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IZA DP No. 10675

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ABSTRACT

Natural Shocks and Marriage Markets: Evolution of Mehr and Dowry in Muslim Marriages

We examine how mehr, a conditional payment from husbands to wives in the event of divorce, and dowry, a transfer from bride families to grooms at the time of marriage, have evolved through natural shocks. We develop a model of marriage market in which dowry acts as a groom price, whereas mehr serves to deter inefficient divorces. Our comparative statics results show that the value of mehr is increasing (decreasing) in shocks that raise (lower) income while the effect of such shocks on dowry is ambiguous; even if dowry increases (decreases), the magnitude will be smaller than the corresponding increase (decrease) in mehr. We then exploit several natural experiments in Bangladesh, that include the Green Revolution around the 1960s, the Independence War in 1971 and the famine of 1974, to explain fluctuations in the value of mehr and dowry observed in Muslim marriages. Using two household survey datasets in Bangladesh, we find support for our theoretical predictions. To rule out alternative explanations, in particular the effect of legal changes, we exploit another natural experiment from the Indian state of West Bengal that experienced the same natural shocks, but not any of the legal shocks affecting Bangladesh. These results demonstrate that natural shocks may influence the evolution of social institutions.

JEL Classification: J12, O13, Z12

Keywords: dowry, mehr, Muslim family law, natural shocks, Bangladesh, West Bengal

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Natural Shocks and Marriage Markets: Evolution of Mehr and Dowry in Muslim Marriages

1 Introduction

In this paper, we seek to examine how mehr and dowry, two well-established social institutions, have evolved through natural shocks. According to Islamic law, Muslim marriage contracts require specifying a mehr, a monetary payment from the husband to the wife (Bianquis 1996, Carroll 1986a). In the Indian subcontinent such as in Bangladesh as well as in other countries, mehr is a deferred payment paid only in the event of a divorce (Amin and Cain 1997).[1] Dowry is in some sense the opposite, as it is a payment from the wife to the husband during marriage, and is a common practice among both Muslims as well as non-Muslims, in not just Bangladesh and the Indian sub-continent, but in many other countries all over the world.

Despite being forbidden by law in India since 1961, in Pakistan since 1976, and in Bangladesh since 1980, dowry persists in all three settings (see Rao 1993 for India, Anderson 2003 for Pakistan, and Esteve-Volart 2004 for Bangladesh). Further, over the last few decades there has been an increase in both the incidence of dowry, as well as substantial dowry inflation (Rao 1993, Anderson 2003).[2] Though there is no systematic data on dowry related violence and death, it is estimated that more than 200 women are being killed every year in Bangladesh due to dowry related violence.[3] Sekhri and Storeygard (2014) report that, on an average, in India 12.1 women die per district per year due to dowry, and the trend, if anything, is increasing over time. Similarly, mehr, which is enshrined in Islamic law, continues to flourish in Muslim societies in many LDCs (Amin and Cain 1997).

A stylized fact about mehr and dowry in Bangladesh is that both have experienced large fluctuations since the 1960s (see Section 2). Further, Bangladesh have experienced three major economic (and political) shocks since the 1960s. These are: (i) the introduction of new agricultural technologies in the 1960s, popularly known as the Green Revolution (GR),[4] (ii) the war of independence of 1971 (IW), and (iii) the famine of 1974. The adoption of new technology during

[1] While Islamic law prescribes that mehr is paid on the consummation of marriage, it is not the case in Bangladesh and in the Indian subcontinent. It has been conjectured by Ambrus et al. (2010) that this is because of two facts, first that polygamy was not feasible for all but the richest, and second that men had unilateral right to divorce. According to the Shari'a, a husband may unilaterally divorce his wife (Brandt and Kaplan 1995-1996), a belief that persists widely among Muslims and is practiced in India (Vatuk 2008), as well as Bangladesh and Pakistan (Carroll 1986b).

[2] In Bangladesh, for instance, it has been argued that not only has the incidence of dowry increased substantially (Esteve-Volart 2004), Amin and Cain (1997) found an increase in the real amount of dowry being paid albeit their finding is based on two villages in northern Bangladesh. Anderson and Binder (2015) write that "the total cash and goods involved are often so large that the transfer can involve impoverishment of the bridal family." Similar points have been made by Rao 1993, and Huda 2006, among others.

[3] See `http://khabarsouthasia.com/en_GB/articles/apwi/articles/features/2012/02/15/feature-02`.

[4] The neighboring country of India (including West Bengal, an Indian state bordering Bangladesh) also experienced similar improvements in agricultural productivity in the 1960s, a phenomenon we shall also call GR for brevity.

the GR period acted as a positive income shock. In particular, given the nature of the technological change, the GR had a positive effect on labor income, especially that of women, increasing the shadow price of their labor. In contrast, the IW and famine both acted as negative income shocks for both men and women.

Our central thesis is that there is a causal link between these income shocks, and the changes in dowry and mehr. We first develop a framework where mehr and dowry together act to clear the marriage market, as well as ensure that it works efficiently. We then develop the comparative statics implications of our framework, in particular how exogenous income shocks affect mehr and dowry. Next we take the model to data, showing that the available evidence supports our theoretical predictions.

We develop a model of marriage markets that respects the institutional realities of these societies. We locate the brides and grooms in extended families, and consider societies where norms and institutions are biased in favor of men. One aspect of this bias is that in the event of a 'failed' marriage (in a sense formalized later), the decision to divorce, if any, is taken by men. Further, men have property rights over the contributions made by the women in their family, in that they obtain a share of such contributions. Such women may include their mothers, unmarried sisters and cousins, as well as their wives.

Given these institutional biases in favor of men, the divorce decisions could be inefficient in that men may opt to divorce their wives even though the aggregate surplus of the couple would be higher if they stayed married rather than got a divorce. It is this possibility of inefficient divorce that creates a role for mehr, in that mehr is a cost which men have to incur in the event of a divorce, thus discouraging such divorces.[5] Moreover, given that the divorce decision is taken by men, mehr equals the net utility of men from divorce vis-á-vis remaining married. Dowry plays the role of a groom price, ensuring that the marriage market clears.

Turning to the effect of various income shocks, we demonstrate that a positive income shock for women, of the kind that presumably happened during the GR, would lead to an increase in mehr. The intuition is as follows. Given that men have property rights over the contributions of women belonging to their extended family, a positive income shock for women has a positive effect on the effective income of men as well. This in turn makes divorce more attractive for men, since an increase in the effective income of men increases their utility from divorce net of their utility from continuing in a 'failed' marriage (as getting a divorce is relatively more 'productive', in a sense formalized later). Thus the level of mehr must increase so as to prevent inefficient divorces. Any increase in the productivity of men following the GR would reinforce this effect. Similarly, the famine and the war of independence can both be interpreted as negative income shocks for men as well as women, thereby making divorce less attractive. Hence these would lead to a decline in mehr.

Next considering the effect of an income shock, say a positive one, on dowry, we find that the effect could go either way, and even when it is positive, it would be of a smaller order of

[5] As we discussed earlier, in the context of Bangladesh, mehr is actually a conditional payment made in the event of a divorce, see Kamal (2001), Huda (2006) and Ambrus et al. (2010).

magnitude compared to the effect on mehr. Intuitively, an increase in the shadow price of women labor benefits not only the bride, but also the groom who has property rights over the contributions of women. Given that dowry acts as a groom price so as to clear the marriage market, any positive effect on dowry arising out of the fact that the worth of the grooms rises, will be at least partially offset by the fact that the worth of the brides increases as well. Again a similar logic suggests that the negative income shocks during the IW and famine period would have an ambiguous effect on dowry. In addition, we also examine the effects of some legal shocks (described later) on the level of mehr and dowry.

To take the model predictions to the data, we exploit the two natural experiments described earlier, the first one being the GR of the 1960s, and the second one being the IW and famine in the 1970s. Our estimation uses two distinct household data sets collected in 2004-2005 and 2010-2011 in Bangladesh. Our identification strategy relies on the pre-post comparisons of the causal effect of income shocks on mehr and dowry. We find that the value of mehr increased significantly during the GR period (1961-1970) vis-á-vis the previous period, though there was no significant change in the value of dowry over the same time span. Both mehr and dowry decreased in the post-famine period with the decrease in mehr being larger in magnitude than that in dowry. Again these results are consistent with our theoretical predictions.

To check the robustness of our results, we analyze a third data set from the Indian state of West Bengal that is similar to Bangladesh in many respects and also experienced the GR at the same time. We find that patterns of fluctuations in the values of dowry and mehr in the GR period are the same in both Bangladesh and West Bengal. It is important to mention that over the period 1960-2000, there were several legal changes in Bangladesh aimed at restricting polygamy and also curbing the practice of dowry. Two of these legal changes namely the Muslim Family Law Ordinance of 1961 (MFLO), and the Registration of Muslim Marriages and Divorces Act of 1974 (MMDA) coincided with the advent of the GR and the occurrence of the famine, respectively. In contrast, there were no such legal changes in West Bengal as being a part of India. Therefore, the similar movements of mehr and dowry in Bangladesh and West Bengal are attributed to the positive economic shocks rather than legal changes. This conclusion finds further support from the existing literature.[6]

Finally, we examine if the increased mehr in the 1960s was a result of "missing women" caused by sex-selective abortion, female infanticide and neglect to female children (Sen 1990). However, based on male-female ratio among marriage age adults in 1960s and its movement over time, we argue that this factor was unlikely to be significant.

We then briefly relate our paper to the literature. The extant literature on marriage market transactions has mostly focused on dowry. We follow a major strand in the literature, that includes, among others, Becker (1981) and Rao (1993), in assuming that dowry is essentially a groom price. Following some of the recent work, e.g. Cole, Mailath and Postelwaite (2001), Peters

[6]Esteve-Volart (2004) used a rural household survey conducted in one sub-district of Bangladesh (Matlab Health and Socio Economic Survey) and found no effect of MMDA on the amount of dowry in Muslims marriages in the post-1974 period (Esteve-Volart 2004, Table 5)

and Siow (2002), Ambrus et al. (2010), and Anderson and Binder (2015), we assume that there is a competitive marriage market where dowry acts as a price to clear the market.

While our paper draws on this literature to a significant extent, there are several significant differences as well. First, we consider a framework with both dowry and mehr, showing that mehr can play an important role in ensuring that the marriage market is efficient. It is somewhat surprising that despite its universal practice in Muslim marriages, the institution of mehr has not received adequate attention in the literature. While there are some notable exceptions, among them Rapoport (2000), Welchman (2000), Kamal (2001), and Huda (2006), none of these papers analyze the co-evolution of mehr and dowry over time. Further, while Ambrus et al. (2010) also analyze a framework with both dowry and mehr, they focus on the effects of legal, rather than income shocks, so that their paper is complementary to ours.[7] Second, the present paper incorporates several institutional realities of the concerned societies, in particular that brides and grooms are located in joint families, rather than nuclear ones, and that the social institutions are biased in favour of men. Third, the central point of this paper, that natural shocks can affect the evolution of social institutions, is an insight that may have more general applicability beyond this specific context, and one that can be ignored by social scientists, let alone by policy makers.

The rest of the paper proceeds as follows. In Section 2 we describe the economic and political shocks that Bangladesh had experienced since the 1960s, and their likely impact on the values of mehr and dowry. In Section 3 we present our theoretical framework, deriving some testable implications of the analysis. Next in Section 4, we discuss the datasets and some key descriptive statistics. The identification and the estimation strategies are explained in Section 5. In Section 6 we present our main empirical findings, and in Section 7 we demonstrate that changes in values of dowry and mehr were not driven by legal changes. Finally, we conclude in Section 8.

2 Natural Shocks During the 1960s and 1970s

2.1 Income shocks

Since the 1960s Bangladesh experienced several exogenous economic (and political) shocks, among them the Green Revolution (GR) being one of the most significant one. Beginning in 1959, the then East Pakistan government adopted several new technologies as well as policies favoring the agricultural sector. Under the Grow More Food program started in 1959, the government introduced chemical fertilizers (Hossain et al. 1994) and mechanized irrigation at heavily subsidized rates (Falcon and Gotsch 1970). These inputs became readily and widely available in the early 1960s; over the 1961-70 period, the disbursement of chemical fertilizers increased by 35.5% per annum (Khan, 1972, Table 5.8, p. 50). Other technological innovations include the introduction of pesticides, improved local seed varieties, and a shift to the Japanese Method of rice cultivation, which involved a series of labor-intensive operations (Falcon and Gotsch 1970, pp. 270, 288-298).

The adoption of these new technologies increased the demand for labor, especially for female

[7] See Appendix 4 for a more detailed discussion of Ambrus et al. (2010).

labor. Post-harvest activities, such as drying, sorting, storing, milling and processing, which are performed manually, are highly labor-intensive and traditionally performed by women. Similarly, pre-planting activities such as seed selection and germination are often performed by women as well.

The new technologies also led to substantial increase in agricultural productivity. During the 1961-70 period, both East and West Pakistan experienced unprecedented growth in agriculture and rural private investment. The annual agricultural growth rate nearly tripled, increasing from 1.2 percent to 3.2 percent. In Bangladesh (the then East Pakistan), the agricultural sector grew at 3 percent on average per annum over this period . Rice, which contributed 70 percent of the value added of all crops, grew at 3.4 percent per annum, and Boro rice, which was a prime consumer of modern inputs, notably grew at 6.2 percent per annum (Falcon and Gotsch, 1970, Table 9.12, p. 293, Table 9.13, p. 295).

We consider 1961 as the start-date of the Green Revolution, as this is the earliest period of documented increase in agricultural income, although our results, presented in Section 5, are largely robust to the choice of alternative start-dates. In particular the analysis goes through qualitatively if we take the starting point to be 1967, when the high yielding variety (HYV) seeds were introduced (David and Otsuka 1994).

A second major event was the Independence War (IW), which broke out abruptly in March 1971 and ended in December 1971 with the birth of a new nation (Bangladesh). The war was extremely costly on several dimensions, most importantly in terms of lives lost, with a loss of 2 to 3 million civilian lives (Riedel 2011). Further, approximately 10 million people were forced to take refuge in neighboring India, with most of them completing their resettlement in Bangladesh only by the end of 1973. In addition, the war devastated the economy; GDP declined by 5.6% in 1971 and by 15% in 1972 (Appendix 3, Figure A1b). The independence war was clearly a large negative income shock.

Soon after the war and resettlement of refugees, the country was hit by another major negative shock, this time a devastating famine in 1974 that disproportionately affected the rural population. Following this famine GDP declined by more than 5 percent in 1975. Taken together, the IW and the famine were not only major negative income shocks, the effects persisted for quite some time with GDP returning to its pre-war level only in 1977 (Appendix 3, Figure A1a).

2.2 Legal shocks

Between 1961 and 2004, Bangladesh witnessed five legal amendments to and case law developments in Muslim family laws governing marriage, dowry and divorce. These include (i) the Muslim Family Law Ordinance (MFLO) of 1961, (ii) the Registration of Muslim Marriages and Divorces Act (MMDA) of 1974, (iii) the Dowry Prohibition Act of 1980 and Dowry Prohibition (Amendment) Ordinances of 1982, 1984 and 1986, (iv) Case Law Development in 1990 (Rustom Ali v. Jamila Khatun) and a Supreme Court verdict in 1998, and (v) the Women and Children Repression Prevention Act of 2000. Note that the first legal change, i.e. the MFLO in 1961, coincided with GR, and the second legal change, i.e. the MMDA in 1974, coincided with famine.

Briefly, the main objective of the MFLO was to restrict polygamy and arbitrary divorce. To that end it imposed the requirement that, in cases of divorce, a husband has to obtain the consent of the first wife, as well as written permission of the local government authorities at the residence of the second wife. The MFLO became effective in Bangladesh (then East Pakistan) in 1963.[8] The main objective of the MMDA was to further restrict polygamy and arbitrary divorce by making a marriage registrar widely available.[9] The main objective of the Dowry Prohibition Act and subsequent amendments in the 1980s was to reduce dowry by making both the giving and receiving of dowry illegal.[10] Anti-dowry laws were further strengthened by the Women and Children Repression Prevention Act of 2000, which mandated the imposition of the maximum possible punishment for dowry related violence and death.

The two case law developments of 1990 and 1998 went against the Maliki[11] interpretations of alimony obligations specified in the MFLO. In 1990, in Rustom Ali v. Jamila Khatun, 43 DLR (1991) 301, the High Court ruled that a former wife may not claim alimony unless the parties have a previously established agreement. In 1998, the Supreme Court upheld the 1990 ruling on alimony.

3 The Framework

Turning to the formal model, we consider an economy that comprises two kinds of families, one of these having a potential groom each, and the other having a potential bride each. The mass of families with a potential groom is 1, whereas the mass of families with a potential bride is N, where $N < 1$.[12] All men have the same income m, whereas all women have the same income w.[13] The two income measures m and w encapsulate several elements that are important in the context of marriages, including not just the economic potentials of men and women, but also their personal characteristics like age, beauty, educational qualifications, etc. In the event of a marriage, a woman brings her income w to the marriage. A man's endowment (which is also his contribution to a marriage), call it $\bar{m}(m)$, however consists of more than just his own income m, as we next explain.

