 (326.40)		-.25 (0.65)	-.67 (0.79)
Wife attended some primary school		27.16 (70.93)	32.38 (69.77)		-.02 (0.28)	-.02 (0.28)
Wife attended some secondary school		22.03 (142.06)	35.79 (143.78)		-.67 (0.5)	-.76 (0.52)
Husb. attended some primary school		15.68 (63.93)	16.79 (66.89)		-.79 (0.25)***	-.81 (0.25)***
Husb. attended some secondary school		209.84 (87.10)**	197.36 (82.99)**		-.27 (0.32)	-.33 (0.31)
Wife’s parents’ land (’000s takas)		0.17 (0.18)	0.17 (0.17)		-.00 (0.00)	-.00 (0.00)
Husband’s parents’ land (’000s takas)		-.05 (0.13)	-.03 (0.12)		0.00 (0.00)	0.00 (0.00)
Wife’s BMI		5.68 (17.60)	5.54 (17.75)		-.03 (0.05)	-.02 (0.05)
Husband’s BMI		-10.01 (16.56)	-11.76 (16.64)		-.01 (0.06)	-.01 (0.06)
Constant	271.46 (35.77)***	4560.92 (2160.45)**	253.93 (1306.78)	2.06 (0.24)***	-12.09 (7.57)	-6.74 (6.63)
Obs.	1051	714	714	1051	714	714
R ²	0.02	0.06	0.08	0.06	0.13	0.14
F statistic	3.35	4.26	4.23	15.12	10.5	8.89

Note: In columns (1)-(3) the dependent variable is real dowry (rice kg); in columns (4)-(6) the dependent variable is log real dowry with a start of 1 added to dowry amounts. Columns (3) and (6) include year of marriage dummies. “Treatment” indicates residence in a treatment village; “Post” indicates a marriage in 1978-1981; “Transition” indicates a marriage in 1977. Parents’ land value is given in 1996 takas. For the schooling dummies, the omitted category is “no school attended.” Robust standard errors, clustered by village. Statistical significance: * 10% ; ** 5% ; *** 1%.

Table 3: Difference-in-Differences Effect on Dowry Participation

	Any Dowry (1)	Any Dowry (2)	Any Dowry (3)
Treatment*Post	0.15 (0.06)***	0.15 (0.08)**	0.16 (0.07)**
Treatment*Transition	0.16 (0.09)*	0.08 (0.12)	0.09 (0.12)
Treatment	-0.01 (0.05)	0.01 (0.07)	0.00 (0.07)
Post	0.18 (0.04)***	-0.03 (0.10)	
Transition	-0.03 (0.07)	-0.10 (0.09)	
Year of marriage (19-)		0.06 (0.02)***	0.04 (0.01)***
Wife's age at marriage		-0.04 (0.01)***	-0.04 (0.01)***
Husband's age at marriage		0.00 (0.00)	0.00 (0.00)
Eligible sex ratio (males/females)		-0.22 (0.13)*	-0.36 (0.17)**
Wife attended some primary school		0.02 (0.05)	0.02 (0.05)
Wife attended some secondary school		-0.10 (0.08)	-0.12 (0.08)
Husband attended some primary school		-0.18 (0.04)***	-0.19 (0.04)***
Husband attended some secondary school		-0.12 (0.05)**	-0.14 (0.05)***
Wife's parents' land value ('000s takas)		-0.00 (0.00)	-0.00 (0.00)
Husband's parents' land value ('000s takas)		0.00 (0.00)*	0.00 (0.00)*
Wife's BMI		-0.01 (0.01)	-0.01 (0.01)
Husband's BMI		0.00 (0.01)	0.01 (0.01)
Obs.	1051	714	714
χ^2	104.52	167.64	191.45

Note: Probit model with marginal effects reported. The dependent variable is “Was any dowry paid at marriage?”. Column (3) includes year of marriage dummies. “Treatment” indicates residence in a treatment village; “Post” indicates a marriage in 1978-1981; “Transition” indicates a marriage in 1977. Parents' land value is given in 1996 takas. For the schooling dummies, the omitted category is “no school attended.” Robust standard errors, clustered by village. Statistical significance: * 10% ; ** 5% ; *** 1%.

Table 4: Robustness: If Dowry Amounts Are Censored—Tobit Model

	Dowry (1)	Dowry (2)	Dowry (3)	log(Dowry+1) (4)	log(Dowry+1) (5)	log(Dowry+1) (6)
Treatment*Post	428.16 (200.42)**	442.13 (238.94)*	457.71 (236.35)*	1.84 (0.87)**	1.89 (1.02)*	1.96 (1.00)*
Treatment*Transition	656.43 (314.67)**	359.13 (342.53)	395.01 (339.84)	2.71 (1.48)*	1.62 (1.54)	1.71 (1.53)
Treatment	-24.47 (171.51)	3.17 (199.14)	-20.67 (195.84)	-1.15 (0.86)	-0.09 (0.97)	-0.16 (0.95)
Post	301.62 (129.42)**	532.42 (303.58)*		2.37 (0.66)***	0.42 (1.25)	
Transition	-96.23 (216.16)	196.01 (250.44)	-112.08 (240.50)	-0.19 (1.13)	-0.37 (1.22)	-1.26 (1.20)
Year of marriage (19–)		0.85 (40.81)	47.15 (38.05)		0.56 (0.2)***	0.36 (0.17)**
Wife’s age at marriage		-129.71 (31.73)***	-131.35 (29.73)***		-0.61 (0.11)***	-0.68 (0.12)***
Husband’s age at marriage		4.07 (6.57)	5.28 (6.66)		0.01 (0.03)	0.02 (0.03)
Eligible sex ratio (males/females)		-339.15 (373.35)	-431.11 (494.64)		-2.25 (1.58)	-4.46 (1.82)**
Wife attended some primary school		10.41 (134.84)	17.69 (131.35)		-0.12 (0.57)	-0.09 (0.56)
Wife attended some secondary school		-134.69 (271.17)	-143.93 (272.27)		-1.46 (1.15)	-1.64 (1.16)
Husb. attended some primary school		-178.58 (116.53)	-192.83 (117.68)		-1.70 (0.57)***	-1.79 (0.56)***
Husb. attended some secondary school		143.62 (163.23)	93.08 (152.77)		-0.83 (0.68)	-1.07 (0.66)
Wife’s parents’ land (’000s takas)		0.14 (0.34)	0.1 (0.35)		-0.00 (0.00)	-0.00 (0.00)
Husband’s parents’ land (’000s takas)		0.18 (0.24)	0.21 (0.24)		0.00 (0.00)*	0.00 (0.00)*
Wife’s BMI		1.80 (32.15)	3.47 (32.38)		-0.07 (0.12)	-0.05 (0.11)
Husband’s BMI		-15.11 (32.01)	-14.60 (31.57)		-0.02 (0.12)	-0.009 (0.12)
Constant	-562.66 (159.19)***	1600.93 (3439.31)	-1616.76 (3316.48)	-1.58 (0.65)**	-29.98 (15.85)*	-12.31 (15.03)
Obs.	1051	714	714	1051	714	714
χ^2 statistic	25.49	47.84	60.05	86.12	136.38	159.08

Tobit model: In columns (1)-(3) dependent variable is real dowry (rice kg); in columns (4)-(6) log real dowry. Columns (3) and (6) include year of marriage dummies. “Treatment” indicates residence in a treatment village; “Post” indicates a marriage in 1978-1981; “Transition” indicates a marriage in 1977. Parents’ land value is given in 1996 takas. For the schooling dummies, the omitted category is “no school attended.” Robust standard errors, clustered by village. Statistical significance: * 10% ; ** 5% ; *** 1%.