We consider a society that is patriarchal in the sense that men have property rights over the income generated by their wives, as well as that generated by the women belonging to their

[8] See `http://bdlaws.minlaw.gov.bd/print_sections_all.php?id=305`, accessed February 29, 2012.

[9] See `http://bdlaws.minlaw.gov.bd/print_sections_all.php?id=476`, accessed on February 29, 2012.

[10] `http://bdlaws.minlaw.gov.bd/sections_detail.php?id=607&sections_id=10780&vol=22`, accessed on February 29, 2012.

[11] Maliki is one of four prominent schools of religious law within Sunni Islam, the dominant interpretation among the Muslims in Bangladesh

[12] The assumption that there are more men than women is realistic for many developing countries, particularly the context in which our model is set. For example, in our data for Bangladesh, the male-female (the total number of male divided by the total number of female) ratio is 1.06 in the case of marriageable age group between 12 and 25. The ratios for 15-30, and 12-30 age groups are 1.12 and 1.09, respectively.

[13] Assuming that all men (respectively women) have the same income m (respectively w) allows us to focus on the issues of interest. Later in Section 3.2 we briefly discuss as to what happens if we relax the assumption that all men, as well as women have identical incomes. This issue is considered in greater details in Appendix 1.

extended family, i.e. that generated by their mother, unmarried sisters, etc.[14] Let $s(w)$ be a measure of this second component, i.e. it denotes the amount that a groom obtains as his share of the family income generated by the women of his family. Thus a man's contribution to a marriage, i.e. $\bar{m}(m)$, includes his own income m, as well as his share of the income generated by the women in his family, i.e. $s(w)$. Formally

$$\bar{m}(m) = m + s(w), \tag{1}$$

where for simplicity we take $\bar{m}(m)$ to be additive in m and $s(w)$. Further, let λ, $0 < \lambda < 1$, denote men's property rights over their wives' contribution to a marriage (see Anderson and Binder 2015).

Once a marriage takes place, it is going to be either *fulfilling* with probability γ, where $0 < \gamma < 1$, or *failed* with probability $1 - \gamma$. A fulfilling marriage has a positive effect on the aggregate surplus of the couple, denoted $F[w + \bar{m}(m)]$, in that $F > 1$. Whereas the surplus in the failed state is given by $t[w + \bar{m}(m)]$, where $t < 1$.[15] Thus, given that men have property rights over spousal income, in case of a successful (respectively failed) marriage, women only obtain an amount $F[1 - \lambda]w$ (respectively $t[1 - \lambda]w$), with the remaining surplus from the marriage going to their spouses.

In these societies marriage is the social norm, so that men and women who either get divorced, or decide not to participate in the marriage market, suffer significant loss in utilities. Under either eventuality, a man has a utility of $\mu_m \bar{m}(m)$, and the woman has a utility of $\mu_w w$, where $F > \mu_m, \mu_w$ (recall that $\bar{m}(m)$ and w denote the endowment of men and women respectively). Further, consistent with the basic reality that this society is biased in favour of men, we assume that it is men who take the divorce decision,[16] and that either being divorced or remaining single is relatively more costly for women (for simplicity these two eventualities are assumed to be yield identical utilities).[17] Formally,

$$F > \mu_m > t > \mu_w.^{18} \tag{2}$$

In order to focus on the case of interest, we assume that men are not too badly affected in case of a divorce, formally

$$\mu_m > \gamma F + (1 - \gamma)t. \tag{3}$$

In case (3) does not hold, we shall find that dowry is never positive (see (16) later). Moreover,

[14] Men's rights on women's earning in patriarchal societies such as Bangladesh is well-recognized. Even in cases where women borrow from MFIs such as Grameen Bank that exclusively focuses on women, men often decide its utilization, as well as take the profit (Rahman 2008).

[15] As we shall find later, not all failed marriages lead to divorce, though some may.

[16] For example, see Brandt and Kaplan 1995-1996, who discuss husbands' rights to divorce their wives among Muslims in Bangladesh, as well as Egypt and Tunisia.

[17] In fact divorced women in Bangladesh and other South Asian countries are socially stigmatized, and are not accorded a status equal to that of married women (Dreze and Sen 1995, Esteve-Volart 2004).

[18] We shall later find that if, instead, either $\mu_w > t$, or $t > \mu_m$, then the equilibrium never involves inefficient divorce, where we say that divorce is inefficient if the aggregate surplus of the couple is lower in case of a divorce. In that case there will be no role for mehr in our framework of course, which is not of interest (see (10) and Proposition 1 later).

the property rights enjoyed by men over spousal contribution is not too large, i.e.

$$\min\{1-\frac{\mu_w}{t}, 1-\frac{\mu_w}{\gamma F+(1-\gamma)t}, \frac{s(w)}{w}[\frac{\mu_m}{t}-1]\} > \lambda. \tag{4}$$

As we shall later argue, the fact that $1-\frac{\mu_w}{t} > \lambda$ is necessary to ensure that the outcome involves a positive level of mehr (see (15) later), whereas the condition that $1-\frac{\mu_w}{\gamma F+(1-\gamma)t} > \lambda$ is necessary to ensure that there is an equilibrium with a positive dowry (see (16) later), which is the case of interest. Finally, the fact that $\frac{s(w)}{w}[\frac{\mu_m}{t}-1] > \lambda$ ensures μ_m is relatively large vis-á-vis t, so that following a divorce men do not suffer a significant loss in their utility.

Marriage contracts potentially involve two kinds of transfers, dowry (denoted D), which is an upfront payment from a woman's family to the groom, and mehr (denoted M), which is a conditional payment made by a man's family to the bride in the event of a divorce. We can now specify the utility functions of men and women, all of whom are taken to be risk neutral.[19] Thus the utility of a man is given by

$$u^M = \begin{cases} F[\bar{m}(m)+\lambda w]+D, \text{ if the marriage is fulfilling and there is no divorce,} \\ t[\bar{m}(m)+\lambda w]+D, \text{ if the marriage has failed but there is no divorce,} \\ \mu_m \bar{m}(m)+D-M, \text{ if there is divorce,} \\ \mu_m \bar{m}(m), \text{ if the man remains single.} \end{cases} \tag{5}$$

Similarly the utility of a woman

$$u^W = \begin{cases} F[1-\lambda]w-D, \text{ if the marriage is fulfilling and there is no divorce,} \\ t[1-\lambda]w-D, \text{ if the marriage has failed and there is no divorce,} \\ \mu_w w-D+M, \text{ if there is divorce,} \\ \mu_w w, \text{ if the woman remains single.} \end{cases} \tag{6}$$

Note that this formulation assumes that men have full property rights over the dowry amount. This is consistent with Anderson and Binder (2015), who argue that men's property rights over dowry has been increasing in Bangladesh since the 1960s. Arunachalam and Logan (2006) also argue that in Bangladesh women have little property rights over dowry. One can however relax this assumption without the results being affected qualitatively.

We next turn to defining a notion of equilibrium for this society, where we shall only be concerned with the utilities of the brides and the grooms themselves. In reality of course, other considerations, e.g. the potential gain in status to the concerned families, can be expected to enter these negotiations. Anderson and Binder (2015), for example, consider the utility of the parents also. We, however, abstract from such considerations.

We follow Rosen (1974), Peters and Siow (2002), Anderson and Binder (2015), among others, in modelling marriage market equilibrium competitively. The equilibrium 'price', denoted (D^*, M^*) comprises of both dowry and mehr. A family's strategy is optimal with respect to (D^*, M^*) if (i) men and women participate in the marriage market if and only if doing so yields them a higher

[19] While assuming risk neutrality simplifies the exposition by abstracting from issues of insurance, it is not critical for the analysis.

utility relative to not participating, and (ii) following a marriage, a man opts to divorce his wife if and only if it yields him a higher utility.

Let $P_M(D^*, M^*)$ denote the number of men, and $P_W(D^*, M^*)$ denote the number of women participating in the marriage market with men deciding on their divorce decision optimally.

We are now in a position to formally define the notion of an equilibrium.

Definition 1 *A marriage market pricing rule* (D^*, M^*) *is an equilibrium if and only if* $P_M(D^*, M^*) = P_W(D^*, M^*)$.

Thus (D^*, M^*) is an equilibrium if the marriage market clears, i.e. the number of participating men and women are equal. We shall be interested in equilibria that satisfies some additional properties, in particular that of efficiency.

Definition 2 *An equilibrium* (D^*, M^*) *is said to be efficient if and only if the outcome involves no inefficient divorce.*

Note that under a *fulfilling* marriage, divorce is never efficient, since, given (2), $F > \mu_m > t$, so that the surplus from marriage i.e. $F[\bar{m}(m) + w]$, exceeds $\mu_m \bar{m}(m) + \mu_w w$, which is the surplus in case of divorce. Whereas in case of a failed marriage divorce is *efficient* whenever $t[\bar{m}(m) + w] < \mu_m \bar{m}(m) + \mu_w w$, i.e. whenever the woman is not too productive relative to $\bar{m}(m)$, i.e.

$$w < \frac{\bar{m}(m)[\mu_m - t]}{t - \mu_w}. \tag{7}$$

Further, given (2), the aggregate *ex ante* surplus from marriage (followed by divorce if that is the efficient outcome in case the marriage fails), i.e. $\gamma F[\bar{m}(m) + w] + (1 - \gamma) \max\{t[\bar{m}(m) + w], \mu_m \bar{m}(m) + \mu_w w\}$, exceeds that from remaining single, i.e. $\mu_m \bar{m}(m) + \mu_w w$.[20]

We shall focus on equilibria that are not only efficient, but moreover the level of mehr M^* is at the minimum possible level consistent with efficiency. In our framework mehr is never paid in equilibrium, so that any higher value won't affect whether divorce takes place or not and, consequently it won't affect the level of dowry as well. Further, focusing on the minimum level of mehr is consistent with the reality that the social norms favour men. For ease of exposition we shall henceforth refer to efficient equilibria satisfying the minimal condition on mehr simply as equilibria.

Divorce never takes place in case the marriage is a *fulfilling* one, since the man's payoff from a stable marriage, exceeds that in case of a divorce, i.e.

$$F[\bar{m}(m) + \lambda w] + D > \mu_m \bar{m}(m) + D - M. \tag{8}$$

Whereas under a *failed* marriage, there can be divorce. In particular divorce happens if and only if $t[\bar{m}(m) + \lambda w] + D < \mu_m \bar{m}(m) - M + D$. This is true if the mehr is small, i.e.

$$M < \bar{m}(m)[\mu_m - t] - t\lambda w. \tag{9}$$

[20] In case $t[\bar{m}(m)+w] \geq \mu_m \bar{m}(m)+\mu_w w$, then $F[\bar{m}(m)+w] > t[\bar{m}(m)+w] \geq \mu_m \bar{m}(m)+\mu_w w$, and consequently $(\bar{m}(m)+w)(\gamma F+(1-\gamma)t) \geq \mu_m \bar{m}(m)+\mu_w w$. Whereas if $t[\bar{m}(m)+w] < \mu_m \bar{m}(m)+\mu_w w$, then the claim reduces to showing that $F[\bar{m}(m) + w] \geq \mu_m \bar{m}(m) + \mu_w w$, which is true given (2).

Note that divorce decisions are not affected by the level of dowry at all, see (9). Thus it must be mehr which ensures that there is no inefficient divorce. Consider a failed marriage. Given the preceding discussion, it is clear that in the absence of mehr, the outcome will involve an inefficient divorce whenever

$$\frac{\mu_m - t}{t - \mu_w} < \frac{w}{\bar{m}(m)} < \frac{\mu_m - t}{t\lambda}, \tag{10}$$

where (10) follows from (7) and (9) earlier. Note that the interval $[\frac{\bar{m}(m)(\mu_m - t)}{t-\mu_w}, \frac{\bar{m}(m)(\mu_m - t)}{t\lambda}]$ is well defined given that property rights are not too large, i.e. $\lambda < 1 - \frac{\mu_w}{t}$ (see (4)).[21] Thus mehr will be positive whenever (w, m) satisfies (10). In order to focus on the case of interest, we henceforth assume that (10) holds.

Recalling that the mehr is set at the minimum level that prevents inefficient divorce, one has that

$$M^* = \bar{m}(m)[\mu_m - t] - t\lambda w,$$

so that given M^*, men are indifferent between divorcing their spouse, and remaining married. Proposition 1 below summarizes the preceding discussion.

Proposition 1 *The equilibrium level of mehr, denoted M^*, satisfies*

$$M^* = \begin{cases} \bar{m}(m)[\mu_m - t] - t\lambda w, \text{ if } \frac{\bar{m}(m)[\mu_m - t]}{t-\mu_w} < w < \frac{\bar{m}(m)[\mu_m - t]}{t\lambda}, \\ 0, \text{ otherwise.} \end{cases} \tag{11}$$

Thus mehr increases with an increase in the property rights of women, i.e. a decrease in λ.

We next turn to solving for the equilibrium dowry, D^*. We first introduce an assumption that ensures that the difference in the contribution of men and women in marriage is not too large:

$$\frac{\mu_m - \gamma F - (1-\gamma)t}{\gamma F + (1-\gamma)t - \mu_w} < \frac{w}{\bar{m}(m)} < \frac{\mu_m - \gamma F - (1-\gamma)t}{\lambda[\gamma F + (1-\gamma)t]}. \tag{12}$$

As we shall later find, this condition ensures two things, first that the equilibrium involves a positive dowry, and second, that women have an incentive to participate in the marriage market in equilibrium. It is easy to check that given (4), $\frac{\mu_m - \gamma F - (1-\gamma)t}{\lambda[\gamma F + (1-\gamma)t]} > \frac{\mu_m - \gamma F - (1-\gamma)t}{\gamma F + (1-\gamma)t - \mu_w}$, so that there exist parameter values that satisfy (12).

We first solve for a level of dowry such that men are indifferent between remaining single, and getting married. Recall from Proposition 1, that M^* ensures that there is no divorce even if the marriage is a failure. Consequently, D^* must satisfy $\mu_m \bar{m}(m) = \gamma F[\bar{m}(m) + \lambda w] + (1 - \gamma)[t(\bar{m}(m) + \lambda w)] + D^*$, so that

$$D^* = \bar{m}(m)[\mu_m - \gamma F - (1-\gamma)t] - \lambda w[\gamma F + (1-\gamma)t], \tag{13}$$

which is non-negative given that $\frac{\mu_m - \gamma F - (1-\gamma)t}{\lambda[\gamma F + (1-\gamma)t]} > \frac{w}{\bar{m}(m)}$ (see (12)).

[21] In case this inequality is reversed, inefficiency can take the form of men staying on in an inefficient marriage. Preventing such inefficiency would require mehr to be negative, which does not appear to be realistic.

We first argue that any equilibrium must involve a dowry of D^*. If the dowry exceeds D^*, then all men participate, so that the marriage market cannot clear given that $N < 1$. Whereas if the dowry is less than D^*, then no man participates. Further, given (12), it is straightforward to check that a woman's utility from participating exceeds that from not participating.[22] Thus the marriage market cannot clear if the dowry is less than D^*.

Clearly (D^*, M^*), where (i) M^* is set to satisfy Proposition 1, (ii) D^* satisfies (13), (iii) all women and a fraction N of the men participate in the market, and (iv) men take the divorce decision optimally, constitutes an equilibrium.

Proposition 2 below summarizes the preceding discussion.

Proposition 2 *There is a unique equilibrium (D^*, M^*) where M^* is set at the minimum level that prevents inefficient divorce, and the dowry D^* ensures that the marriage market clears. The dowry D^* increases with an increase in property rights of women, i.e. a decrease in λ.*

It is clear of course that there can be inefficient equilibria where mehr is either absent, or not sufficiently large to prevent inefficient divorce. In fact, there are countries where Muslim marriages do not involve a mehr which is conditional on divorce. For simplicity let the mehr be zero. It is then straightforward to check that the equilibrium dowry would be negative. While the fact that in this case dowry is negative, is perhaps an artifact of the present simple framework, this result does suggest that dowry is likely to be lower in societies where there is no mehr.

3.1 Exogenous shocks: Income and legal

We then examine the impact of various shocks - income, as well as legal - on both mehr, as well as dowry in an effort at generating some testable hypothesis that we can take to data. We shall use the following properties of D^* in the subsequent analysis. The proof, which is straightforward, has been omitted.

Observation 1.

(i) D^* is decreasing in F and t.

(ii) D^* is increasing in μ_m.

(iii) D^* is decreasing in λ.

For tractability, we specialise to a specific functional form for $s(w)$, in particular

$$s(w) = s_w w, \tag{14}$$

[22] Note that women's utility from participation equals $w\gamma F[1-\lambda] + w[1-\gamma]t[1-\lambda] - D^* = w\gamma F[1-\lambda] + w[1-\gamma]t[1-\lambda] - \bar{m}(m)[\mu_m - \gamma F - (1-\gamma)t] + \lambda w[\gamma F + (1-\gamma)t] = w[\gamma F + (1-\gamma)t] - \bar{m}(m)[\mu_m - \gamma F - (1-\gamma)t]$. This exceeds the women's utility from remaining single, i.e. $w\mu_w$ if and only if $\frac{w}{\bar{m}(m)} > \frac{\mu_m - \gamma F - (1-\gamma)t}{\gamma F + (1-\gamma)t - \mu_w}$.

where $s_w > 0$.[23] Substituting (14) into (11), the equilibrium mehr for any m satisfying $\frac{\bar{m}(m)[\mu_m - t]}{t - \mu_w} < w < \frac{\bar{m}(m)(\mu_m - t)}{t\lambda}$, is

$$M^* = m[\mu_m - t] + w[s_w[\mu_m - t] - t\lambda], \tag{15}$$

whereas from (13) and (14) the equilibrium dowry can be written as

$$D^* = m[\mu_m - \gamma F - (1-\gamma)t] + w[s_w\mu_m - (\gamma F + (1-\gamma)t)(s_w + \lambda)]. \tag{16}$$

Example. In order to establish that the various assumptions are mutually consistent, consider an example where $F = 2,\ \mu_m = 1,\ m = 2,\ t = 0.4,\ \mu_w = 0,\ \gamma = 5/16,\ w = 10,\ \lambda = 0.5$ and $s_w = 0.4$. These parameter values satisfy all the constraints, (2), (3), (4), (10) and (12). Moreover, mehr and dowry are positive and women prefer to participate in the marriage market rather than remain single.

3.1.1 Income shocks

As discussed in Section 2 earlier on, in the context of Bangladesh, the green revolution that happened around the 1960s can be interpreted as primarily a positive income shock for women, whereas the independence war of 1971, together with the 1974 famine, can be interpreted as a negative income shock for both men, as well as women.

Recall, from (15) that $M^*(m) = m[\mu_m - t] + w[s_w(\mu_m - t) - t\lambda]$. Thus, given (4), the level of mehr is increasing in w.

Proposition 3 *The mehr M^* is increasing in the income of women w, as well as that of men, i.e. m.*

Turning to the effect of income shocks on dowry, it is straightforward to check that

$$\frac{dD^*}{dw} = s_w\mu_m - [s_w + \lambda][\gamma F + (1-\gamma)t] \quad < \quad s_w(\mu_m - t) - t\lambda = \frac{dM^*}{dw}, \tag{17}$$

$$\text{and } \frac{dD^*}{dm} = \mu_m - \gamma F - (1-\gamma)t \quad < \quad \mu_m - t = \frac{dM^*}{dm}. \tag{18}$$

Thus a change in the income of both women, as well as men will have a smaller impact on dowry relative to that on mehr.

Proposition 4 *Consider the effect of income shocks on dowry. A income shock for men, as well as women, has a smaller effect on dowry, relative to that on mehr.*

It is straightforward to see that following a income shock, mehr and dowry can move in opposite directions. Suppose $s_w[\mu_m - t] - t\lambda > 0 > s_w\mu_m - [s_w + \lambda][\gamma F + (1-\gamma)t]$. Then while an increase in the income of women will increase mehr, it will decrease dowry. Whereas if

[23] It is straightforward to see that the analysis extends qualitatively to the case where where $s(w)$ is non-linear, though increasing in w.

$\mu_m - \gamma F - (1-\gamma)t < 0 < \mu_m - t$, then while an increase in the income of men will increase mehr, it will decrease dowry.

Recall that the role of mehr is to prevent inefficient divorce. Given that the divorce decision is taken by men, mehr equals the net utility of men from divorce vis-á-vis remaining married. While an increase in the shadow price of women, i.e. w, will tend to increase the net utility because payoff of men from their share of the family income increases, such an increase in w will tend to decrease the net utility because the women's payoff also increases. The first effect dominates given that the man's income from his family is not too small.

The magnitude of dowry however depends on the utility of both men as well as women from marriage, net of their utility from remaining single. With an increase in w, while the net payoff of the man tends to increase, it will also tend to increase for the woman. Consequently, the net effect on dowry is ambiguous. Further, even if the effect is positive, it will tend to be of a lower order of magnitude, given the trade-offs involved.

Finally, we should point out that while the GR was staggered over the 1960s, the IW and famine happened over a three year period in the 1970s. Given this longer temporal spread, and the fact that women appear to have benefitted relatively more during the GR, we expect that the GR will lead to an increase in the property rights of women in the long run, i.e. cause a fall in λ. Given (15) and (16), we note that a fall in λ can be expected to increase both mehr and dowry in the long run.[24] How does this long term effect interact with the immediate effects of the natural shock? During the GR, these changes work in the same direction, ensuring that mehr is going to increase both because of an increase in w, as well as a decline in λ.[25] Of course, this long term effect will counteract some of the negative income shocks during the IW and famine episodes.

Propositions 3 and 4 together suggest the following testable hypotheses:

1. During the green revolution period in Bangladesh, as well as India
   (a) the level of mehr will increase,
   (b) whereas the level of dowry can either increase, or decrease. Even if dowry increases, the increase in dowry will be of a smaller order compared to that in mehr.
2. The independence war and famine in Bangladesh will
   (a) adversely affect the level of mehr.
   (b) However, the level of dowry can either increase or decrease.

[24] Of course, property rights of women should improve within the family as well, i.e. there should be a decline in s_w as well. Given that both these legal changes were explicitly dealing with muslim marriages, it seems natural to expect that λ would be affected to a greater extent.

[25] Note that this suggests that mehr might increase during the GR because of an increase in λ, even if the last inequality in (3), i.e. $\frac{s(w)}{w}(\frac{\mu_m}{t} - 1) > \lambda$ does not hold.

3.1.2 Legal shocks

During the period under consideration, there were several changes in Muslim personal law, in particular the Muslim Family Law Ordinance of 1961 (MFLO) and the Registration of Muslim Marriages and Divorces Act of 1974 (MMDA).

As discussed in the preceding section, the MFLO had an effect in restricting polygamy. For a second marriage, it required that the husband obtain the permission of the local government (i.e. the Union Parisad) of the second wife's residence, satisfying the Parishad that he had his current wife's consent.[26] In our framework this can be expected to increase the utility from the first marriage, both fulfilling as well as failed, so that F and t should both increase. Given that men take the divorce decision, and that the divorce decision is only relevant in the failed sate, F does not affect mehr at all. Turning to the effect of t, from (15) and Observation 1 we note that both mehr and dowry are decreasing in t.

Whereas the MMDA mandated that divorce can only be granted in court and also set up a universal system of divorce registration and physical registries. This should raise the costs of divorce, which can be expected to reduce μ_m in our framework. From (15) and Observation 1, it is straightforward to see that M^* and D^* are both increasing in μ_m, so that mehr and dowry both decrease with an decrease in μ_m.

Proposition 5 *Consider the impact of MFLO and MMDA.*

(i) Following the implementation of MFLO, formalised as an increase in F and t, mehr and dowry both decreases.

(ii) Following the implementation of MMDA, formalised as a decrease in μ_m, mehr and dowry will both decrease.

Thus our framework predicts that the immediate effect of MFLO would be to *reduce* the level of mehr (and also dowry), so that MFLO does not explain the empirical realities found in the 1960s in Bangladesh. The predictions from MMDA are, however, consistent with reality.

3.2 Discussion of the framework

Motivated by the institutional realities in Bangladesh as well as in India and Pakistan, we assume that mehr is a conditional payment made only in the event of a divorce. Mehr is usually divided into two parts, a prompt mehr which is payable immediately on marriage, and a deferred mehr which is paid in case of divorce (Rapoport 2000, Welchman 2000). In Bangladesh while the formal marriage contract (*kabin*) can involve both forms of mehr, typically most of the mehr is deferred, rather than prompt (Kamal 2001, Huda 2006). This was also verified by Ambrus et al. (2010), who found that in their data none of the marriages had a prompt mehr exceeding $1.

Finally, as robustness checks, we discuss several extensions of this framework:

[26] While restrictions were imposed on divorce also, these may not have been very effective in the absence of penalties for failure to comply, or or explicit specification of maintenance payments.

1. How robust is the analysis to the assumption that all agents are homogenous in terms of their productivities? In an earlier version of the paper we examined a framework where the productivities of men are random, and vary over the interval $[0, 1]$, whereas the income of all women is identical at w, where $0 < w < 1$. Further, the number of men exceed that of women. We find that there exists an equilibrium where dowry still acts to clear the marriage market. In particular in this equilibrium there is a cutoff $\tilde{m}$ such that (a) all men with income less than $\tilde{m}$ participate in the marriage market, (b) the number of men and women participating in the marriage market is the same, and (c) mehr is such that there is no inefficient divorce. Further, the comparative statics results show that the equilibrium mehr is increasing in the income of women, while it does not depend on the income of men. Finally, the level of dowry is increasing in the income of men, while the effect of an increase in the income of women is ambiguous. Taken together, these yield testable hypotheses that are identical to those developed earlier.[27]

2. While we follow the literature in assuming that dowry acts as a groom price that clears the market, it may be of interest to examine as to what happens if dowry is determined through negotiations between the two concerned families. It may be argued that in these societies a significant fraction of all marriages are arranged with fairly lengthy interactions between the two concerned families. In most cases this involves checking for family background and status, educational qualifications, earning abilities, etc., not just through direct interaction, but often using matchmakers, contacts in the neighbourhood, etc. This suggests that formalising this interaction as inter-family bargaining over dowry may capture some important elements of reality. In an earlier version of the paper we had examined an alternative framework where while mehr is still set so as to prevent inefficient divorce, dowry is settled through asymmetric Nash bargaining between the families. We find that that the comparative statics results are qualitatively similar under both formulations, and would thus yield very similar testable hypotheses.[28]

3. There is some evidence to suggest that, in Bangladesh, till the early 1970s dowry was perhaps more of a pre-mortem bequest to daughters, i.e joutuk. Arunachalam and Logan (2006) argue that, relative to groom-price dowries, bequest dowries have decreased in prevalence and amount over time.[29] This is the position taken, among others, by Anderson and Binder (2015). For completeness, we briefly discuss this possibility. The theoretical prediction from this literature (Zhang and Chan 1999, Edlund 2000, Botticini and Siow 2003, Brown 2009) is that the dowry does not depend on the productivity of the groom and is decreasing in the income of the bride. Thus if we think of a framework where mehr still serves to prevent

[27] See Appendix 1.

[28] See Appendix 2.

[29] The data sets used for the empirical analysis do not allow one to separate out bequest dowry from total dowry. Although information about three types of dowry, both cash and kind such as jewelry, land and animals, and their ownership was collected, monetary value of only total dowry was ascertained. Since marriages involve multiple types of dowries and their complex ownerships, the value of bequest dowry cannot be separated.

inefficient divorce, whereas dowry is a pre-mortem bequest, then the comparative statics predictions would again be similar: an increase in productivity will have a positive effect on mehr, but not on dowry.

4 Data and Descriptive Statistics

To test our model predictions, we have utilized three household survey data sets; two surveys were conducted in Bangladesh, and the third one in the Indian state of West Bengal that borders Bangladesh. All three surveys used identical modules on marriage, divorce, mehr and dowry. The first survey was administered to 1,820 households in 91 villages across all major geographical regions of Bangladesh in between December 2010 and January 2011.[30] After employing the cleaning steps described below, the sample contains 1,981 marriages in 1,457 households.

The second data set was collected between December 2004 and January 2005 for the Bangladesh Rural Urban Linkage Survey (BRULS) by the International Food Policy Research Institute (IFPRI). It was a follow-up study to the Household Income and Expenditure Survey (HIES) of 2000 conducted by the Bangladesh Bureau of Statistics (BBS). In HIES 2000, the BBS surveyed 1,360 rural households drawn from 68 villages (mouzas) in 16 districts of the Rajshahi Division. In 2004, BRULS re-surveyed 1,271 households from the existing sample (6.5 percent attrition) and also added 200 new households from 10 new villages in the same division, so that the sample had 1471 households drawn from 78 villages. After employing the same cleaning steps described below, the sample has 1,367 marriages in 865 households.

The third data set was collected from 2,000 households drawn from 100 villages distributed over six districts in West Bengal. All these districts (Cooch Behar, Malda, Murshidabad, Nadia, North Dinajpur, and South Dinajpur) are adjacent to Bangladesh (Appendix 3, Figures A2 & A3), and all of them with the exception of one share borders with Bangladesh. The survey was commissioned by the Indian Statistical Institute (ISI), Delhi and was conducted by the National Field Service of India (NFSI) in between December 2014 and January 2015.

To create our working sample we adopt the following cleaning procedure. First, only Muslims households are included (by discarding all non-Muslim households); second, only households members between 18 and 65 years of age are included; third, only first marriages are included; fourth, only relationships involving household heads, spouses or sons/daughters are included; and finally, missing values of dowry and mehr are deleted. In both the datasets from Bangladesh, real values of dowry and mehr have been calculated using the price deflater reported in the online Appendix in Ambrus et al. (2010). For the West Bengal data, the consumer price indices published by the Ministry of Statistics and Program Implementation, India, has been used to calculate the real values of dowry and mehr.

Figure 1 shows the trends in dowry and mehr observed in the PKSF data, where we plot the real mean values by year for these variables. For ease of exposition, the three natural shocks discussed

[30] These households were drawn from an earlier existing survey commissioned by Palli Karma Shahayak Foundation (PKSF) and conducted by the Bangladesh Institute of Development Studies (BIDS) in 1997-98.

in Section 2, the green revolution (GR), the war of independence (IW), and famine of 1974 (Fam), are marked along the horizontal axis. It is evident that both dowry and mehr fluctuated considerably from the 1950s through the 1970s and then both stabilized in the subsequent period. We attribute these large fluctuations in earlier periods to the small number of observations because of the survivorship bias (that we discuss at the end of this section). However, some patterns can be observed from the graph. Both dowry and mehr were larger in the pre-war period compared to the post-famine period. Further, although both increased secularly since the mid-1980s with the increase in mehr being more pronounced, they did not revert to their pre-famine levels.

[Insert Figure 1 and Table 1 about here]

Table 1 presents the descriptive statistics regarding the real values of dowry, mehr and other variables used in the analysis. These help clarify the trends observed in Figure 1. The real value of mehr substantially increased from an average of 18,009 taka in the pre-GR period, to 56,759 taka in the GR period. There was a further increase to 65,113 taka in the IW-famine period, before it declined to 59,328 taka in the post-famine period. A similar trend is observed in case of dowry as well. The BRULS and West Bengal data also depict similar trends (Appendix 3, Figures A4 and A5, and Tables A1 and A2).[31] In terms of bride and groom attributes, the average year of schooling of the brides increased over time. In the PKSF data, for example, it increased to 3.98 in the post-famine period from 0.78 in the pre-GR period. The age at marriage also increased for the brides over the same time period (from 13.5 to 16.5), while that for grooms remained almost unchanged.

The survivorship bias[32] leaves a smaller number of observations in the earlier periods. It is more acute in the BRULS, than in the PKSF data. In the BRULS survey, the percentages of observations in the pre-GR, GR, IW-famine and post-famine periods are 0.59%, 3.29%, 2.64%, and 93.49%, respectively. In contrast, the respective numbers in the PKSF data are 4.04%, 9.19%, 5%, and 81.78%. One explanation is that the rural northwestern region in Bangladesh, where BRULS was conducted, has historically been the poorest region in the country, with the highest incidence of poverty and the shortest life expectancy.[33] Therefore, the number of surviving married individuals who married in earlier periods is smaller in the BRULS dataset. In contrast,

[31] It is important to mention that values of dowry and mehr among Muslims are substantially lower in West Bengal than in Bangladesh even Ambrus et al. after adjusting for the exchange rate. This difference, although an interesting topic on its own right, is beyond the scope of the current investigation.

[32] The concept of survivorship bias is often used in the finance and public health literatures. In finance, it refers to a tendency for failed companies to be excluded from performance studies (for example, Brown et al., 1992). In the public health literature, it refers to a tendency to exclude information on dead persons that is vital in estimating the treatment effects of public health interventions (for example, Liu et al., 2010). In our case, only a small fraction of individuals who married in earlier periods were alive during the survey.

[33] In 2005, the extreme poverty rate (defined as the percentage of individuals who cannot consume 2,100 calories per day, even if they spend their entire incomes on food purchases) was 25 percent nationwide but 35 percent in the northwestern region (BBS 2005). Because life expectancy and income are highly correlated, it is likely that surviving members came from relatively well-off households and hence had commanded high levels of mehr and dowry that may not represent national averages.

the PKSF data covers all of Bangladesh, thereby reducing survivorship bias in the sample. In the West Bengal data, the percentages of observations in the pre-GR, GR and post-GR periods are 1.5%, 6.7%, and 91.8%, respectively.