Table 5: Instrumental Variables Model

	Dowry	log(Dowry+1)	Births×Post
Births×Post	-259.30 (133.58)*	-1.12 (0.56)**	
Births	68.38 (55.62)	0.38 (0.24)	0.41 (0.03)***
Treatment×Post			-.79 (0.14)***
Treatment			0.38 (0.08)***
Post	1439.05 (663.21)**	5.55 (2.60)**	4.98 (0.14)***
Year of marriage	-42.61 (25.62)*	0.18 (0.09)*	-.06 (0.03)**
Wife's age at marriage	-35.22 (7.94)***	-.23 (0.04)***	-.03 (0.01)**
Husband's age at marriage	-1.52 (2.58)	-.004 (0.02)	-.002 (0.006)
Eligible sex ratio (males/females)	-55.86 (199.26)	-.87 (0.73)	-.57 (0.2)***
Wife attended some primary school	3.03 (67.17)	-.09 (0.28)	-.03 (0.07)
Wife attended some secondary school	-10.14 (142.83)	-.71 (0.54)	0.009 (0.15)
Husband attended some primary school	11.89 (65.14)	-.77 (0.26)***	0.02 (0.07)
Husband attended some secondary school	220.44 (79.56)***	-.22 (0.31)	0.02 (0.06)
Wife's parents' land ('000s takas)	0.18 (0.16)	-.00 (0.00)	0.00 (0.00)
Husband's parents' land ('000s takas)	-.04 (0.14)	0.00 (0.00)	-.00 (0.00)
Wife's BMI	-1.10 (17.48)	-.05 (0.06)	-.03 (0.01)**
Husband's BMI	-4.14 (15.81)	0.008 (0.06)	0.02 (0.01)
Constant	3764.73 (2060.56)*	-7.88 (7.40)	3.54 (2.16)
Obs.	714	714	714
R^2	0.002	0.01	0.88
F Statistic	0.63	1.48	335.66

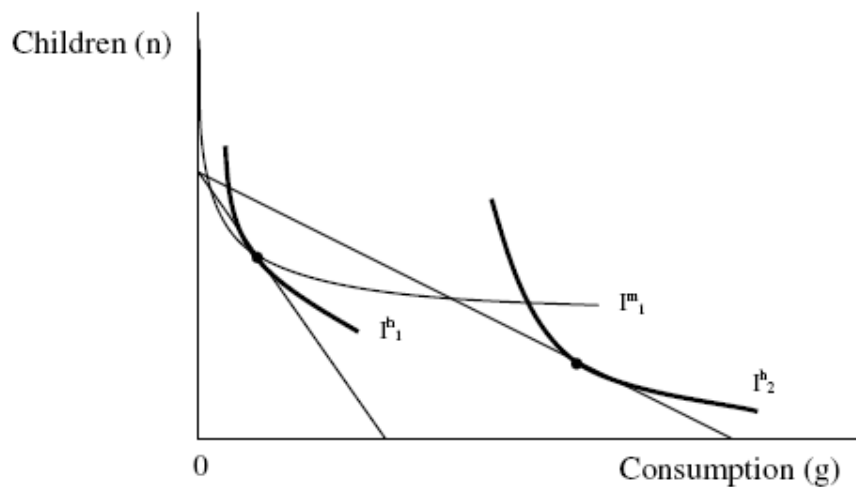
Note: First and second stages of two-stage least squares instrumental variables model. "Treatment" indicates residence in a treatment village; "Post" indicates a marriage in 1978-1981; "Transition" indicates a marriage in 1977. Parents' land value is given in 1996 takas. For the schooling dummies, the omitted category is "no school attended." Robust standard errors, clustered by village.

Table 6: No Evidence of Sorting on Observables

Variable	Treatment×Post (Std Error)	Treatment×Transition (Std Error)
Wife's age at marriage	0.33 (0.42)	0.61 (0.81)
Husband's age at marriage	1.06 (1.17)	0.85 (1.47)
Wife's BMI	-0.77 (0.34)**	0.42 (0.49)
Husband's BMI	-0.24 (0.34)	0.17 (0.75)
Wife did not attend school	-0.01 (0.06)	-0.06 (0.10)
Wife attended some primary school	0.02 (0.06)	-0.01 (0.11)
Wife attended some secondary school	-0.00 (0.04)	0.07 (0.05)
Husband did not attend school	-0.00 (0.06)	-0.22 (0.10)**
Husband attended some primary school	0.04 (0.05)	0.01 (0.09)
Husband attended some secondary school	-0.03 (0.05)	0.21 (0.08)***
Wife's mother's school (years)	0.24 (0.24)	0.52 (0.33)
Wife's father's school (years)	-0.49 (0.46)	1.22 (0.61)**
Husband's mother's school (years)	-0.09 (0.10)	0.14 (0.15)
Husband's father's school (years)	-0.07 (0.38)	-0.38 (0.48)
Wife's parents' land value (1996 takas)	-27110.52 (21853.84)	-37885.55 (28872.56)
Husband's parents' land value (1996 takas)	21916.91 (25108.02)	14354.74 (31398.74)
Wife was previously married	0.05 (0.05)	-0.01 (0.08)
Husband is polygynous	0.01 (0.02)	0.04 (0.03)
Dowry given at marriage	0.14 (0.05)***	0.15 (0.09)*
Nominal dowry (takas)	1242.26 (401.08)***	1156.51 (480.98)**
Real dowry (rice kg)	212.16 (90.79)**	293.60 (130.14)**
Births	-0.03 (0.22)	-0.30 (0.36)

Note: Each row reports the estimated coefficient on the interactions Treatment×Post and Treatment×Transition in a series of separate OLS regressions. The specification for each regression is:

Variable = $\delta + \gamma_1 \text{Treatment} \times \text{Post} + \gamma_2 \text{Treatment} + \gamma_3 \text{Post} + \gamma_4 \text{Treatment} \times \text{Transition} + \gamma_5 \text{Transition} + v$
For dummy variables, the specification is a linear probability model. Statistical significance: * 10% ; ** 5% ; *** 1%.



Note: Lowering the price of contraception moves the budget line from its tangency with I_1^h a household indifference curve to a tangency with I_2^h , a higher household indifference curve. However, the new tangency lies beneath the husband's indifference curve at the old tangency, I_1^m . In this case, the decrease in the price of contraception lowers his welfare.