5 Estimation Strategy

To test the impact of the natural shocks on the values of dowry and mehr, we estimate the following two equations:

$$lnM_{iy} = \alpha^M + \gamma^r + \beta^M \mu_y + \delta^M X^M_{iy} + \varepsilon^M_{iy}, \quad (19)$$

$$lnD_{iy} = \alpha^D + \gamma^r + \beta^D \mu_y + \delta^D X^D_{iy} + \varepsilon^D_{iy}. \quad (20)$$

where lnM_{iy} and lnD_{iyr} are the logarithm of the real value of mehr and dowry,[34] respectively, for a woman i married in year y, and μ_y is a vector of three dummy variables for four time periods and are the same in both equations: (i) pre-GR, (ii) GR (1961-1970), (iii) IW-famine (1971-1974), and (iv) post-famine (post-1974). γ^r is the set of regional (district) dummies to account for geographic variations in dowry and mehr. Given the exogeneity of the shocks, our identification relies entirely on the pre-post comparisons. To find out the effect of a particular shock, we compare the values of both mehr and dowry after the shock with the respective values in the previous period: the GR values with the pre-GR values; the IW-famine values with the GR values, and the post-famine values with the IW-famine values.[35]

Both the vector X^M and X^D include an indicator of relationship to the household head (specifically, whether the woman is the daughter-in-law as opposed to the daughter or wife of the household head), a polynomial of the marriage year up to order three (to capture the non-linearity in the trend of the values of mehr and dowry). They also include a set of attributes of brides and grooms: age and education differences between the bride and the groom, two dummies for relative wealth of the brides' and grooms' families[36] at the time of marriage, and an indicator of whether the groom chose the bride or the marriage was arranged by the families. When mehr is the dependent variable, the equation includes the brides' education and age in the regression. Similarly, in the case of dowry, the estimating equation includes the grooms' education and age in the regression.[37]

In the marriage market literature since Becker (1973), it is widely recognized that brides and grooms have preferences for certain attributes and that such preferences can lead to the

[34] As the steps outlined to select the working sample retain only positive values of dowry and mehr (there was no zero values), logarithmic transformation does not decrease the sample size in our analysis. Such transformation is also very useful in accounting for heteroskedasticity.

[35] Equations (19) and (20) are estimated independently. However SURE estimations give qualitatively similar results. See Ambrus et al. (2010) who also estimated the mehr and dowry equations independently.

[36] Relative wealth is categorized into three groups, depending on whether the brides' family was (i) economically richer, (ii) poorer, and (iii) equal relative to the groom's family.

[37] Other attributes such as skin tone and height (Banerjee et al. 2013) are not controlled for in the regression as such data were not collected; the caste system is absent among Muslims.

emergence of marriage-related payments. Moreover, the nature and direction of such payments are often affected by socio-economic factors (Anderson 2003). Empirical evidence pertaining to both developed (Hitsch et al. 2010) and developing countries (Rao 1993, Edlund 2000) usually supports the existence of preferences regarding spousal attributes. One might argue that bride and groom attributes are endogenous. However, our main focus is on the β^M and β^D coefficients, which compare average values of mehr and dowry, respectively, in different periods. Given that the relevant economic and political events are completely exogenous, the estimated β^M and β^D coefficients will be unbiased even without controlling for bride and groom attributes. In all estimations, the standard errors are clustered at the household level.

We apply our main empirical estimation strategy to PKSF and BRULS data, as well as to a combined data set constructed by merging these two data sets. Merging the two datasets is justified as the information used in the analysis is the year of marriage and the values of mehr and dowry paid or specified as part of the marriage, which are independent of the timing of the survey. The same is true of bride and groom attributes at the time of marriage.

6 Results

Before presenting the results, it is worth reiterating the predictions of the model developed in Section 3.1.1. Recall that the GR increases the value of mehr, while IW-famine decrease it. The effect on dowry is ambiguous; however, if movements in dowry follow the same pattern as that of mehr, its change will be smaller in magnitude to that of mehr. Therefore, we compare the values of mehr and dowry in the GR period relative to pre-GR period, and the same in the post-IW-famine (post-1974) relative to the GR period.

In the following, we first present the results for the two data sets in Bangladesh and then check robustness using the data from the West Bengal. The latter results are also used to counter the alternative explanation of the fluctuations in dowry and mehr values such as legal changes in Bangladesh.

6.1 Results from the PKSF (2010) data

The regression results are presented in Table 2. The (log) value of mehr and dowry are estimated relative to the pre-GR period, which is the base category in the regression. The values in the subsequent periods relative to their previous period are reported at the bottom of the table. Column 1 presents the results for mehr, without controlling the attributes of bride and groom. The value of mehr increased significantly during the GR relative to the previous period (the coefficient is 0.672 with a t-value of 1.987). Further, although the value of mehr did not decline in the IW-famine period (1971-74) compared to the GR level, it declined significantly in the post-famine period (the coefficient is -1.163 with a t-value of -3.631). Lastly, it declined in the post-famine period vis-á-vis the IW-famine period (the coefficient is -0.899 with a t-value of -3.336). These results are robust to controlling for bride and groom attributes (column 2). The value of dowry did not change in the GR period from its pre-GR level, but otherwise it followed

a trend similar to that of mehr, although with slightly lower statistical significance (columns 3 and 4). Comparison the results for mehr and dowry (columns 1 vs. 3; columns 2 vs. 4) in the post-famine period shows that the decrease in dowry was smaller than that in mehr.

These results strongly support our model's predictions.

[Insert Table 2 about here]

6.2 Results from the BRULS (2004) data

The regression results are presented in Table 3. Column 1 presents the results for mehr when bride and groom attributes are excluded from the regression. The value of mehr increased during the GR compared to the pre-GR period, but the difference is not statistically significant. It decreased in the post-famine period relative to the GR period, but the difference is again not statistically significant. However, the value of mehr decreased significantly in the post-famine period relative to the IW-famine period (the coefficient is -0.634 with a t-value of -1.806), a result that is qualitatively similar when the bride and groom attributes are included (column 2). The value of dowry followed a very similar trend. Comparing the results with PKSF data, the main difference is that the change in mehr in the GR period is insignificant. However, in contrast to the value of mehr, the value of dowry significantly decreased in the post-famine period from its GR level; the coefficient (t-value) is -0.730 (-1.864) when bride and groom attributes are excluded and -0.834 (-2.218) when these attributes are included (columns 3 and 4).

Although, the decrease in the values of mehr and dowry in the post-famine period do not differ much, the overall results provide qualified support for the model's predictions.

It is important to mention that the survivorship bias is more acute in the BRULS than the PKSF data because of the smaller sample in earlier periods (discussed in Section IV); there are only 8 observations in the pre-GR period. This may the reason why the estimated coefficient of mehr for the GR period is statistically insignificant.

[Insert Table 3 about here]

6.3 Results from the merged (PKSF and BRULS) data

Our final exercise is to merge the PKSF and BRULS datasets to take advantage of an even larger sample size. One caveat, however, should be noted. The PKSF dataset represents all major geographical regions of the country, while the BRULS dataset represents only the Northwestern region. As a result, the merged dataset places a relatively larger weight on the northwest.

The regression results are presented in Table 4. The results for mehr, without and with inclusion of the bride and groom attributes, are presented in columns 1 and 2, respectively. The corresponding results for dowry are presented in columns 3 and 4, respectively. All of these results are similar to those obtained using the PKSF data and with higher levels of statistical significance.

To summarize, the results indicate that the value of mehr increased during the GR period and then declined during both the IW-famine and post-famine periods. However, only the decline in the latter period is statistically significant, probably owing to the time lag required for the effect of the shock to be realized. Dowry, on the other hand, did not change during the GR period but otherwise followed a trend similar to that of mehr, though with a lower level of significance.

These results are consistent with the theoretical predictions summarized in the two testable hypotheses. More specifically, the GR had a positive effect on mehr and the IW-famine had a negative effect on both dowry and mehr with the decrease in mehr being larger in magnitude than dowry. Why is the result on dowry significant for the post famine period, while it is insignificant for the GR period? The theoretical framework suggests a possible answer. Note that it may be argued that the GR has a relatively greater effect on the income of women relative to that of men, so that the effect on dowry is primarily driven by changes in w. Whereas the IW and famine period affects the income of both men and women. Consequently, if the parameter values are such that an increase in the income levels of men also increase dowry, then this is an additional effect that will come into play during the IW and famine periods, but not during the GR period.

[Insert Table 4 about here]

Although our focus in on the β^M and β^D coefficients, we briefly discuss below the estimated coefficients of bride and groom attributes. The results presented in Tables 2-4 demonstrate that the bride and groom attributes affect the values of both mehr and dowry. Education levels of brides and grooms increase the values of both mehr and dowry, whereas educational differences (groom's education minus bride's education) decreases the value of mehr, and increases that of dowry. These results are robust in all datasets. Recall that (15) implies that the value of mehr is increasing in the income of both men and women, so that these results are consistent with our theoretical framework. Mehr decreases with the age of the bride, while dowry increases with the age of the groom. Again note that that the fact that mehr decreases with the age of the bride is consistent with (15), assuming that younger women are more productive/attractive. Both mehr and dowry increase with age difference (groom's age minus bride's age). The groom receives less dowry when he chooses his bride, than when the bride is chosen by his family and relatives. These results are pronounced in the PKSF and merged datasets.

Of course, these results may not reflect true causality because of possible endogeneity. Nonetheless they do find support in the marriage market literature that seeks to explain marriage-related payments in Bangladesh (Esteve-Volart 2004, Arunachalam and Logan 2006) and other parts of South Asia (Rao 1993, Anderson 2004, Dalmia and Lawrence 2005).

7 Other Plausible Explanations

We next examine other possible explanations for the observed patterns in mehr and dowry, in particular legal changes and missing women. We shall argue that these do not explain the observed

patterns in these two social institutions.

7.1 Natural shocks or legal changes?

As discussed in Section 3, in the post-1960 period, there were two legal changes in Bangladesh aimed at restricting polygamy among Muslims and curb the practice of dowry that coincided with the natural shocks. Although our theoretical analysis, as opposed to Ambrus et al. (2010), suggests that the MFLO actually works to decrease rather than increase both mehr and dowry (see Section 3.1.2), empirically disentangling the effect of natural shocks from the legal changes is a daunting challenge. In the following, we do that by exploiting another natural experiment from the Indian state of West Bengal. In Appendix 4, we also demonstrate that the empirical results reported in Ambrus et al. (2010) are sensitive to their empirical methodology.

7.1.1 Evidence from the Indian state of West Bengal: Another natural experiment

(United) Bengal was partitioned by the British in 1947 into two regions, the eastern region became a part of Pakistan (East Pakistan, now Bangladesh), whereas the western region became a part of India (West Bengal). Bangladesh and West Bengal are not only similar in many respects including climate, geography, language, and level of economic development, but also the new agricultural technologies under the GR was introduced in Bangladesh and West Bengal almost at the same time. However, being parts of two different countries, Bangladesh and West Bengal differ in terms of legal changes introduced after 1947. Therefore if the changes in the values of mehr and dowry in West Bengal mirror those in Bangladesh during the GR period, we can conclude that these changes most likely be driven by the GR and not by legal changes.

In examining West Bengal we follow an approach similar to Banerjee et al. (2002) that takes the agriculture sector of Bangladesh as a valid counter-factual for that in West Bengal and identifies the effect of a policy change (tenancy reform) in West Bengal on agricultural rice yields by comparing rice yields in Bangladesh (through a difference-in-difference model). They relied on the assumption that in the absence of the policy reform, agriculture was growing at the same rate in both countries. Similar to Banerjee et al. (2002) we test if agricultural growth was the same in the Bangladesh and the West Bengal districts examined by us between 1961 and 1970. We regressed agricultural value added over the period 1961-70 against year dummies and an indicator that tracks if the district is in Bangladesh or not.[38] Similar to Banerjee et al. (2002), the hypothesis is rejected as the coefficient on the Bangladesh dummy is significantly different from zero.[39]

In the absence of negative shocks, such as IW or famine, in West Bengal, we expect no decline

[38] For Bangladesh, the growth data is calculated from agricultural value added in constant LCU. The data source is the online World Development Indicators of the World Bank. For West Bengal the growth is calculated from agricultural yield data for six separate districts (Cooch Behar, Malda, Murshidabad, Nadia, North Dinajpur, and South Dinajpur) from where we collected our marriage market data. The data is sourced from various issues of Statistical Abstract of the West Bengal Government.

[39] The coefficient of the Bangladesh dummy is -3.73 with a t-stat of -0.59.

in dowry and mehr after 1974. Although about 1.5 million refugees from Bangladesh took shelter in bordering Indian regions including West Bengal, and some West Bengal districts may have suffered from the flood of 1974 (that was one of the reasons for the famine in Bangladesh), there were no reports of either famine or extreme hunger in these districts of West Bengal. Therefore, there is no evidence to argue that during the 1971-74 period there was any negative shock in West Bengal.

We choose the following cut-off periods: (i) pre-GR (pre-1961), (ii) GR (1961-1974), and (iii) post-1974. The 1974 cut-off is chosen so as to compare the effect of the legal changes that occurred in Bangladesh. We expect, based on our arguments in Section II, that mehr would have increased in the 1961-1974 period relative to the pre-GR period, while the effect on dowry would be ambiguous. In the absence of any further shocks, the values of dowry and mehr would have stabilized and therefore no significant changes are expected in the post-1974 period.

[Insert Table 5 about here]

The results are presented in Table 5. Columns (1) and (2) present the results for mehr without and with controlling for the attributes of the brides and grooms, respectively. In both specifications, the value of mehr increased significantly in the 1961-1974 period, but there were no significant change in post-1974 period relative to the 1961-1974 period. In contrast, there were no significant changes in the value of dowry in either 1961-1974 or post-1974 period. The results strongly support our argument that it is natural shocks, rather than legal ones, that explain the changes in the values of mehr and dowry.

7.2 Missing Women and Marriage Squeeze

We then examine if the increased mehr in the 1960s was a result of missing women (a term coined in Sen 1990). The gender ratio (the number of males per 100 females) at birth in Bangladesh remains normal in the sense that it is similar to countries where prenatal discrimination is not observed or reported (UNFPA 2012).

Bangladesh however had high excess female mortality rate (Kabeer et al., 2013). In addition, age-specific sex ratio and marriage rates need to be considered while examining if missing women and marriage squeeze were happening in Bangladesh. In Appendix 3, Table A3 shows gender ratios at different age group for the period 1951-2011 collected for various census years. It is clear that the gender ratio at birth in Bangladesh had not changed in the 1950s and 1960s. Besides, missing İ women and abnormal İ rise in the proportion of male births in India (West Bengal) and other developing countries, is mostly a post 1970s phenomenon owing to the availability of prenatal sex determination technologies, among others (Sen 1990, UNFPA 2012).

However, there was an abrupt decline in the number of males in between 20 and 29 years, implying that at marriage age, the number of girls exceeds the number of boys.[40] However, this

[40]One plausible explanation of this phenomenon is high incidence of age-specific, both internal and international, migration of males in Bangladesh.

was observed since the 1950s and did not experience any significant change in the 1960s and 1970s. Hence this phenomenon is unlikely to be confounded with the two natural shocks discussed here.

8 Conclusion

In this paper we seek to explain the evolution of mehr and dowry in Bangladesh since the 1960s in terms of natural shocks. We first develop a model based on the institutional realities in our setting in which the role of dowry and mehr is to ensure that the marriage market clears and also that it is efficient. Our comparative statics results show that the observed fluctuations in mehr and dowry can indeed be explained as responses to exogenous income shocks. More specifically, a positive (negative) income shock for women would lead to an increase (decrease) in mehr. In contrast, the effect of an income shock on dowry is indeterminate; however, if it is positive, it would be of a smaller magnitude compared to the effect on mehr.

To test the model predictions, we exploit several natural experiments. In Bangladesh, the introduction of modern agricultural technologies in the 1960s, popularly referred to as the Green Revolution, caused a substantial increase in agricultural productivity and particularly in the demand for women labor in agriculture. Subsequently the country was subject to several negative shocks, first the devastating Independence War of 1971, followed in 1974 by a famine that primarily affected the rural households. Our empirical results find support for the model predictions in that while the value of mehr increased significantly during the GR period (1961-1970), there was no significant change in the value of dowry. Further both mehr and dowry decreased in the post-famine period, with the decrease in mehr being relatively larger in magnitude. Taken together these results suggest that natural shocks affect how social institutions evolve over time, an insight that may well be true beyond the specific example studied in this paper.

To check the robustness of our results, we exploit another natural experiment from the Indian state of West Bengal (bordering Bangladesh) that also experienced the GR at the same period. The results from these data strongly corroborate the results obtained in the context of Bangladesh. Equally importantly, given that West Bengal experienced a similar GR but was not subject to any of the legal changes in Bangladesh (being a part of India), these results suggest that the effects on mehr and dowry can be traced to income, rather than legal shocks.

It is important to note that agricultural productivity gradually increased in Bangladesh in the post-1980 period. This increase may be attributed to cumulative experiences gained over time since the GR shock, increasing role played by NGOs in the agricultural sector or innovation of newer rice varieties but none of them can be regarded as an exogenous shock. Another important aspect of the development process in Bangladesh is that the aggregate growth in the 1960s was driven mainly by the growth in agricultural sector, while the same in the post-1980 period was driven by the growth in non-agricultural sector in urban areas. We also observe in the data that there have been no sharp changes in the values of dowry and mehr or even persistent gradual changes to indicate trend reversion since the last shock during the famine, which suggests that the impacts of last negative shock still persist.

Acknowledgments: We would like to thank Arnab Basu, Christopher Barrett, Robert Barro, Shahe Emran, Abhiroop Mukhopadhyay, Fahad Khalil, Tridip Ray, conference participants at the IZA, the 10th Australian Development Economics Workshop, 2015 ASSA meeting, the 11th ACEGD, the ISI Growth and Development Conference, 2015, audiences at Gottingen University, Erasmus University, Indian Statistical Institute, and Jadavpur University for their helpful comments. We thank Dyotona Dasgupta and Shilpi Mukherjee for their help in the process of data collection. All errors and omissions are the sole responsibility of the authors.

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Figures & Tables

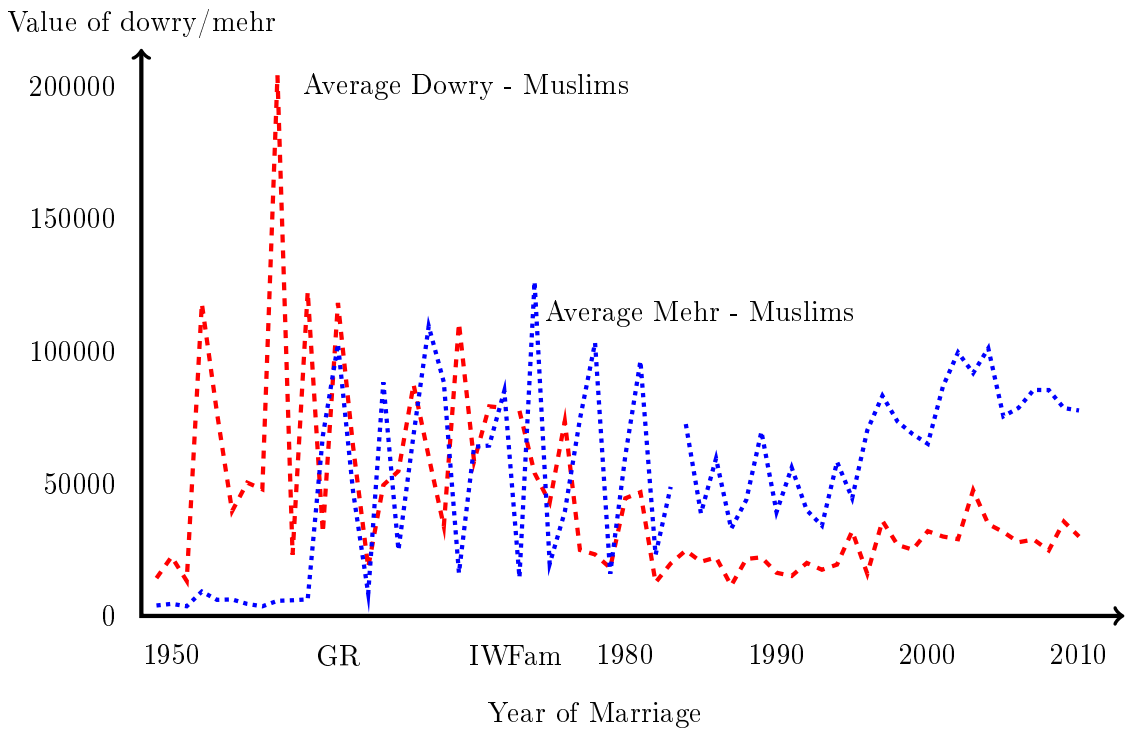

Figure 1: Mean Real Value of Mehr and Dowry by Year of Marriage (based on PKSF data)

Table 1: Summary Statistics - PKSF (2010) data

	All Marriages over the period (1)	Regime I Marriages (before 1961) (2)	Regime II Marriages (1961-1970) (3)	Regime III Marriages (1971-1974) (4)	Regime IV Marriages (1975-2010) (5)
Value of mehr	57712.865	18009.451	56759.742	65112.773	59328.39
	(2372.78)	(11629.072)	(11330.143)	(14784.868)	(2370.902)
Value of dowry	31642.026	54256.62	58591.527	67704.356	25293.787
	(1615.99)	(12496.895)	(8700.909)	(14992.95)	(1267.562)
Education, bride	3.503	0.775	1.412	1.778	3.978
	(0.085)	(0.208)	(0.19)	(0.274)	(0.096)
Education, groom	3.653	1.625	2.181	2.404	3.994
	(0.09)	(0.336)	(0.268)	(0.371)	(0.1)
Age at marriage, bride	16.09	13.475	14.434	14.717	16.489
	(0.068)	(0.391)	(0.201)	(0.289)	(0.071)
Age at marriage, groom	23.996	23.887	24.335	23.707	23.981
	(0.108)	(0.616)	(0.413)	(0.513)	(0.116)
Bride's family richer	0.311	0.212	0.28	0.374	0.316
	(0.01)	(0.046)	(0.033)	(0.049)	(0.012)
Groom's family richer	0.234	0.313	0.231	0.172	0.235
	(0.01)	(0.052)	(0.031)	(0.038)	(0.011)
N (All female)	1981	80	182	99	1620

Figures in parentheses are standard errors.

Table 2: Impact of exogenous shocks on the real values of mehr and dowry (PKSF 2010 data) base category: pre-GR (pre-1961)

	Log of Mehr		Log of Dowry	
	(1)	(2)	(3)	(4)
GR (1961-1970)	0.672**	0.589*	0.13	0.058
	(1.987)	(1.783)	(0.469)	(0.209)
IW-famine (1971-1974)	0.408	0.31	0.308	0.204
	(0.867)	(0.674)	(0.841)	(0.565)
Post-famine (post-1974)	-0.491	-0.46	-0.3	-0.339
	(-0.848)	(-0.819)	(-0.720)	(-0.825)
Bride's education at marriage		0.146***		
		(7.677)		
Education difference		-0.055***		0.037***
		(-2.647)		(2.607)
Bride's age at marriage		-0.038*		
		(-1.832)		
Age difference		0.005		-0.006
		(0.228)		(-0.484)
Groom's family was richer at time of marriage		0.164		0.05
		-1.352		-0.691
Bride's family was richer at time of marriage		0.059		0.025
		(0.492)		(0.369)
Who choose bride (1=bride/groom; 0=otherwise)		0.003		-0.231*
		-0.015		(-1.772)
Groom's education at marriage				0.090***
				(8.933)
Groom's age at marriage				0.025**
				(2.103)
Number of observations	1,981	1,981	1,981	1,981
R-squared	0.182	0.214	0.212	0.255
IW-famine relative to GR	-0.264	-0.279	0.178	0.146
	(-0.978)	(-1.044)	-0.809	-0.683
Post-famine relative to GR	-1.163***	-1.049***	-0.431*	-0.397*
	(-3.631)	(-3.374)	(-1.909)	(-1.793)
Post-famine relative to IW-famine	-0.899***	-0.770***	-0.609***	-0.543***
	(-3.336)	(-2.905)	(-3.123)	(-2.862)

Robust t-statistics in parentheses; *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table 3: Impact of exogenous shocks on the real values of mehr and dowry (BRULS 2004 data)
base category: pre-GR (pre-1961)

	Log of Mehr		Log of Dowry	
	(1)	(2)	(3)	(4)
GR (1961-1970)	1.54	1.245	1.076	0.491
	(1.257)	(0.981)	(0.883)	-0.406
IW-famine (1971-1974)	1.625	1.212	1.042	0.361
	(1.228)	(0.895)	(0.797)	-0.28
Post-famine (post-1974)	0.991	0.557	0.346	-0.344
	(0.686)	(0.383)	(0.245)	(-0.250)
Bride's education at marriage		0.097***		
		(9.933)		
Groom's education at marriage				0.117***
				(12.991)
Education difference		-0.045***		0.042***
		(-3.639)		(3.71)
Squared education difference		-0.001		0.001
		(-0.280)		(0.608)
Bride's age at marriage		0.003		
		(0.229)		
Groom's age at marriage				0.003
				(0.223)
Age difference		-0.002		0.013
		(-0.106)		(0.655)
Squared age difference		0		0
		(-0.224)		(-0.214)
Who choose bride (1=bride/groom; 0=otherwise)		0.164		-0.266
		-0.955		(-1.566)
Groom's family richer at time of marriage		0.012		0.048
		(0.153)		(0.717)
Bride's family richer at time of marriage		0.034		0.099
		(0.434)		(1.473)
Observations	1,367	1,364	1,367	1,364
R-squared	0.136	0.205	0.11	0.244
IW-famine relative to GR	0.086	-0.034	-0.034	-0.13
	-0.198	(-0.078)	(-0.097)	(-0.366)
Post-famine relative to GR	-0.549	-0.688	-0.730*	-0.834**
	(-1.187)	(-1.523)	(-1.864)	(-2.218)
Post-famine relative to IW-famine	-0.634*	-0.655*	-0.696**	-0.704**
	(-1.806)	(-1.889)	(-2.441)	(-2.504)

Robust t-statistics in parentheses; ***$p < 0.01$, ** $p < 0.05$, * $p < 0.1$. All regressions control for dummies for relationship with the household head, dummies for regions, and a constant.

Table 4: Impact of exogenous shocks on the real values of mehr and dowry (PKSF + BRULS data) base category: pre-GR (pre-1961)

	Log of Mehr		Log of Dowry	
	(1)	(2)	(3)	(4)
GR (1961-1970)	1.036***	0.877***	0.255	0.112
	(3.244)	(2.823)	(0.913)	(0.418)
IW-famine (1971-1974)	0.946**	0.766*	0.353	0.179
	(2.24)	(1.871)	(1.01)	(0.533)
Post-famine (post-1974)	0.235	0.12	-0.369	-0.481
	(0.465)	(0.246)	(-0.938)	(-1.280)
Bride's education at marriage		0.126***		
		(11.598)		
Groom's education at marriage				0.099***
				(14.077)
Education difference		-0.053***		0.034***
		(-3.779)		(3.695)
Squared education difference		0		0
		(-0.112)		(-0.252)
Bride's age at marriage		-0.038***		
		(-2.844)		
Groom's age at marriage				0.025***
				(3.249)
Age difference		0.040***		0.020***
		(6.897)		(5.11)
Squared age difference		0		-0.001
		(0.56)		(-1.597)
Who choose bride (1=bride/groom; 0=otherwise)		0.077		-0.241**
		(0.47)		(-2.281)
Groom's family richer at time of marriage		0.102		0.066
		(1.299)		(1.287)
Bride's family richer at time of marriage		0.067		0.055
		(0.859)		(1.131)
Observations	3,348	3,345	3,348	3,345
R-squared	0.209	0.253	0.158	0.233
IW-famine relative to GR	-0.089	-0.112	0.097	0.066
	(-0.383)	(-0.492)	(0.509)	(0.359)
Post-famine relative to GR	-0.800***	-0.757***	-0.624***	-0.593***
	(-2.992)	(-2.973)	(-3.207)	(-3.177)
Post-famine relative to IW-famine	-0.711***	-0.646***	-0.721***	-0.660***
	(-3.236)	(-3.021)	(-4.367)	(-4.147)

Robust t-statistics are in parentheses; *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. All regressions control for the dummies for relationship with the household head, dummies for the regions, and a constant.

Table 5: Impact of exogenous shocks on the real values of mehr and dowry in West Bengal (pre-GR is the base category)

	Log of Mehr		Log of Dowry	
	(1)	(2)	(3)	(4)
GR (1961-1974)	1.608**	1.308*	0.228	-0.361
	(2.141)	(1.709)	(0.109)	(-0.176)
Post-1974	1.757**	1.342	-0.812	-1.347
	(2.022)	(1.532)	(-0.345)	(-0.586)
Bride's education at marriage		0.076***		
		(5.371)		
Education difference		-0.042***		0.105***
		(-2.723)		(2.954)
Bride's age at marriage		0.017		
		(1.017)		
Age difference		-0.023		-0.083*
		(-1.100)		(-1.669)
Bride's family was richer at time of marriage		0.168		0.403
		(1.383)		(1.63)
Groom's family was richer at time of marriage		-0.093		0.347
		(-0.784)		(1.366)
Who choose bride (1=bride/groom; 0=otherwise)		-0.113		-2.576***
		(-0.647)		(-5.849)
Groom's education at marriage				0.194***
				(6.709)
Groom's age at marriage				-0.134***
				(-4.123)
Number of observations	1,158	1,158	1,186	1,186
R-squared	0.202	0.235	0.131	0.214
Post-1974 relative to GR	0.149	0.033	-1.039	-0.986
	(0.455)	(0.105)	(-1.268)	(-1.237)

Robust t-statistics in parentheses; *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Other controls include relationship with the household head, education difference square, age difference square,

Table 6: Impact of legal changes on the real values of mehr and dowry (BRULS data cleaned by Ambrus et al. (2010))

	(1) Value of Mehr	(2) Value of Dowry	(3) Value of Mehr	(4) Value of Dowry	(5) Value of Mehr	(6) Value of Dowry
Married post-1963	114,849.754***	18,213.205**	34,515.82	18,732.050**	33,751.36	18,618.318**
	(3.824)	(2.037)	(1.051)	(2.421)	(1.037)	(2.39)
Married post-1974	-85,571.043***	-14,834.380*	-63,312.803***	-7,301.05	-61,322.529***	-6,977.55
	(-3.932)	(-1.853)	(-3.340)	(-1.301)	(-3.264)	(-1.239)
Married post-1990	12,418.632*	5,782.05	12,955.63	5,772.283*	13,626.43	5,885.806*
	(1.662)	(1.373)	(1.575)	(1.913)	(1.626)	(1.941)
Married post-1998	42,639.01	13,874.05	33,743.861*	17,998.046***	29,165.96	17,364.569***
	(1.218)	(1.46)	(1.665)	(3.117)	(1.53)	(3.068)
Year of marriage	-3,194.735**	453.963	-1,491.513*	-217.231	-1,932.312**	-283.507
	(-2.077)	(0.632)	(-1.961)	(-0.919)	(-2.361)	(-1.187)
How old was at the time of					3,966.032**	586.026
first marriage?					(2.525)	(1.53)
Age difference between spouses					-3.337	18.174
					(-0.005)	(0.061)
Bride's family wealthier than groom's					5,214.61	1,431.62
					(0.782)	(0.588)
7 Eight year dummies included?	Yes	Yes	No	No	No	No
Bride & groomâĂŹs characteristics included?	No	No	No	No	Yes	Yes
Observations	1,367	1,367	1,367	1,367	1,367	1,367
R-squared	0.099	0.034	0.087	0.031	0.095	0.033

Figures in parentheses are robust t-values clustered at the household level. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Columns 1 & 2 use exact specification of Ambrus et al. and their data. In columns 3 to 6, the seven eight-year dummies have been dropped. In columns 5 & 6, three characteristics (how old was at the time of first marriage, age difference between spouses, bride family wealthier than grooms) found in Ambrus et al. (2010) data & used as dependent variables in their analysis (Ambrus et al. (2010) Table 3, columns 4 to 6) are added.

Appendices for Online Publication

Appendix 1: Income is Random

We next extend the basic framework to the case where the income of men is random, in particular let m be distributed over the interval $[0,1]$ with distribution $G(m)$, the associated density function being $g(m)$, so that the 'number' of men is normalized to 1. Further, the income of all women is taken to be identical at w, where $0 < w < 1$ (though later we briefly discuss the case where w is also random). As earlier there are N women, where $N < 1$. We shall also focus on the case where t is not too small, in that $\frac{t-\mu_w}{\mu_m - t} > \frac{s(w)}{w}$.

The time-line is the same as earlier. Further, the notion of equilibrium is the same, so that the marriage market price (D^*, M^*) is such that (a) the marriage market clears, and (b) men take the decision to divorce, as well as the decision to participate optimally. Further, we focus on equilibria that are efficient, and the level of mehr is the minimum possible that is consistent with efficiency.

Turning to the analysis, recall that the role of mehr is to prevent inefficient divorce. From our earlier analysis, a positive mehr will be required for all m in the interval $[m'(w), m''(w)]$. For all such m, in the absence of any mehr, inefficient divorce will take place in case the marriage fails. Given (10), one has that $m'(w)$ satisfies $w = \frac{\bar{m}(m)(\mu_m - t)}{t\lambda}$ and $m''(w)$ satisfies $w = \frac{\bar{m}(m)(\mu_m - t)}{t - \mu_w}$. Thus

$$m'(w) \equiv w[\frac{t\lambda}{\mu_m - t} - \frac{s(w)}{w}] \text{ and } m''(w) \equiv w[\frac{t - \mu_w}{\mu_m - t} - \frac{s(w)}{w}],$$

where note that given (4), the interval $[m'(w), m''(w)]$ is well defined. Recall that for any marriage involving a man with income m, the minimum level of mehr that can prevent inefficient divorce is given by $M^*(m)$, where $M^*(m)$ satisfies (11). Note from (11) that $M^*(m)$ is increasing in m, so that the minimal level of mehr that prevents *all* inefficient divorces is given by

$$M^*(m'') = w[\frac{t - \mu_w}{\mu_m - t} - \frac{s(w)}{w}](\mu_m - t) + s(w)(\mu_m - t) - wt\lambda. \tag{21}$$

We next turn to solving for the equilibrium dowry, D^*. Define $\tilde{m}$, where $0 < \tilde{m} < 1$, to be such that the 'number' of men with income $\tilde{m}$ or less is exactly equal to the number of women, i.e.

$$N = G(\tilde{m}). \tag{22}$$

We assume that $\tilde{m}$ is not too large, in that

$$\tilde{m} \leq w[\frac{t\lambda}{\mu_m - t} - \frac{s(w)}{w}]. \tag{23}$$

Hence for a couple where the man has income $m \leq \tilde{m}$, it is efficient to remain married even in case the marriage turns out to be unproductive.[41] We shall construct a D^* such that a man

[41] This follows because a man with income $\tilde{m}$ is indifferent, and the incentive to remain married even for an unproductive marriage is decreasing in m. In case this is not satisfied, it can be shown that dowry is negative, which is not realistic.

participates in the marriage market if and only if his income is at most $\tilde{m}$, thus ensuring that the marriage market clears.