Figure 1: Fall in Contraceptive Price Can Lower Husband's Welfare

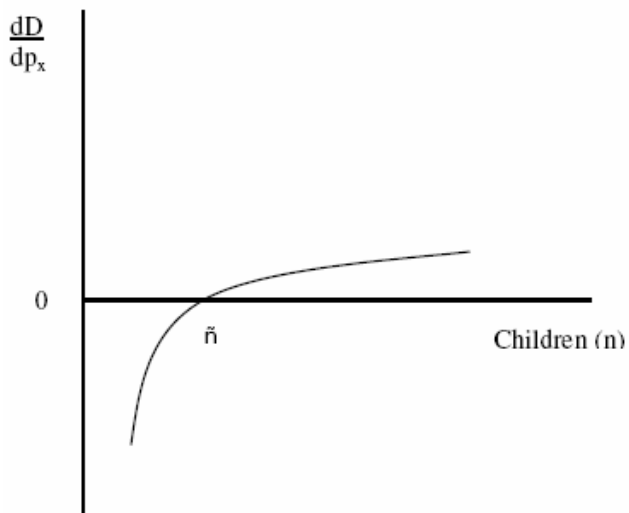
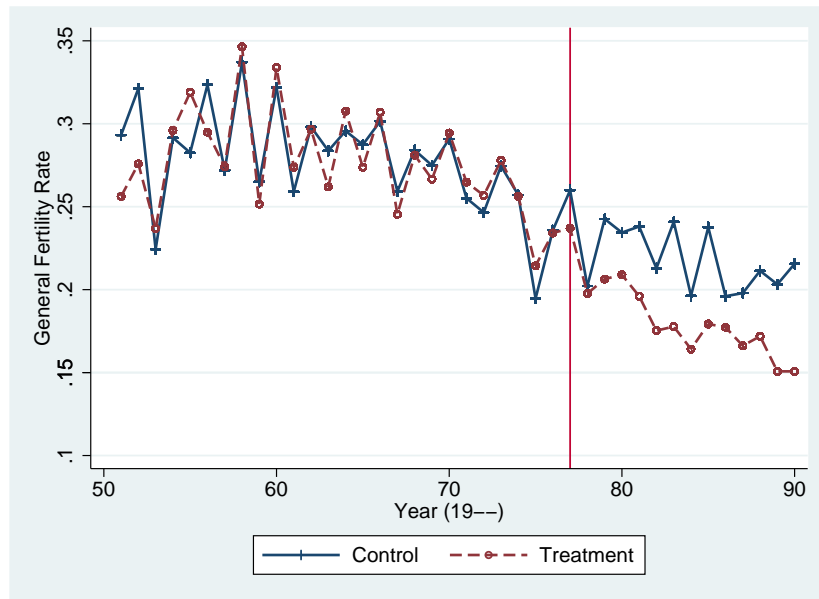
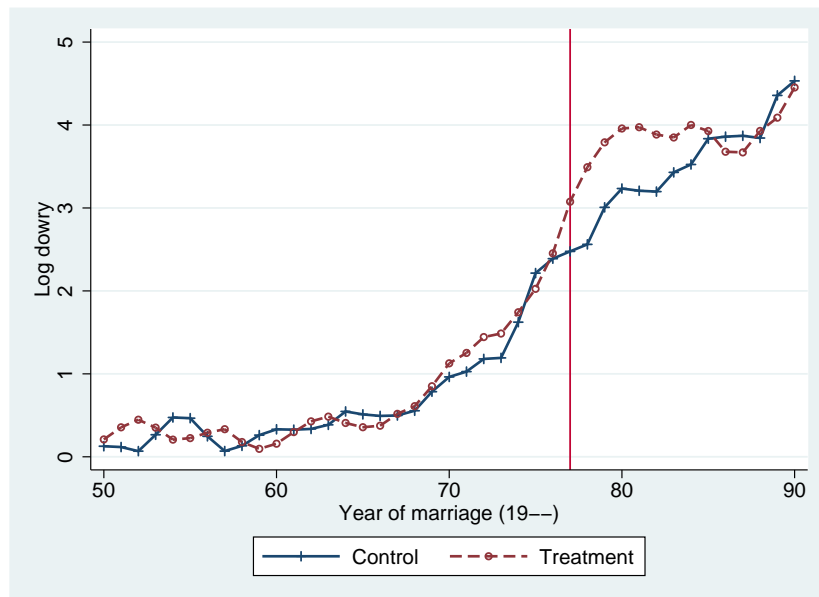


Figure 2: Fertility and the Dowry Effect of Contraception



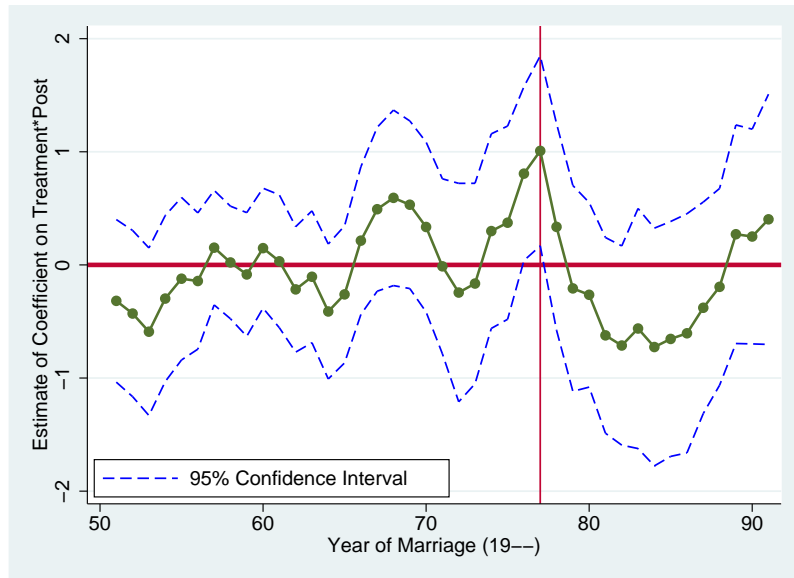
Note: The general fertility rate is the ratio: $\frac{\# \text{ children born in Year } X}{\# \text{ women age 15-44 in Year } X}$. Before the program year (1977, marked in red), the general fertility rate in the treatment area closely tracks the control areas. Family planning workers visited villages starting in October 1977; the reduction in fertility is visible starting in 1979.

Figure 3: General Fertility Rate



Note: The y-axis is $\log(\text{dowry} + 1)$, where real dowry is measured in rice kg. Due to limited number of observations in some years, we use the three-year centered moving average, weighted by number of marriages. The program onset (1977) is marked in red.

Figure 4: Log Real Dowry by Year of Marriage



Note: The y-axis is the estimated coefficient on the variable $\text{Treatment} \times \text{Post}$ ($\hat{\beta}_1$) in a series of separate placebo regressions. In each regression, the specification is: $\log(\text{Dowry} + 1) = \alpha + \beta_1 \text{Treatment} \times \text{Post} + \beta_2 \text{Treatment} + \beta_3 \text{Post} + \beta_4 \text{Treatment} \times \text{Transition} + \beta_5 \text{Transition} + \varepsilon$. Each regression uses a different year of marriage as the fake onset of the program—this fake year is given on the x-axis. In each regression marriages are restricted to within four years before and after the fake year of onset. Only for the true program year (1977) is the estimate significant.

Figure 5: Difference-in-Differences Effect Only Significant in Program Year

Appendices

A Mathematical Appendix

A.1 Proofs

Proof of Proposition 1:

The proof proceeds in three steps. We first derive a statement comparing the marginal rates of substitution of quantity of children (n) for household consumption (g) of the husband and the household.¹ Second, we derive (in terms of the husband's marginal rate of substitution) conditions under which a fall in the price of contraception lowers the husband's utility (i.e., $\frac{du^m}{dp_x} > 0$). Third, we use the expressions from the first two steps to state a condition about fertility (n) under which $\frac{du^m}{dp_x} > 0$.

Without loss of generality we can characterize the household decision by maximizing the log of the Nash product:

$$\begin{aligned} \max_{x,g} \quad \log u^h(\bar{n} - x, g) &= w \log (u^f(\bar{n} - x, g) - z_f) + (1 - w) \log (u^m(\bar{n} - x, g) - z_m) \\ \text{s.t.} \quad &g + \Pi(\bar{n} - x) + p_x x = I \end{aligned} \tag{A.1}$$

Step 1: From the expression for $\log u^h$ in (A.1), we take derivatives with respect to quantity of children (n) and the household consumption good (g):

$$\begin{aligned} \frac{d \log u^h}{dn} &= \frac{w u_n^f}{u^f - z_f} + \frac{(1 - w) u_n^m}{u^m - z_m} \\ \frac{d \log u^h}{dg} &= \frac{w u_g^f}{u^f - z_f} + \frac{(1 - w) u_g^m}{u^m - z_m} \end{aligned} \tag{A.2}$$

¹Here, we slightly abuse terminology by calling $\frac{u_n^h}{u_g^h}$ the household marginal rate of substitution; strictly speaking u^h is not a utility function but a “utility-gain product function” (McElroy and Horney, 1981).

We claim that:

$$\frac{u_n^h}{u_g^h} < \frac{u_n^m}{u_g^m} \quad (\text{A.3})$$

Cross-multiplying, noting that $\frac{\frac{d \log u^h}{dn}}{\frac{d \log u^h}{dg}} = \frac{u_n^h}{u_g^h}$, and substituting from (A.2) :

$$\begin{aligned} \frac{u_n^h}{u_g^h} < \frac{u_n^m}{u_g^m} &\iff u_n^h u_g^m < u_g^h u_n^m \\ \iff \left(\frac{w u_n^f}{u^f - z_f} + \frac{(1-w)u_n^m}{u^m - z_m} \right) u_g^m &< \left(\frac{w u_g^f}{u^f - z_f} + \frac{(1-w)u_g^m}{u^m - z_m} \right) u_n^m \\ \iff \frac{w u_n^f u_g^m}{u^f - z_f} + \frac{(1-w)u_g^m u_n^m}{u^m - z_m} &< \frac{w u_g^f u_n^m}{u^f - z_f} + \frac{(1-w)u_g^m u_n^m}{u^m - z_m} \\ &\iff \frac{w u_n^f u_g^m}{u^f - z_f} < \frac{w u_g^f u_n^m}{u^f - z_f} \\ &\iff u_n^f u_g^m < u_g^f u_n^m \\ &\iff \frac{u_n^f}{u_g^f} < \frac{u_n^m}{u_g^m} \end{aligned}$$

This last inequality is true by Assumption 1, proving the claim.

Step 2: The budget constraint in (A.1) is equivalent to:

$$g + (\Pi - p_x)(\bar{n} - x) = I - p_x \bar{n}$$

Defining $Y \equiv I - p_x \bar{n}$ and $p_n \equiv \Pi - p_x$, we rewrite the budget constraint using the definition of child quantity, $n \equiv \bar{n} - x$:

$$g + p_n n = Y \quad (\text{A.4})$$

Denote by $n(p_n, Y)$ and $g(p_n, Y)$ the household demand functions for number of children and family good consumption, respectively. That is, $n(\cdot)$ and $g(\cdot)$ give the maximand of the constrained Nash product.

We are trying to find the conditions under which $\frac{du^m}{dp_x} > 0$. The husband's utility using

the new notation is $u^m(n, g)$. Differentiating, we have:

$$\frac{du^m(n, g)}{dp_x} > 0 \iff u_n^m(n, g) (-n_{p_n} - n_Y \bar{n}) + u_g^m(n, g) (-g_{p_n} - g_Y \bar{n}) > 0 \quad (\text{A.5})$$

By the Slutsky equation, we have:

$$\begin{aligned} g_{p_n} &= g_{p_n}^C - n g_Y \\ n_{p_n} &= n_{p_n}^C - n n_Y \end{aligned} \quad (\text{A.6})$$

where g^C and n^C denote compensated demands. Substituting the expressions in (A.6) into (A.5) yields:

$$\frac{du^m(n, g)}{dp_x} > 0 \iff u_n^m(n, g) (-n_{p_n}^C - x n_Y) + u_g^m(n, g) (-g_{p_n}^C - x g_Y) > 0 \quad (\text{A.7})$$

By symmetry of compensated demands, we have:

$$g_{p_n}^C = -p_n n_{p_n}^C \quad (\text{A.8})$$

Substituting for $g_{p_n}^C$ from (A.8) into (A.7):

$$\frac{du^m(n, g)}{dp_x} > 0 \iff u_n^m(n, g) (-n_{p_n}^C - x n_Y) + u_g^m(n, g) (p_n n_{p_n}^C - x g_Y) > 0$$

To derive an expression in terms of compensated elasticities, we divide throughout by

$nu_g^m(n, g)$, and then rearrange and multiply through by p_n :

$$\begin{aligned}
\frac{du^m(n, g)}{dp_x} > 0 &\iff \frac{u_n^m(n, g)}{u_g^m(n, g)} \left(\frac{-\epsilon_{n,p_n}^C}{p_n} - \frac{x}{n} n_Y \right) + \left(\epsilon_{n,p_n}^C - \frac{x}{n} g_Y \right) > 0 \\
&\iff \frac{u_n^m(n, g)}{u_g^m(n, g)} \left(\frac{-\epsilon_{n,p_n}^C}{p_n} - \frac{x}{n} n_Y \right) > \left(-\epsilon_{n,p_n}^C + \frac{x}{n} g_Y \right) \\
&\iff \frac{u_n^m(n, g)}{u_g^m(n, g)} \left(-\epsilon_{n,p_n}^C - \frac{x p_n}{n} n_Y \right) > p_n \left(-\epsilon_{n,p_n}^C + \frac{x}{n} g_Y \right) \quad (\text{A.9})
\end{aligned}$$

where ϵ_{n,p_n}^C is the compensated own-price elasticity of demand for quantity of children.