To that end, we first solve for a level of dowry $\hat{D}(\tilde{m})$ such that the man with income $\tilde{m}$ is indifferent between remaining single, and getting married. Recall from Proposition 1, that in that case $M^*(\tilde{m})$ ensures that there is no divorce even if the marriage turns out to be unproductive. Consequently, $\hat{D}(\tilde{m})$ must satisfy, $\mu_m \bar{m}(\tilde{m}) = \gamma F(\bar{m}(\tilde{m}) + \lambda w) + (1-\gamma)t(\bar{m}(\tilde{m}) + \lambda w) + \hat{D}(\tilde{m})$ so that

$$\hat{D}(\tilde{m}) = \bar{m}(\tilde{m})(\mu_m - \gamma F - (1-\gamma)t) - \lambda w(\gamma F + (1-\gamma)t). \tag{24}$$

We restrict ourselves to the interesting case where $\hat{D}(\tilde{m}) > 0$.[42] We shall use the following properties of $\hat{D}(\tilde{m})$ in the subsequent analysis (the proof follows straightaway from the definition of $\hat{D}(\tilde{m})$).

Observation 1.*

(i) $\hat{D}(\tilde{m})$ is decreasing in F and t.

(ii) $\hat{D}(\tilde{m})$ is increasing in μ_m.

(iii) $\hat{D}(\tilde{m})$ is decreasing in λ.

We next argue that a profile (D^*, M^*), where $M^* \equiv M^*(m'')$ and $D^* \equiv \hat{D}(\tilde{m})$, constitutes an equilibrium. First, note that for a man with income m, the utility from getting married, net of the utility from remaining single, is given by $\bar{m}(m)(\gamma F + (1-\gamma)t - \mu_m) + \lambda w(\gamma F + (1-\gamma)t)$, which is decreasing in the income of men, i.e. m, given that $\mu_m > \gamma F + (1-\gamma)t$. Hence given that $\tilde{m}$ is indifferent between entering the marriage market, and remaining single, a man participates in the marriage market if and only if $m \leq \tilde{m}$. Thus, given (22), the number of men entering the market, i.e. $G(\tilde{m})$, equals the number of women, so that the market clears.

Proposition below summarizes the preceding discussion.

Proposition 6 *The dowry mehr configuration (D^*, M^*) satisfying the following properties constitute an equilibrium:*

(i) the mehr M^* equals

$$M^*(m'') = w[\frac{t - \mu_w}{\mu_m - t} - \frac{s(w)}{w}](\mu_m - t) + s(w)(\mu_m - t) - wt\lambda,$$

(ii) the dowry D^* equals

$$\hat{D}(\tilde{m}) = \bar{m}(\tilde{m})(\mu_m - \gamma F - (1-\gamma)t) - \lambda w(\gamma F + (1-\gamma)t)),$$

(iii) a man participates in the marriage market if and only if his productivity is not too large, i.e. $m \leq \tilde{m}$, and

[42] One sufficient condition is equation (16) earlier, evaluated at $m = \tilde{m}$.

(iv) a man divorces his spouse if and only if it is efficient to do so.

We then examine the impact of various shocks - productive, as well as legal - on both mehr, as well as dowry. As earlier, we focus on the case where $s(w) = s_w w$. Thus the equilibrium mehr for any m satisfying $\frac{\bar{m}(m)(\mu_m - t)}{t - \mu_w} < w < \frac{\bar{m}(m)(\mu_m - t)}{t\lambda}$, is given by

$$M^*(m'') = w[\frac{t - \mu_w}{\mu_m - t} - s_w](\mu_m - t) + w(s_w(\mu_m - t) - t\lambda), \tag{25}$$

whereas the equilibrium dowry can be written as

$$\hat{D}(\tilde{m}) = \tilde{m}(\mu_m - \gamma F - (1-\gamma)t) + s_w w(\mu_m - \gamma F - (1-\gamma)t) - \lambda w(\gamma F + (1-\gamma)t). \tag{26}$$

Income Shocks

First consider mehr. If there is an increase in the income of women, i.e. in w, then from (15) recall that $M^*(m'') = m''(\mu_m - t) + w(s_w(\mu_m - t) - t\lambda)$, so that the level of mehr is increasing in w whenever $[\frac{t-\mu_w}{\mu_m - t} - s_w](\mu_m - t) + s_w(\mu_m - t) - t\lambda > 0$.[43] We should point out that this condition is weaker than that required in the baseline model, where one requires (4), i.e. $s_w(\mu_m - t) - t\lambda > 0$, for the level of mehr to the increasing in w.

We next turn to formalising the idea of an increase in the income of men. We say that there is a positive income shock if, for a man with identity m, the shock causes his income to increase from m to αm, where $\alpha > 1$. It is straightforward to see that the level of mehr for any man with intial income m will be given by

$$M^*(m, \alpha) = m\alpha(\mu_m - t) + w(s_w(\mu_m - t) - t\lambda). \tag{27}$$

Further, it is easy to see that

$$m'(w, \alpha) = \frac{w}{\alpha}[\frac{t\lambda}{\mu_m - t} - s_w], \text{ and } m''(w, \alpha) = \frac{w}{\alpha}[\frac{t - \mu_w}{\mu_m - t} - s_w].$$

Thus

$$M^*(m''(\alpha)) = w[\frac{t - \mu_w}{\mu_m - t} - s_w](\mu_m - t) + w(s_w(\mu_m - t) - t\lambda),$$

so that the equilibrium mehr does not depend on α at all.

Proposition 7 *Consider the effect of income shocks on mehr.*

(i) The equilibrium mehr is increasing in the income of women w, whenever $[\frac{t-\mu_w}{\mu_m - t} - s_w](\mu_m - t) + s_w(\mu_m - t) - t\lambda > 0$.

(ii) The equilibrium mehr is independent of the income of men.

[43] This is a sufficient condition since $m''(w)$ is also increasing in w.

Thus this proposition suggests that the mehr would increase following the green revolution since the income of women increases, whereas during the famine and independence war, the mehr would decrease as the income of women decreases.

Turning to the effect of income shocks on dowry, it is straightforward to check that the dowry is decreasing in the income of women w whenever

$$[s_w(\mu_m - t) - t\lambda] - (s_w + \lambda)\gamma(F - t) < 0,$$

whereas recall that the mehr is increasing in w whenever $[\frac{t-\mu_w}{\mu_m - t} - s_w](\mu_m - t) + s_w(\mu_m - t) - t\lambda > 0$.

Next note that

$$\hat{D}(\tilde{m}, \alpha) = \alpha\tilde{m}(\mu_m - \gamma F - (1-\gamma)t) + s_w w(\mu_m - \gamma F - (1-\gamma)t) - \lambda w(\gamma F + (1-\gamma)t). \quad (28)$$

Thus an increase in the income of men, i.e. α, will necessarily increase dowry given that $\mu_m - \gamma F - (1-\gamma)t > 0$.

Proposition 8 *Consider the effect of income shocks on dowry.*

(i) Whenever $[\frac{t-\mu_w}{\mu_m - t} - s_w](\mu_m - t) + s_w(\mu_m - t) - t\lambda > 0 > s_w(\mu_m - t) - t\lambda - (s_w + \lambda)\gamma(F - t)$, *while the mehr increases with an increase in* w, *dowry would decrease.*

(ii) The dowry is increasing in the income of men.

Thus this proposition suggests that the effects of any income shocks, either positive or negative, on dowry will be relatively muted since the effects of changes in the income of men and women will act in opposite directions. Consequently, even under this extended formulation, the preceding argument suggests that both the testable hypotheses go through qualitatively.

Legal Shocks

Given (25) and (26), we can immediately specify the effects of various legal shocks in the extended framework.

Proposition 9 *Consider the effect of MFLO and MMDA.*

(i) Consider the implementation of MFLO, so that there is an increase in F *and* t*:*

(a) With an increase in F, *there is no change in mehr, whereas dowry decreases.*

(b) With an increase in t, *mehr increases, however dowry decreases.*

(ii) Following the implementation of MMDA, formalised as a decrease in μ_m, *there is no effect on mehr, whereas the dowry increases.*

Thus our framework predicts that the immediate effect of MFLO would be to *reduce* the level of dowry, whereas mehr increases. Further, note that our theoretical predictions differ from that of Ambrus et al. (2010), who argued that MFLO would cause an increase in both mehr, as well as dowry. As far as the effect of MMDA is concerned, we find that there is no effect on mehr, which is again different from Ambrus et al. (2010).

Remark 10 *We next briefly consider the case where the income of women is also random, and the 'number' of women N is less than that of men. In that case also one can construct an equilibrium where the equilibrium mehr ensures that all inefficient divorces are prevented, and the dowry ensures that the marriage market clears. It is straightforward to show that, as earlier, the equilibrium mehr is the maximal $M^*(m,w)$ over all possible (m,w) combinations, and the equilibrium dowry ensures that the number of men entering the marriage market is exactly N. The comparative statics results are also the same.*

Appendix 2: Dowry determined through Nash Bargaining

Recall that so far dowry has been interpreted as a groom price that clears the marriage market. We now examine a related framework where the dowry is instead determined through asymmetric Nash bargaining. Such a framework may not be too far fetched, given that marriages in these societies often involve intensive negotiations. However, as in the baseline framework, mehr is taken to be a conditional payment that serves to prevent inefficient divorce. The framework is the same as before, except that we assume that the economy consists of exactly one man, and one woman, so as to abstract from issues related to matching. The central question is whether such a framework generates comparative statics predictions that are qualitatively similar to those developed in Propositions 3, 4 and 5.

The timeline is as follows:

- *Stage 1:* The man and the woman bargain over the surplus. If they reach an agreement then marriage takes place and the agreement is codified in a contract (D, M), with the amount D being paid upfront.
- *Stage 2:* Following a marriage, the man and the woman get to know if the marriage is a success, or a failure, and the man decides whether to get divorced or not. In case of divorce, he pays the woman the agreed upon mehr M. Finally, the man and the woman consume.

In this framework an *equilibrium* is a vector (D^*, M^*) and a divorce rule such that:

1. The man takes the divorce decision in his own interest, given the contract (D^*, M^*) and the state of the marriage.
2. M^* is the minimum level of mehr such that inefficient divorce is prevented.
3. The dowry D^* is set through asymmetric Nash bargaining between the man and the woman where the man's bargaining power is taken to be β, with $\beta < \lambda$.

We next turn to solving for the equilibrium mehr and dowry. It is clear that one can mimic the argument in the main text to argue that Proposition 1 holds in this case as well. Further, in what follows we assume that (10) holds, so that mehr is positive, which is the case of interest.

Turning to dowry, we then solve for the asymmetric Nash bargaining game between the man and the woman, where the bargaining power of the man is β, and that of the woman is $1-\beta$, $0 < \beta < 1$. Letting H (respectively W) denote the utility of the man (respectively the woman) in this bargaining game, one can define the set of feasible outcomes

$$\mathcal{F} = \{(H,W) | H + W \leq \gamma F(\bar{m}+w) + (1-\gamma)\max\{t(\bar{m}+w), \mu_m \bar{m} + \mu_w w\}, H \geq \mu_m \bar{m}, W \geq \mu_w w\}.$$

Observe that the frontier of the feasible set is derived using the fact that efficiency entails the marriage taking place, as well as divorce, if any, being efficiency enhancing. Given that (10) hold,

we have that

$$\mathcal{F} = \{(H,W)|H+W \leq \gamma F(\bar{m}+w) + (1-\gamma)t(\bar{m}+w), H \geq \mu_m \bar{m}, W \geq \mu_w w\}. \tag{29}$$

The solution to the Nash bargaining program call it (H^*, W^*), solves

$$\begin{aligned} \max_{H,W} \quad & (H-\bar{m}\mu_m)^{\beta}(W-w\mu_w)^{1-\beta} \\ \text{s.t.} \quad & (H,W) \in \mathcal{F}. \end{aligned} \tag{30}$$

Implementing this (H^*, W^*) will require transfers among agents, which is the role played by dowry in this framework. Let the corresponding dowry be denoted D^*.

We then solve for the equilibrium level of dowry D^*. Recall from (10) that $w \geq \frac{\bar{m}(\mu_m - t)}{t - \mu_w}$. Thus the man's expected payoff following Nash bargaining is given by

$$\bar{m}\mu_m + \beta[(\gamma F + (1-\gamma)t)(\bar{m}+w) - \bar{m}\mu_m - w\mu_w].$$

Equating this with $\gamma F(\bar{m}+\lambda w) + (1-\gamma)t(\bar{m}+\lambda w) + D^*$, we find that the dowry

$$D^* = \bar{m}(1-\beta)(\mu_m - \gamma F - (1-\gamma)t) - w[(\lambda-\beta)(\gamma F + (1-\gamma)t) + \beta\mu_w]. \tag{31}$$

We focus on the interesting case where the dowry D^* is positive.

The following proposition summarizes the preceding discussion.

Proposition 11 *The equilibrium level of dowry, denoted D^*, is given by*

$$D^* = \bar{m}(1-\beta)(\mu_m - \gamma F - (1-\gamma)t) - w[(\lambda-\beta)(\gamma F + (1-\gamma)t) + \beta\mu_w]. \tag{32}$$

Further, dowry increases with an increase in property rights of women, i.e. a decrease in λ.

Again, for tractability, we specialise to a specific functional form for $s(w)$, in particular $s(w) = s_w w$, where $s_w > 0$. Recall that given (14), the equilibrium mehr $M^* = m(\mu_m - t) + w(s_w(\mu_m - t) - t\lambda)$, as before. Whereas the equilibrium dowry

$$\begin{aligned} D^* &= m(1-\beta)(\mu_m - \gamma F - (1-\gamma)t) \\ &+ w[s_w(1-\beta)(\mu_m - \gamma F - (1-\gamma)t) - (\lambda-\beta)(\gamma F + (1-\gamma)t) - \beta\mu_w)]. \end{aligned} \tag{33}$$

Given that Proposition 1 holds, it is clear that effect of a income shock on mehr is identical to that in Proposition 3 earlier. We next consider the effect of income shocks on dowry, the results following from (33).

Proposition 12 *Consider the effect of income shocks on dowry.*

(i) An increase in the income of women has an ambiguous effect on dowry. The level of dowry is going to decrease if the man's property rights over his wife's contribution is large, i.e.

$$\lambda > \frac{s_w(1-\beta)(\mu_m - \gamma F - (1-\gamma)t) + \beta(\gamma F + (1-\gamma)t) - \beta\mu_w}{\gamma F + (1-\gamma)t}.$$

(ii) The dowry is increasing the income of men.

Propositions 3 and 12 together suggest that while a positive income shock for women of the kind that happened during the green revolution will increase mehr, the effect on dowry is ambiguous. Further, mehr and dowry are both increasing in the productivity of men, i.e. m. Thus the two testable hypotheses go through in this case as well.

We next examine the effects of legal shocks on dowry and mehr. Given (15) and (33), we have

Proposition 13 *Consider the effect of MFLO and MMDA.*

(i) Following the implementation of MFLO, i.e. an increase in F and t, the mehr, as well as the dowry would decrease.

(ii) Following the implementation of MMDA, formalised as a decrease in μ_m, the mehr and dowry will both decrease.

Proof. (i) The mehr decreases since, from (15), $\frac{dM^*}{dt} = -m - tw < 0$ and $\frac{dM^*}{dF} = 0$. Further, the dowry decreases since, from (33), $\frac{dD^*}{dF} = -\gamma[m(1-\beta) + w(\lambda - \beta)] < 0$ and $\frac{dD^*}{dt} = -(1-\gamma)[m(1-\beta) + w(\lambda - \beta)] < 0$.

(ii) From (15), we have that $\frac{dM^*}{d\mu_m} = m > 0$, so that mehr decreases. Whereas from (33), $\frac{dD^*}{d\mu_m} = m(1-\beta) > 0$ so that dowry increases. ∎

Thus the comparative statics results for the legal shocks also appear to be qualitatively very similar compared to our baseline framework.