In order to sign the expression $\left(-\epsilon_{n,p_n}^C - \frac{x p_n}{n} n_Y\right)$, note that the definitions $p_n \equiv \Pi - p_x$ and $n \equiv \bar{n} - x$ yield: $n_{p_n}^C = -x_{p_n}^C = x_{p_x}^C$ and $n_Y = -x_Y$. Writing out the definition of the compensated own-price elasticity and using these substitutions gives:

$$\begin{aligned}
\left(-\epsilon_{n,p_n}^C - \frac{x p_n}{n} n_Y\right) &= -\left(\epsilon_{n,p_n}^C + \frac{x p_n}{n} n_Y\right) \\
&= -\left(\frac{p_n n_{p_n}^C}{n} + \frac{x p_n}{n} n_Y\right) \\
&= -\left(\frac{(\Pi - p_x)(-x_{p_n}^C)}{n} + \frac{x(\Pi - p_x)}{n} n_Y\right) \\
&= -\left(\frac{(\Pi - p_x)(x_{p_x}^C)}{n} - \frac{x(\Pi - p_x)}{n} x_Y\right)
\end{aligned}$$

Collecting terms:

$$\left(-\epsilon_{n,p_n}^C - \frac{x p_n}{n} n_Y\right) = -\left(\frac{\Pi - p_x}{n}\right) (x_{p_x}^C - x x_Y) \quad (\text{A.10})$$

By the Slutsky equation: $x_{p_x} = x_{p_x}^C - x x_Y$. Substituting into (A.10):

$$\left(-\epsilon_{n,p_n}^C - \frac{x p_n}{n} n_Y\right) = -\left(\frac{\Pi - p_x}{n}\right) x_{p_x}$$

As long as x is not a Giffen good, $x_{p_x} < 0$, allowing us to sign the expression:

$$\left(-\epsilon_{n,p_n}^C - \frac{xp_n}{n}n_Y\right) > 0 \quad (\text{A.11})$$

Now, using (A.11) in (A.9):

$$\frac{du^m(n, g)}{dp_x} > 0 \iff \frac{u_n^m(n, g)}{u_g^m(n, g)} > p_n \left(\frac{-\epsilon_{n,p_n}^C + \frac{x}{n}g_Y}{-\epsilon_{n,p_n}^C - \frac{xp_n}{n}n_Y} \right) \quad (\text{A.12})$$

Step 3: Since n and g are chosen to maximize the constrained Nash product, we have that:

$$p_n = \frac{u_n^h(n^*, g^*)}{u_g^h(n^*, g^*)} \quad (\text{A.13})$$

That is, at the optimum, the household marginal rate of substitution of child quantity for consumption is equal to the ratio of prices. Using (A.13) in (A.12) and substituting in for n_Y yields:

$$\frac{du^m(n^*, g^*)}{dp_x} > 0 \iff \frac{u_n^m(n^*, g^*)}{u_g^m(n^*, g^*)} > \frac{u_n^h(n^*, g^*)}{u_g^h(n^*, g^*)} \left(\frac{\epsilon_{n^*,p_n}^C - \frac{x^*}{n^*}g_Y}{\epsilon_{n^*,p_n}^C - \frac{x^*p_n}{n^*}x_Y} \right) \quad (\text{A.14})$$

We can implicitly define some number of avoided children \hat{x} :

$$\frac{u_n^m(n^*, g^*)}{u_g^m(n^*, g^*)} = \frac{u_n^h(n^*, g^*)}{u_g^h(n^*, g^*)} \left(\frac{\epsilon_{n^*,p_n}^C - \frac{\hat{x}}{n^*}g_Y}{\epsilon_{n^*,p_n}^C - \frac{\hat{x}}{n^*}p_n x_Y} \right) \quad (\text{A.15})$$

Expression (A.15) gives us the desired sufficient condition under which a fall in the price of contraception lowers the husband's utility. We know that $\hat{x} > 0$ since as $x^* \rightarrow 0$ in (A.14), the right hand side goes to $\frac{u_n^h}{u_g^h}$, which is less than $\frac{u_n^m}{u_g^m}$ by (A.3). If $x^* < \hat{x}$, then $\frac{du^m(n^*, g^*)}{dp_x} > 0$. In the proposition, we state this in terms of fertility n : if $n^* > \hat{n} \equiv \bar{n} - \hat{x}$, then $\frac{du^m(n^*, g^*)}{dp_x} > 0$.

Proof of Proposition 2:

We prove the proposition in two steps. First, we show that the household marginal rate of substitution of quantity of children for consumption is decreasing in the wife's bargaining power. Second, we use this result and the principle of diminishing marginal rate of substitution to show that the husband is made worse off with an increase in the wife's bargaining power.

Step 1: We begin by introducing the notation $MRS_{ng}^h \equiv \frac{u_n^h}{u_g^h}$ to denote the household's marginal rate of substitution of quantity of children for consumption. We claim that:

$$\frac{dMRS_{ng}^h}{dw} < 0 \tag{A.16}$$

Since:

$$\frac{dMRS_{ng}^h}{dw} = \frac{d\frac{u_n^h}{u_g^h}}{dw} = \frac{u_{nw}^h u_g^h - u_{gw}^h u_n^h}{(u_g^h)^2}$$

We have that:

$$\frac{dMRS_{ng}^h}{dw} < 0 \iff u_{nw}^h u_g^h < u_{gw}^h u_n^h \tag{A.17}$$

Defining $\alpha \equiv \frac{u^h}{(u^f - z_f)}$ and $\beta \equiv \frac{u^h}{(u^m - z_m)}$, (A.2) implies:

$$\begin{aligned} u_g^h &= w\alpha u_g^f + (1-w)\beta u_g^m \\ u_n^h &= w\alpha u_n^f + (1-w)\beta u_n^m \end{aligned} \tag{A.18}$$

Differentiating (A.18) with respect to w yields:

$$\begin{aligned} u_{gw}^h &= \alpha u_g^f - \beta u_g^m \\ u_{nw}^h &= \alpha u_n^f - \beta u_n^m \end{aligned} \tag{A.19}$$

Now we expand (A.17) using (A.18) and (A.19):

$$\begin{aligned} \frac{dMRS_{ng}^h}{dw} < 0 &\iff \alpha u_n^f(w\alpha u_g^f + (1-w)\beta u_n^m) - \beta u_n^m(w\alpha u_g^f + (1-w)\beta u_n^m) < \\ &\alpha u_n^f(w\alpha u_n^f + (1-w)\beta u_n^m) - \beta u_n^m(w\alpha u_n^f + (1-w)\beta u_n^m) \end{aligned}$$

Multiplying out and cancelling yields:

$$\begin{aligned} \frac{dMRS_{ng}^h}{dw} < 0 &\iff (1-w)\alpha\beta u_n^f u_g^m - w\alpha\beta u_n^m u_g^f < (1-w)\alpha\beta u_g^f u_n^m - w\alpha\beta u_g^m u_n^f \\ &\iff (1-w)u_n^f u_g^m - wu_n^m u_g^f < (1-w)u_g^f u_n^m - wu_g^m u_n^f \\ &\iff u_n^f u_g^m < u_g^f u_n^m \\ &\iff \frac{u_n^f}{u_g^f} < \frac{u_n^m}{u_g^m} \end{aligned}$$

This last inequality is true by Assumption 1, proving the claim.