Appendix 3: Additional Figures and Tables

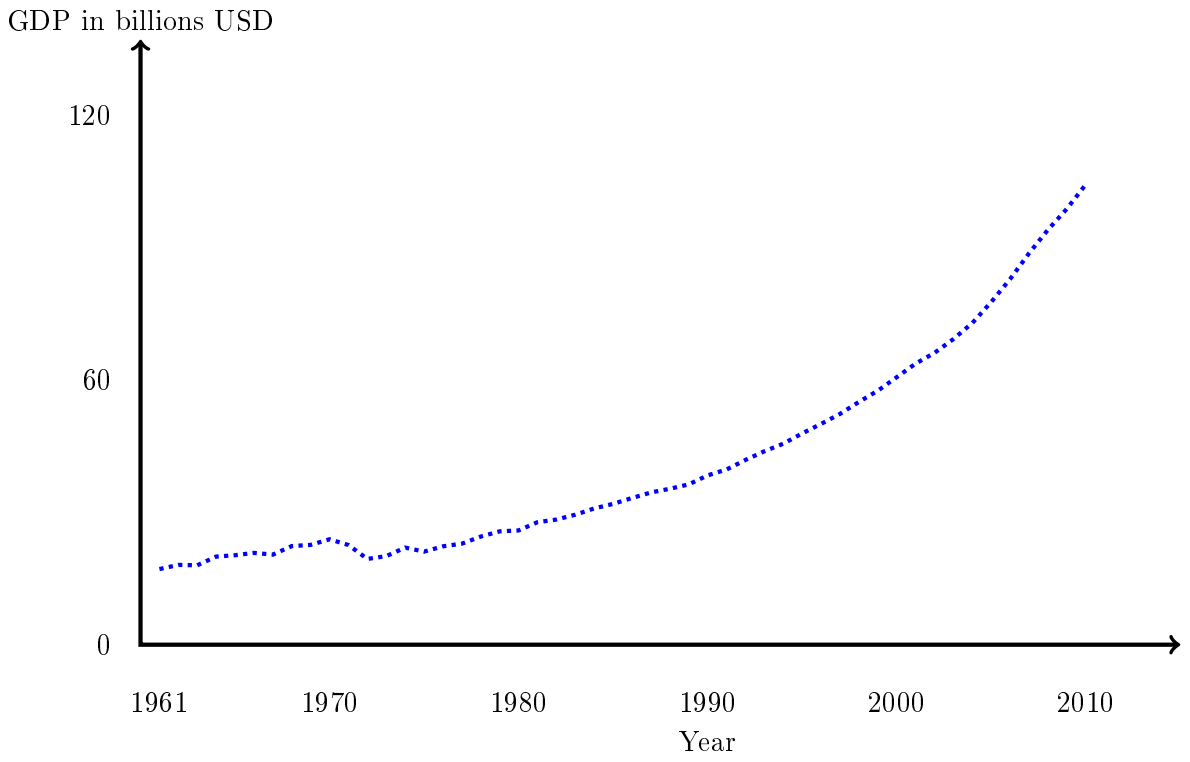

Figure-A1a: GDP of Bangladesh in costant USD, 1961-2010, Data Source: WDI

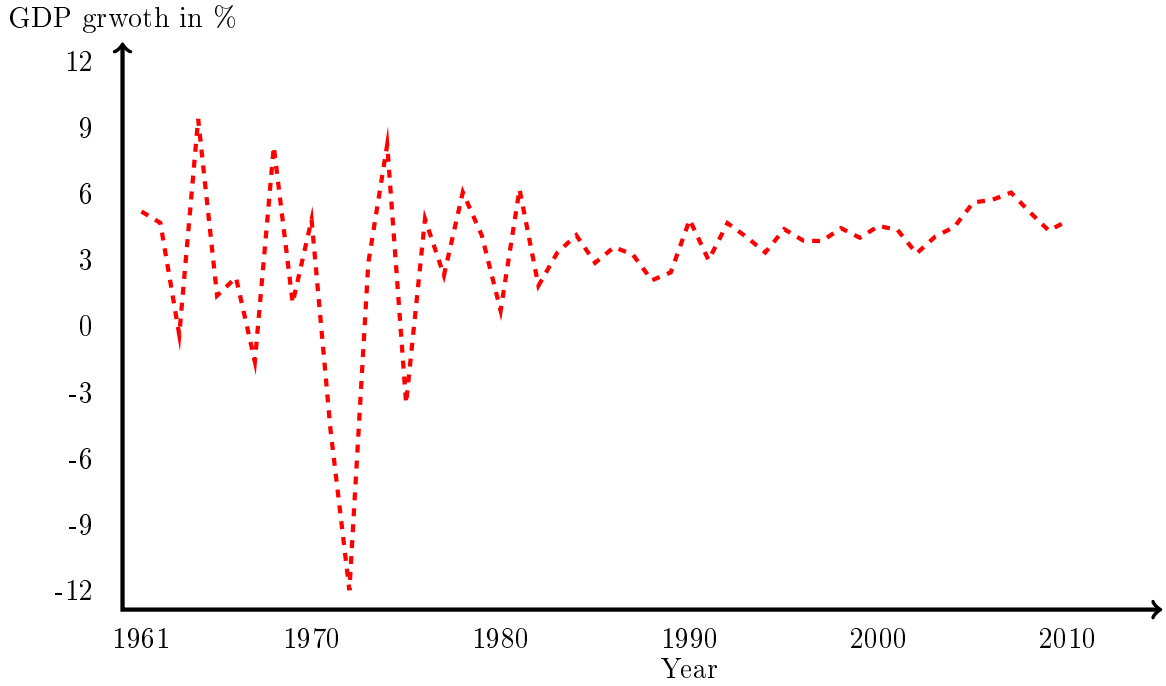

Figure-A1b: GDP Growth, 1961-2010, Data Source: WDI

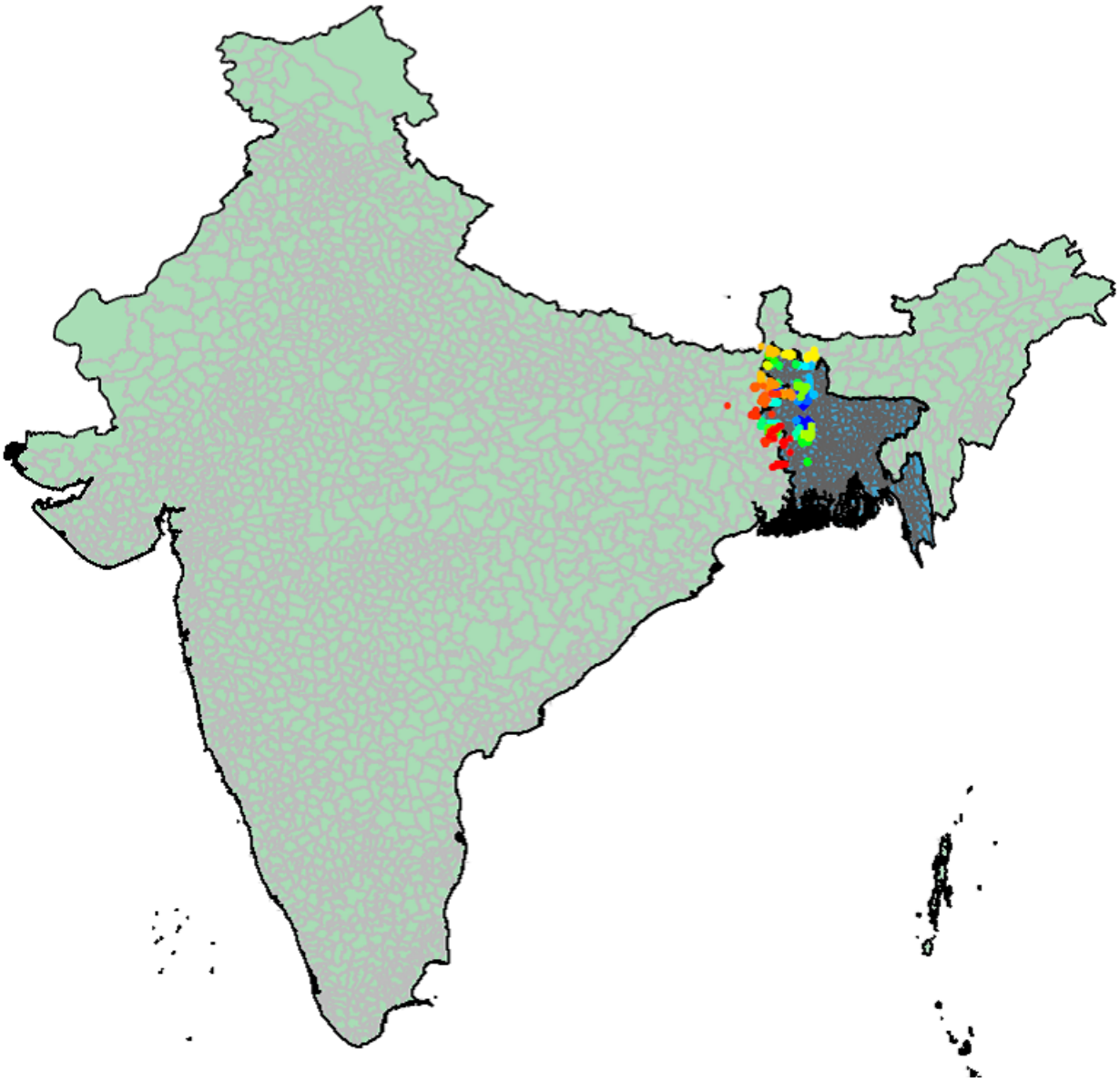

Figure A2: Data Collection Regions in Bangladesh and India

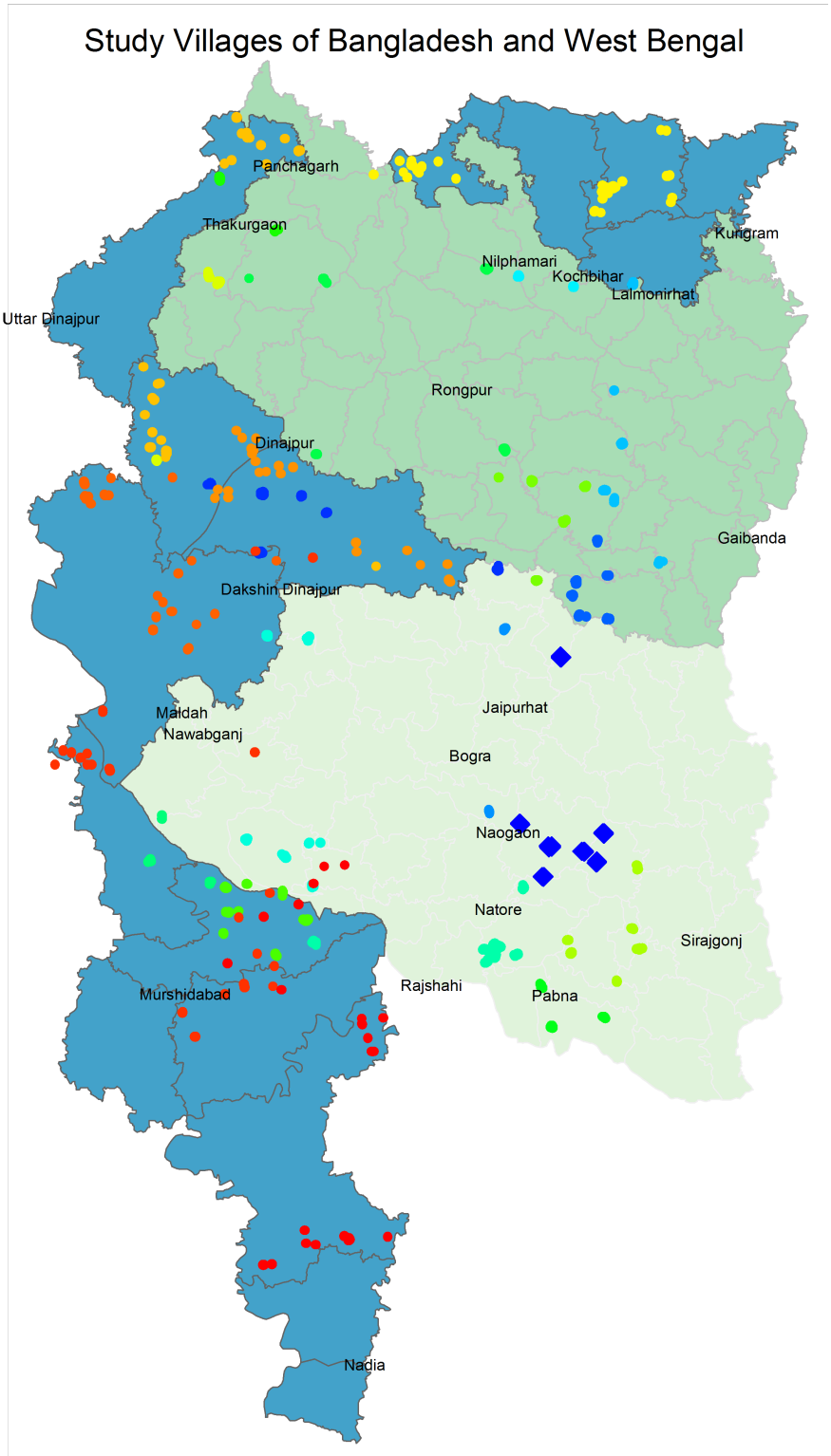

Figure A3: Location of Study Villages in Bangladesh (BRULS data) and West Bengal

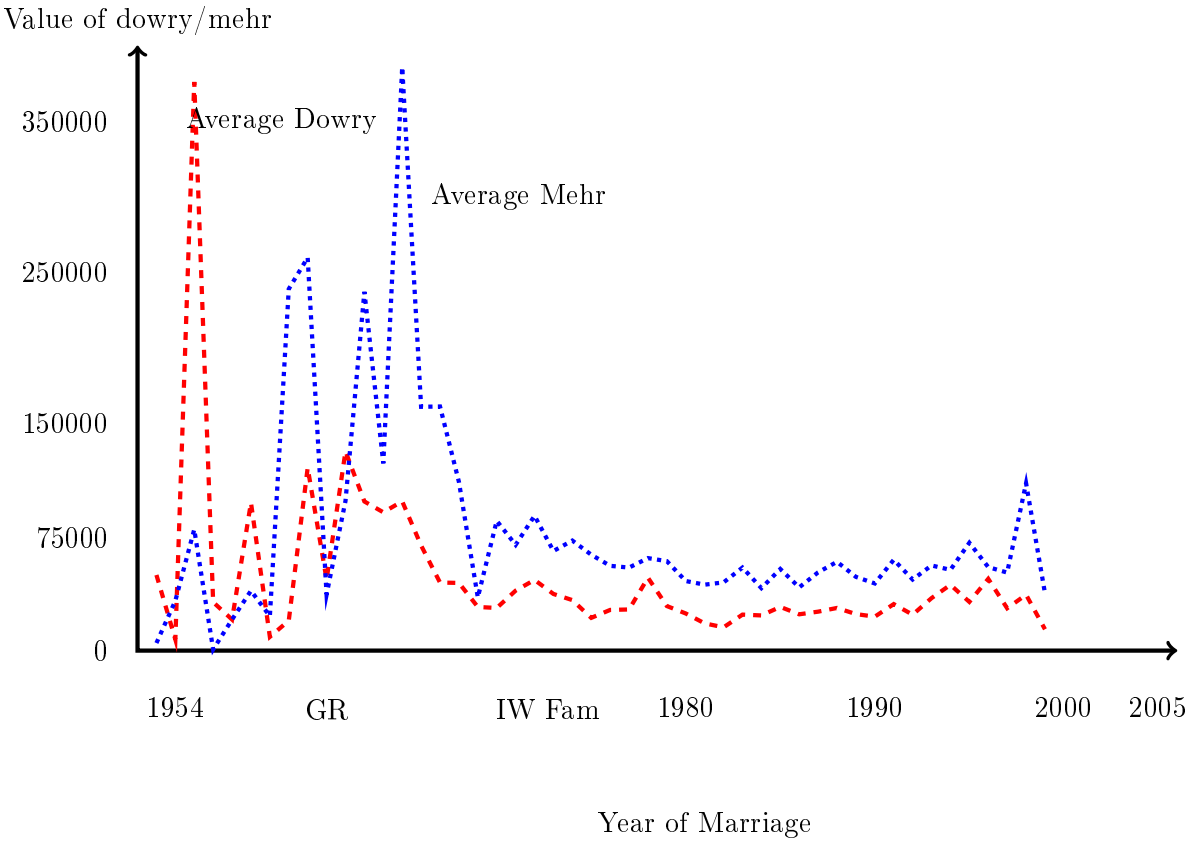

Figure A4: Mean Real Value of Mehr and Dowry by Year of Marriage (BRULS 2004 data)