Step 2: Differentiating the husband's utility $u^m(n, g)$ with respect to the wife's bargaining power w yields:

$$u_w^m = u_n^m n_w + u_g^m g_w \tag{A.20}$$

By (A.3) and (A.13), we have at the optimum:

$$\frac{u_n^m(n^*, g^*)}{u_g^m(n^*, g^*)} > \frac{u_n^h(n^*, g^*)}{u_g^h(n^*, g^*)} = p_n \tag{A.21}$$

Differentiating the budget constraint in (A.4) yields:

$$p_n = \frac{-g_w^*}{n_w^*} \tag{A.22}$$

Substituting (A.22) into (A.21):

$$\frac{u_n^m(n^*, g^*)}{u_g^m(n^*, g^*)} > \frac{-g_w^*}{n_w^*} \tag{A.23}$$

By the implicit function theorem:

$$n_w = \frac{-\frac{dMRS_{ng}^h}{dw}}{\frac{dMRS_{ng}^h}{dn}} \quad (\text{A.24})$$

Since we have assumed u^m and u^f are concave, we know that the Nash product is log-concave and thus quasi-concave. This immediately implies that $\frac{dMRS_{ng}^h}{dn} < 0$. From (A.16), we have that $\frac{dMRS_{ng}^h}{dw} < 0$. Thus, the denominator of (A.24) is negative and the numerator is positive, allowing us to state: $n_w < 0$. Using this fact in cross-multiplying (A.23) yields:

$$u_n^m(n^*, g^*)n_w^* < u_g^m(n^*, g^*)(-g_w^*)$$

Finally, substituting back into (A.20) yields:

$$u_w^m(n^*, g^*) = u_n^m(n^*, g^*)n_w^* + u_g^m(n^*, g^*)g_w^* < 0$$

proving the desired result.

A.2 Extension: Becker-Lewis in a Bargaining Framework

In this extension, we extend the fertility bargain to include another choice variable: child quality, in order to gauge how our framework holds up in the classical setting of Becker and Lewis (1973).

As before, in the first stage, marriages are arranged by parents, in that each set of parents chooses their child's spouse. Also as before, f indexes the bride's side and m indexes the groom's side. Here, however, parents of brides and grooms have utility:

$$\begin{aligned} \text{Bride's parents' utility:} \quad & v^f(M, n, q, g, c; W, W_f) = v^f(M, c, u^f(n, q, g); W, W_f) \\ \text{Groom's parents' utility:} \quad & v^m(W, W_f, n, q, g, c; M) = v^m(W, W_f, c, u^m(n, q, g); M) \end{aligned}$$

The bride's parents' utility, v^f , is comprised of three parts: their direct utility from the match, which is a function of the vector of groom-side characteristics, M , given the vector of characteristics of the bride's parents and their daughter, W , and her fertility-relevant characteristics, W_f ; their own consumption, c ; and the bride's utility, u^f . Here as before, the bride's utility, u^f , is given from the second-stage intrahousehold bargain, but now her utility is a function of the number of children, n , the quality of each child, q , and the public good consumed within marriage, g . The groom's parents' utility, v^m , is specified similarly, where u^m is the groom's utility.

The new utility-gain product function is:

$$\begin{aligned} \max_{x,q,g} \quad u^h(\bar{n} - x, q, g) &= w \log(u^f(\bar{n} - x, q, g) - z_f) + (1 - w) \log(u^m(\bar{n} - x, q, g) - z_m) \\ \text{s.t.} \quad &\Pi(\bar{n} - x) + \Pi_s q(\bar{n} - x) + p_g g + p_x x + p_q q = I \end{aligned} \quad (\text{A.25})$$

Here, Π_s is the price of child services; p_q is the price of child quality; and p_g is the price of the consumption good (previously normalized to 1). All other variables and parameters are as defined previously.

Proposition 4: If fertility is sufficiently high, and the joint consumption good is a net complement with the number of children, then $\frac{du^m}{dp_x} > 0$.

Following the proof of Proposition 1, we first rewrite the budget constraint, utilizing the same definitions as before: ($Y \equiv I - p_x \bar{n}$; $p_n \equiv \Pi - p_x$; and $n \equiv \bar{n} - x$):

$$(\Pi - p_x)(\bar{n} - x) + \Pi_s q(\bar{n} - x) + p_g g + p_q q = Y$$

Again, we can write the husband's utility using the new notation as $u^m(n, q, g)$. We want to find conditions under which $\frac{du^m(n,q,g)}{dp_x} > 0$. Differentiating, we have:

$$\begin{aligned} \frac{du^m(n, q, g)}{dp_x} > 0 \quad \iff \quad & u_n^m(n, q, g) (-n_{p_n} - n_Y \bar{n}) + u_g^m(n, q, g) (-g_{p_n} - g_Y \bar{n}) \\ & + u_q^m(n, q, g) (-q_{p_n} - q_Y \bar{n}) > 0 \end{aligned} \quad (\text{A.26})$$

The interaction term of child quantity and quality makes the budget constraint non-linear. Utilizing the general results on optimization under nonlinear budget constraints in Blomquist (1989), we can write the Slutsky conditions from the linear component of the budget constraint as:

$$\begin{aligned} n_{p_n} &= n_{p_n}^C - (\bar{n} - x)n_Y \\ g_{p_n} &= g_{p_n}^C - (\bar{n} - x)g_Y \\ q_{p_n} &= q_{p_n}^C - (\bar{n} - x)q_Y \end{aligned} \quad (\text{A.27})$$

Again following Blomquist (1989), the symmetry of compensated demands gives:

$$\begin{aligned} n_{p_g}^C &= g_{p_n}^C \\ n_{p_q}^C &= q_{p_n}^C \end{aligned} \quad (\text{A.28})$$

Substituting the expressions in (A.27) and (A.28) into (A.26), we have:

$$\begin{aligned} \frac{du^m(n, q, g)}{dp_x} > 0 \quad \iff \quad & u_n^m(n, q, g) (-n_{p_n}^C - xn_Y) + u_q^m(n, q, g) (-n_{p_q}^C - xq_Y) \\ & + u_g^m(n, q, g) (-n_{p_g}^C - xg_Y) > 0 \end{aligned}$$

Multiplying where appropriate using $1 = \frac{\Pi_s q + p_n}{\Pi_s q + p_n} = \frac{\Pi_s n + p_q}{\Pi_s n + p_q} = \frac{p_q}{p_g}$ yields:

$$\begin{aligned}
\frac{du^m(n, q, g)}{dp_x} > 0 &\iff \frac{u_n^m}{\Pi_s q + p_n} \left(-(\Pi_s q + p_n)n_{p_n}^C - x(\Pi_s q + p_n)n_Y \right) \\
&+ \frac{u_q^m}{\Pi_s n + p_q} \left(-(\Pi_s n + p_q)n_{p_q}^C - x(\Pi_s n + p_q)q_Y \right) \\
&+ \frac{u_g^m}{p_g} \left(-p_g n_{p_g}^C - x p_g g_Y \right) > 0
\end{aligned}$$