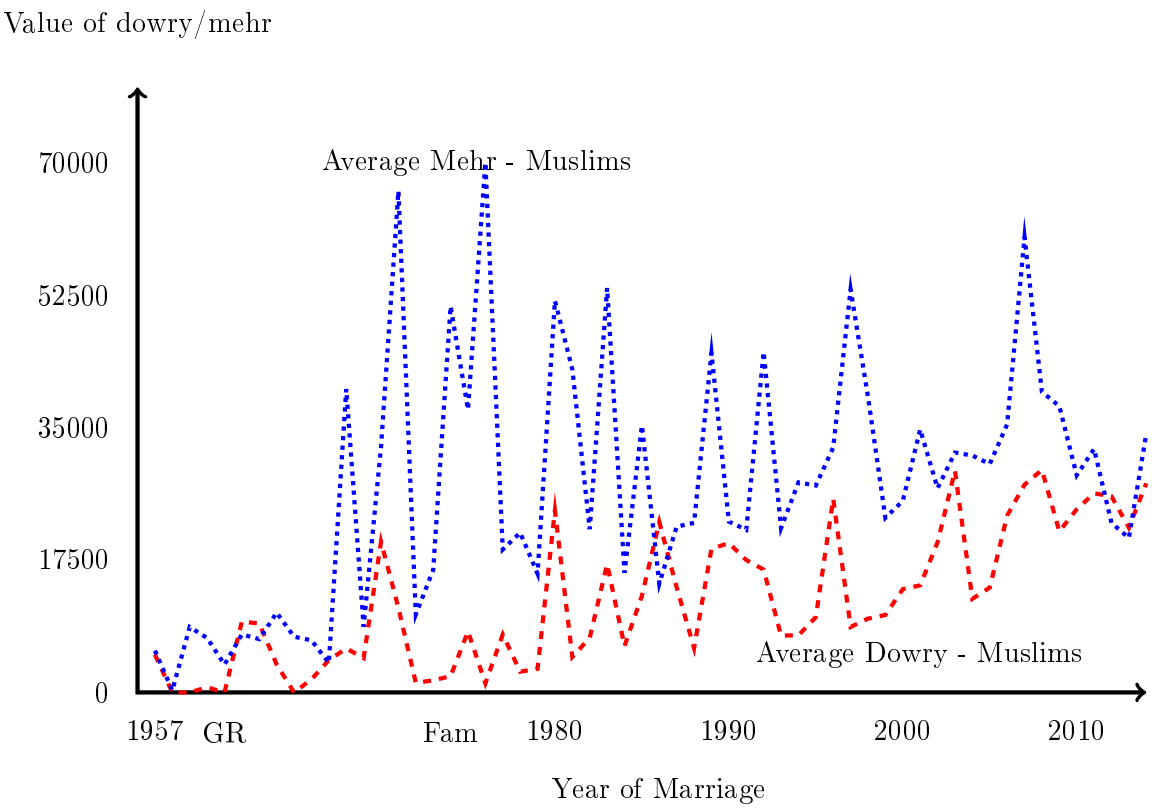

Figure A5: Mean Real Value of Mehr and Dowry by Year of Marriage (based on West Bengal data)

Table A1: Summary Statistics - BRULS (2004-05) data

	All Marriages over the period (1)	Regime I Marriages (before 1961) (2)	Regime II Marriages (1961-1970) (3)	Regime III Marriages (1971-1974) (4)	Regime IV Marriages (1975-2004) (5)
Value of mehr	61919	367000	198000	165000	52308
	(3886)	(342000)	(52750)	(34551)	(2773)
Value of dowry	34858	350000	144000	95996	27309
	(3168)	(214000)	(50939)	(41849)	(2114)
Education, bride	3.113	1.125	1.289	1.694	3.23
	(0.102)	(0.743)	(0.389)	(0.521)	(0.106)
Education, groom	3.754	3.429	2.733	2.889	3.817
	(0.107)	(1.478)	(0.522)	(0.65)	(0.111)
Age at marriage, bride	15.739	12.375	13.822	14.528	15.862
	(0.075)	(1.117)	(0.364)	(0.45)	(0.076)
Age at marriage, groom	22.636	21.75	22.622	22.306	22.652
	(0.108)	(0.861)	(0.564)	(0.701)	(0.112)
Bride's family richer	0.345	0.5	0.356	0.222	0.347
	(0.013)	(0.189)	(0.072)	(0.07)	(0.013)
Groom's family richer	0.296	0.5	0.356	0.333	0.292
	(0.012)	(0.189)	(0.072)	(0.08)	(0.013)
N (All female)	1367	8	45	36	1278

Figures in parentheses are standard errors.

Table A2: Summary Statistics - West Bengal (2014-15) data

	All Marriages over the period (1)	Regime I Marriages (before 1961) (2)	Regime II Marriages (1961-1974) (3)	Regime III Marriages (1974-2014) (4)
Value of mehr (in Ruppee)	31,101.72	3,802.83	22,633.80	31,817.04
	(2,018.03)	(1,952.55)	(6,787.37)	(2,114.24)
Value of dowry (in Ruppee)	31,101.72	1,973.87	6,675.55	15,991.39
	(803.92)	(1,318.95)	(1,834.84)	(853.66)
Education, bride (in years of schooling)	3.64	0.16	0.89	3.9
	(0.12)	(0.16)	(0.23)	(0.12)
Education, groom (in years of schooling)	3.68	0.32	2.11	3.85
	(0.12)	(0.23)	(0.35)	(0.13)
Age at marriage, bride (in years)	16.5	12.74	14.14	16.74
	(0.1)	(0.7)	(0.3)	(0.1)
Age at marriage, groom (in years)	23.18	23.42	21.65	23.29
	(0.14)	(1.28)	(0.4)	(0.15)
Bride's family richer (yes=1, 0 otherwise)	0.36	0.42	0.33	0.36
	(0.01)	(0.12)	(0.05)	(0.01)
Groom's family richer (yes =1, 0 otherwise)	0.37	0.26	0.34	0.37
	(0.01)	(0.1)	(0.05)	(0.01)
N (All female)	1242	19	83	1140

Numbers in parentheses are standard errors.

Table A3: Gender Ratio (male divided by female) by Age Group, 1951-2011

Age Group	1951	1961	1974	1981	1991	2011
0-4	99.1	98.3	99.3	101.4	102.1	102.91
5-9	101.8	104.5	101.2	103	106.3	103.08
10-14	126.3	128.2	118.9	114.8	114.8	107.12
15-19	126.3	97	114.1	102.8	103.6	108.1
20-29	97.6	96	95.2	96.6	89	82.58
30-39	115.6	116.3	106.9	106.6	111.7	91.72
40-49	130.7	118.5	119.6	114.9	116.1	108.36
50-59	124.1	126.1	122.5	118.9	116.9	113.07
60+	122.5	123	129.9	129.3	128.6	109.67

Appendix 4: Replication of Ambrus et al. (2010) using the BRLUS data

In the following, we discuss Ambrus et al. (2010) who also analyze a framework with deferred mehr, attributing the changes in dowry and mehr to the legal shocks discussed in Section 2.2, rather than to income shocks. We first compare our theoretical framework with theirs, before turning to some important differences in estimations and results.

We note that there are several important differences in the modelling assumptions between the two papers. First, in contrast to Ambrus et al. (2010), and similar to Anderson and Binder (2015), men have property rights over the contribution of women. Second, in our framework dowry is not a price paid for mehr. We focus on efficient equilibria where mehr ensures that inefficient divorces do not take place, while dowry essentially serves to clear the marriage market. Consequently, in our framework dowry and mehr need not necessarily move in the same direction following some exogenous shocks. Further, unlike Ambrus et al. (2010), we do not assume that mehr is non-negative, this is something that emerges naturally in our framework. Ambrus et al. (2010) provides an institutional justification for this assumption, pointing out that negative mehr is forbidden in Qur'an, so that religious courts do not enforce contracts with negative mehr. This justification is of course valid for the present framework as well. Finally, the comparative statics results developed in this paper suggests that the legal shock in the 1960s, i.e. the MFLO, would cause a decline in mehr, unlike in Ambrus et al. (2010). As far as the effect of the MMDA is concerned however, our theoretical predictions do coincide with that in Ambrus et al. (2010), in that both frameworks suggest that mehr and dowry would be adversely affected, at least in the short run.

Before replicating the estimation by Ambrus et al. (2010), it is imperative to note that Ambrus et al. (2000) used the BRULS dataset but employed a different data cleaning procedure from ours (in Section 4).[44]

Ambrus et al. (2010) estimated the same equations as (19) and (20) with the exceptions that the values of dowry and mehr were not expressed in logarithm and the attributes of the brides and grooms were excluded. Their identifying assumption is that the legal changes in 1961 and 1974 did not coincide with any other changes that may have influenced dowry and mehr. More importantly, they divided the entire period into seven equal (eight year) sub-periods, and included these sub-period dummies as additional controls in their regressions. We show below that their results crucially depend on inclusion of these ad hoc dummies. As stated in their paper, these

[44] Ambrus et al. (2010) has made available their cleaned data and STATA estimation codes in `http://sites.duke.edu/ericafield/data/` (accessed March 19, 2014). However, they employed an extensive cleaning procedure to construct their working data that involves changing the values of dowry and mehr recorded in the survey (their cleaning code in STATA has become available to us through the Quarterly Journal of Economics (QJE)). We also received an acknowledgment from these authors through the QJE that a small perturbation in the cleaning procedure leads to changes their main results. But, they only reported how their working sample is selected from the households included in the survey. Our (BRULS) data construction and working sample selection, discussed in Section 4, do not involve any cleaning, such as imputation of missing values or changing the recorded values.

dummies were included to account for non-linearity in the trends of dowry and mehr. However, the movements in the values of dowry and mehr displayed in Figure 2 do not suggest cyclical patterns repeating every eight years as in the business-cycle literature.[45] These dummies rather confound the interpretation of dummies of legal changes. The coefficients of these sub-period dummies provide estimates of the average value of dowry or mehr in each sub-period relative to the base category. Similarly, the dummies for the legal changes also provide estimates of the average value of dowry or mehr in the respective periods (relative to the base category). Given that these two sets of dummies substantially overlap with one another, it is not clear what the dummies for legal changes capture.

We first replicate the Ambrus et al. (2010) benchmark results (Ambrus et al. Table II, p.1384) using their cleaned data cleaned. Despite minor differences in magnitudes, we can replicate their benchmark results in Table A4 (columns 1 and 2). The two legal changes, MFLO and MMDA, are represented by post-1963 and post-1974, respectively. Post-1990 and post-1998 represent two other legal changes. As found in Ambrus et al. (2010), the first two legal changes had statistically significant impact on both mehr and dowry.

[45]The pattern of business-cycle fluctuations of GDP in Bangladesh (Appendix 3, Figures A1a-A1b) is different from that in developed countries, especially that in the USA (see Baxter and King, 1999 for the patterns of business-cycle in the USA), so inclusion of these dummies cannot also be justified on the ground of controlling for fluctuations in aggregate economic activity in Bangladesh.

Table A4: Impact of legal changes on the real values of mehr and dowry (BRULS data cleaned by Ambrus et al.)

	(1) Value of Mehr	(2) Value of Dowry	(3) Value of Mehr	(4) Value of Dowry	(5) Value of Mehr	(6) Value of Dowry
Married post-1963	114,849.754***	18,213.205**	34,515.82	18,732.050**	33,751.36	18,618.318**
	(3.824)	(2.037)	(1.051)	(2.421)	(1.037)	(2.39)
Married post-1974	-85,571.043***	-14,834.380*	-63,312.803***	-7,301.05	-61,322.529***	-6,977.55
	(-3.932)	(-1.853)	(-3.340)	(-1.301)	(-3.264)	(-1.239)
Married post-1990	12,418.632*	5,782.05	12,955.63	5,772.283*	13,626.43	5,885.806*
	(1.662)	(1.373)	(1.575)	(1.913)	(1.626)	(1.941)
Married post-1998	42,639.01	13,874.05	33,743.861*	17,998.046***	29,165.96	17,364.569***
	(1.218)	(1.46)	(1.665)	(3.117)	(1.53)	(3.068)
Year of marriage	-3,194.735**	453.963	-1,491.513*	-217.231	-1,932.312**	-283.507
	(-2.077)	(0.632)	(-1.961)	(-0.919)	(-2.361)	(-1.187)
How old was at the time of					3,966.032**	586.026
first marriage?					(2.525)	(1.53)
Age difference between spouses					-3.337	18.174
					(-0.005)	(0.061)
Bride's family wealthier than groom's					5,214.61	1,431.62
					(0.782)	(0.588)
7 Eight year dummies included?	Yes	Yes	No	No	No	No
Bride & groom'ĂŹs characteristics included?	No	No	No	No	Yes	Yes
Observations	1,367	1,367	1,367	1,367	1,367	1,367
R-squared	0.099	0.034	0.087	0.031	0.095	0.033

Figures in parentheses are robust t-values clustered at the household level. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Columns 1 & 2 use exact specification of Ambrus et al. and their data. In columns 3 to 6, the seven eight-year dummies have been dropped. In columns 5 & 6, three characteristics (how old was at the time of first marriage, age difference between spouses, bride family wealthier than groom's) found in Ambrus et al. data & used as dependent variables in their analysis (Ambrus et al. (2010) Table III, columns 4 to 6) are added.

Table A5: Impact of legal changes on the real values of mehr and dowry (PKSF + BRULS data) alternative specification)

	Value of Mehr (1)	Value of Dowry (2)	Value of Mehr (3)	Value of Dowry (4)
Post-1963	-11,834.07	-18,108.57	48,888.49	14,882.17
	(-0.251)	(-0.878)	(1.598)	(0.747)
Post-1974	-58,680.68	-30,113.34	8,404.67	-27,002.88)
	(-1.024)	(-1.310)	(0.253)	(-1.519)
Post-1990	-47,682.42	-25,948.56	9,473.20	-20,175.85
	(-0.835)	(-1.065)	(0.262)	(-1.081)
Post-1998	-29,380.52	-12,113.44	33,173.32	-1,931.23
	(-0.506)	(-0.479)	(0.837)	(-0.097)
Observations	2,996	2,996	2,996	2,996
R-squared	0.077	0.069	0.064	0.058

Robust t-statistics are in parentheses; *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. All regressions control for dummies for relationship with household head, marriage year, dummies for regions, seven 8-year period dummies, and a constant. Columns (3) and (4) do not include seven 8-year period dummies.

We now verify whether the above results are due to the inclusion of the ad hoc eight-year sub-period dummies. The results for mehr and dowry excluding these dummies are presented in columns (3) and (4), respectively. In the case of the value of mehr, the magnitude of the coefficient of the MFLO (the first legal change) is not statistically significant and much smaller. Similarly in the case of the value of dowry, the magnitude of the coefficient of the MMDA (the second legal change) is also not statistically significant and again much smaller. Thus, their main results do not hold. The results after controlling for the bride and groom characteristics, reported in columns 5 and 6, are very similar to those in columns 3 and 4.

We now estimate the benchmark specification of Ambrus et al. (2010) using our data, and we use the merged (BRULS and PKSF) datasets to take advantage of a larger and more representative sample. To be consistent with Ambrus et al. (2010), we retain marriages from the PKSF dataset only through 2004. The results are presented in Table A5. Columns 1 and 2 exactly replicate the specification in Table II in Ambrus et al. (2010) including the sub-period dummies. Columns 3 and 4 exclude the sub-period dummies, for reasons discussed earlier. In both cases, we find no impact of any legal changes on the values of mehr or dowry. To summarize, we find that the results in Ambrus et al. (2010) are not robust to alternative data cleaning, modest changes in specification, or using alternative data.

Difference in the data cleaning procedure is a non-trivial issue and requires further attention. We therefore investigate whether our explanation of the role of natural shocks holds in the BRULS data cleaned by Ambrus et al. (2010). The results are presented in Table A6. It is worth

Table A6: Impact of exogenous shocks on the real values of mehr and dowry (BRULS data cleaned by Ambrus et al. (2010)) base category: pre-GR (pre-1961)

	Log of Mehr	Log of Dowry
	(1)	(2)
GR (1961-1970)	-0.024	-0.038
	(-0.064)	(-0.066)
IW-famine (1971-1974)	-0.026	-0.719
	(-0.063)	(-1.217)
Post-famine (post-1974)	-0.6	-1.925***
	(-1.543)	(-3.326)
Observations	1,367	915
R-squared	0.097	0.091
IW-famine relative to GR	-0.002	-0.681**
	(-0.009)	(-2.340)
Post-famine relative to GR	-0.576***	-1.887***
	(-2.760)	(-7.427)
Post-famine relative to IW-famine	-0.573**	-1.206***
	(-2.393)	(-4.841)

Figures in parentheses are robust t-values clustered at the household level. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

mentioning that the sample size in the dowry equation decreases by about 30% after taking logarithm.[46] The results show that they are qualitatively very similar to the results reported in Tables 2-4. Although the value of mehr in the GR period relative to the pre-GR period is now negative, it remains statistically insignificant as in Table 3 based on BRULS data following our own cleaning procedure.

[46]One important assumption made in their data cleaning involves changing the values of dowry and mehr recorded in the survey. Since many recorded (and missing) values were replaced by 0s, logarithmic transformation reduces the effective sample size. On the other hand, our data cleaning does not involve any change in the recorded values of dowry and mehr.