At the optimized Nash product, we have that:

$$\begin{aligned}
u_g^h &= \lambda p_g \\
u_n^h &= \lambda(\Pi_s q + p_n) \\
u_q^h &= \lambda(\Pi_s n + p_q)
\end{aligned}$$

where $\lambda > 0$ is the Lagrange multiplier on the budget constraint. Substituting and dividing throughout by λ , we get:

$$\begin{aligned}
\frac{du^m(n, q, g)}{dp_x} > 0 &\iff \frac{u_n^m}{u_n^h} \left(-(\Pi_s q + p_n)n_{p_n}^C - (\Pi_s q + p_n)x n_Y \right) \\
&+ \frac{u_q^m}{u_q^h} \left(-(\Pi_s n + p_q)n_{p_q}^C - x(\Pi_s n + p_q)q_Y \right) \\
&+ \frac{u_g^m}{u_g^h} \left(-p_g n_{p_g}^C - x p_g g_Y \right) > 0
\end{aligned}$$

From Blomquist (1989) we have:

$$(\Pi_s q + p_n)n_{p_n}^C + (\Pi_s n + p_q)n_{p_q}^C + p_g n_{p_g}^C = 0 \tag{A.29}$$

Note that this implies, since net complementarity of joint consumption and fertility implies $n_{p_g}^C < 0$, that quality and quantity are net substitutes, so that $n_{p_q}^C > 0$

Dividing throughout by $\frac{u_g^m}{u_h^g}$ and substituting:

$$\begin{aligned} \frac{du^m(n, q, g)}{dp_x} > 0 &\iff \frac{\frac{u_n^m}{u_g^m}}{\frac{u_n^h}{u_g^h}} \left(-(\Pi_s q + p_n)n_{p_n}^C - x(\Pi_s q + p_n)n_Y \right) \\ &\quad + \frac{\frac{u_q^m}{u_g^m}}{\frac{u_q^h}{u_g^h}} \left(-(\Pi_s n + p_q)n_{p_q}^C - x(\Pi_s n + p_q)q_Y \right) \\ &\quad + \left(-p_g n_{p_g}^C - x p_g g_Y \right) > 0 \end{aligned}$$

To see the result, group all the income and substitution effects together:

$$\begin{aligned} \frac{du^m(n, q, g)}{dp_x} > 0 &\iff \frac{\frac{u_n^m}{u_g^m}}{\frac{u_n^h}{u_g^h}} \left(-(\Pi_s q + p_n)n_{p_n}^C \right) \\ &\quad + \frac{\frac{u_q^m}{u_g^m}}{\frac{u_q^h}{u_g^h}} \left(-(\Pi_s n + p_q)n_{p_q}^C \right) - p_g n_{p_g}^C \\ &\quad - x \left(\frac{\frac{u_n^m}{u_g^m}}{\frac{u_n^h}{u_g^h}} (\Pi_s q + p_n)n_Y + \frac{\frac{u_q^m}{u_g^m}}{\frac{u_q^h}{u_g^h}} (\Pi_s n + p_q)q_Y + p_g g_Y \right) > 0 \end{aligned}$$

The result follows as x goes to 0. This is true because $\frac{\frac{u_n^m}{u_g^m}}{\frac{u_n^h}{u_g^h}} > 1 > \frac{\frac{u_q^m}{u_g^m}}{\frac{u_q^h}{u_g^h}}$, so that the weight on a positive component of the expression, $-(\Pi_s q + p_n)n_{p_n}^C$, is larger than 1, and the weight on the only negative component, $-(\Pi_s n + p_q)n_{p_q}^C$, is less than 1. Thus when the income effect term is negligible, the linear dependence of the substitution effects in (A.29) implies that this expression must be greater than 0.

B Data Appendix

B.1 Matlab Data

The complete dataset is described in Rahman et al. (1999). There are 4731 ever-married Muslim women in the data for whom year of marriage is reported or can be reconstructed from age and age at marriage.² Of these women, 388 report information (including dowry information) about previous marriages, but we lack detailed data on their former husbands. Of these women, 1357 report that a dowry was given in the marriage, and of those 1338 reported an amount (which includes the total value of in-kind dowry as of the time of marriage). In 441 marriages, the husband also reported that a dowry was given, and of those 435 reported the amount. In addition, we have 95 marriages in which the husband reported a dowry even when the wife did not, and of these 91 reported an amount. When we have reports of dowry amount from both spouses, we take the average of the reports; all results are qualitatively similar when we exclude husbands' dowry reports.

In the main estimation sample, we restrict to women whose year of marriage is during 1972-1981. This gives us a total of 1055 women (including those reporting dowries from previous marriages); four of these have “missing” for whether dowry was giving, yielding a total of 1051 women for whom we have information on year of marriage, whether dowry was paid, the dowry amount, and village of residence—this is the sample used in the regression reported in Column 1 of Table 1, for example. Of these, 103 report dowry for previous marriages and are excluded from consideration in the regressions with husband characteristics. Due to other missing covariates, the estimation sample uses 714 women for whom we have information on whether year of marriage, whether dowry was paid, the dowry amount, residence in treatment village, and the other bride and groom side characteristics used in the regressions.

²As described above, we exclude Hindus from the analysis in this paper due to their historical usage of bequest dowries.

Some additional notes on variable construction:

- We use height and weight information to calculate Body Mass Index (BMI) and categorize individuals as underweight, normal weight, or overweight/obese using World Health Organization guidelines. The vast majority of the sample (97% of women and 98% of men) have a BMI that is classified as normal or underweight.
- Level of school attainment (primary, low secondary, or high secondary) are assigned from the years of schooling, in accordance with Rahman et al. (2003). The omitted category in the regression results is “wife/husband did not attend school.”

B.2 Rice Prices

To deflate nominal dowry amounts, we follow Khan and Hossain (1989), and Amin and Cain (1998) in using rice prices. No single source contains rice prices for the entire period, so we constructed a series using the *Statistical Abstracts for British India*³ for the period 1910-1946; the Pakistan Central Statistical Office’s *Statistical Yearbook 1955* for 1949; the Pakistan Central Statistical Office’s *20 Years of Pakistan in Statistics* for 1950-1967; and the *Statistical Yearbooks of Bangladesh* for 1965-1996. Details of the sources as well as unit conversions are given in Table A. Duplicate observations for the years 1964 to 1967 were used to convert between takas and rupees, and overlapping medium and common rice prices for the years 1950 to 1967 are used to convert between rice qualities. We used a linear interpolation to cover the missing years (1947-1948). Real dowries are expressed in (medium quality) rice kilograms.

B.3 Sex Ratio

Constructing a sex ratio time series has proven treacherous in previous dowry work (Edlund, 2000; Rao, 2000). We adopt a simple approach that takes account of the mortality trajectory

³Volumes compiled before partition but published afterward are simply called *Statistical Abstract, India*.

in the years between Census records. We calculate the sex ratio from the Census Records of India (1931, 1941), Pakistan (1951, 1961), and Bangladesh (1974, 1984). Where possible, we use the lowest level of geographic detail to correspond with the district in the Matlab study, although this was not possible for early years of the Census records, particularly the Indian Census records. Taking the count of males and females in the Census year, we construct the adjusted sex ratio as described by Rao (1993), where the adjusted sex ratio gives the number of males aged 20-29 divided by the number of females aged 10-19. We calculate the relevant ratio for each age group, from ages 10 to age 90, using the same ten year differential.

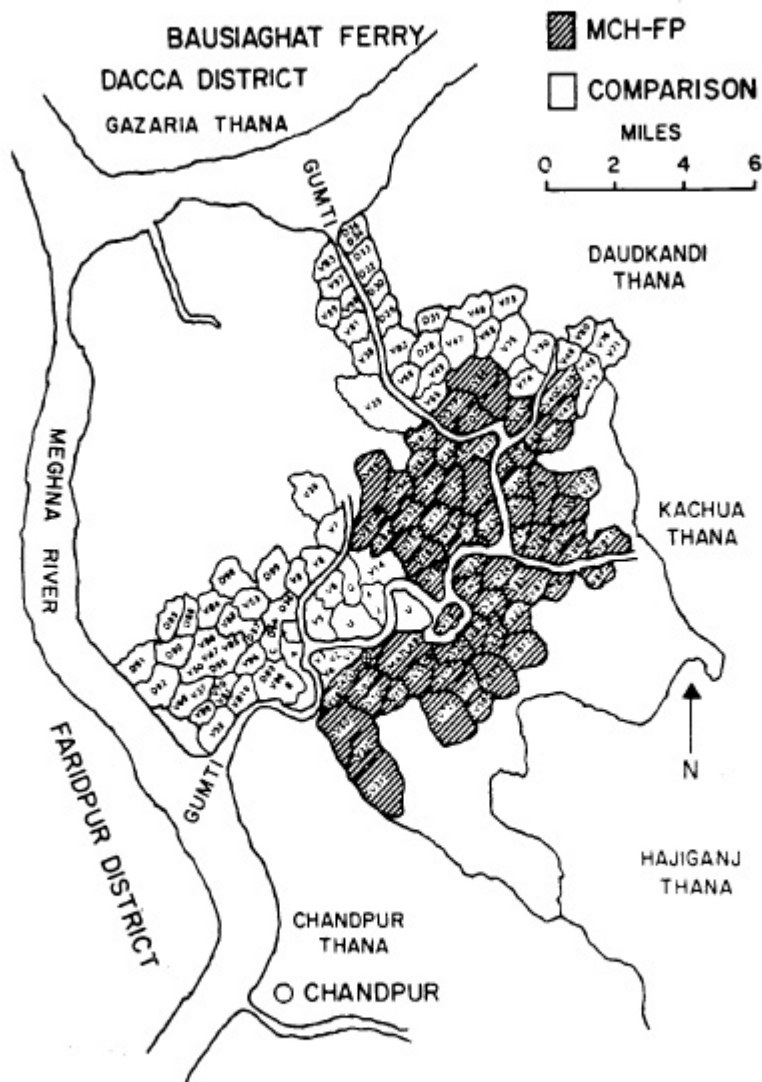
For the years between the Census years, the cohorts' age and mortality, particularly child mortality in the earlier years of our records, is pronounced, so the relevant sex ratio for each age must be adjusted for mortality each year. We use the actual number of males and females in the Census year, and then use the period lifetable constructed with the Census records to derive an estimate of survivorship to the next age (${}_nq_x$). Since these values will differ for both men and women, the sex ratio will change for the years between Censuses. For example, males aged 20-29 in 1961 will be aged 25-34 in 1966, and the best available estimate for the fraction of men surviving to that age would be the period survival rate for men aged 25-34 in 1961. For the final Census we use, we create a quasi-synthetic cohort and assume that the course of mortality over the subsequent years will be the same as for the later cohorts whose mortality trajectory is recorded in the Census.

Table A: Rice Price Sources for Deflating Nominal Dowries

Years covered	Source	Details
1910-1929	Statistical Abstract for British India 1931	No. 300, pg. 671 [Variations in Average Annual Retail Prices Current of Food Grains in British India]. Common rice in Dacca, rupees per maund (base year: 1873= 100 rupees).
1912-1932	Statistical Abstract for British India 1934	No. 301, pgs. 764-765 [Average Annual Retail Prices Current of Food Grains in British India]. Common rice in Dacca, rupees per maund.
1930-1939	Statistical Abstract for British India 1941	No. 164, pg. 445 [Average Annual Retail Prices Current of Food Grains in British India]. Common rice in Dacca, rupees per maund.
1942-1946	Statistical Abstract, India 1949	No. 165, pg. 1238 [Average Annual Retail Prices Current of Food Grains in British India]. Common rice in Dacca, rupees per maund.
1949	Statistical Yearbook 1955, Pakistan Central Statistical Office	No. 67, pg. 105 [Average (Annual) Retail Prices of Important Articles Consumed by the Industrial Workers at Dacca]. Medium rice, rupees per seer.
1950-1967	20 Years of Pakistan in Statistics, Pakistan Central Statistical Office	Table 11.7 [Average Retail Prices of Basic Articles of Consumption in East Pakistan]. Common and medium rice in Dacca, rupees per seer.
1965-1967	Statistical Yearbook of Bangladesh 1975	Table 8.1 [Annual Average Retail Price of Selected Consumer Goods in Dacca, pg. 195]. Medium rice, takas per maund.
1968-1978	Statistical Yearbook of Bangladesh 1979	Table 10.6 [Annual Average Retail Price of Selected Consumer Goods in Dhaka, pg. 374]. Medium rice, takas per maund.
1978-1988	Statistical Yearbook of Bangladesh 1989	Table 10.16 [Annual Average Retail Price of Selected Consumer Goods in Dhaka, pg. 448]. Medium rice, takas per seer.
1987-1996	Statistical Yearbook of Bangladesh 1997	Table 10.16 [Annual Average Retail Price of Selected Consumer Goods in Dhaka, pg. 477]. Medium rice, takas per kilogram.

Unit conversions (*2000 Statistical Yearbook of Bangladesh*, pgs. 645-650):
1 kilogram = 1.071 seer = .0267 maund.

MATLAB AREA SHOWING VILLAGES OF
DEMOGRAPHIC SURVEILLANCE SYSTEM



SOURCE: Mostafa G, K.M.A. Shaikh, J.K. van Ginneken and A.M. Sarder, 1998. "Demographic Surveillance System-Matlab. Registration of Demographic Events", vol 28; International Centre for Diarrhoeal Disease Research, Bangladesh, Scientific Report No. 82.

Figure A: Map of Matlab Region: Treatment Villages Shaded