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## Natural shocks and marriage markets: Fluctuations in mehr and dowry in Muslim marriages

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## ABSTRACT

We examine how mehr, a conditional payment from husbands to wives in the event of divorce, and dowry, a transfer from the bride's family to the groom at the time of marriage, have fluctuated in Bangladesh due to natural shocks. We develop a model of the marriage market in which dowry acts as a groom price, whereas mehr serves to deter inefficient divorces. Our comparative statics results show that mehr and dowry are both increasing (decreasing) in shocks that raise (lower) income. We then exploit several natural experiments in Bangladesh including the Green Revolution in the 1960s, war of independence in 1971, and famine of 1974 to explain fluctuations in the value of mehr and dowry observed in Muslim marriages. Using two household survey datasets, we find partial support for our theoretical predictions. To rule out alternative explanations, particularly the effect of legal changes, we use household survey data from the Indian state of West Bengal that experienced a similar increase in agricultural productivity but none of the legal changes affecting Bangladesh. These results demonstrate that natural shocks may affect social institutions.

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## 1. Introduction

In this study, we examine how mehr and dowry, two well-established social institutions in Bangladesh, have fluctuated through natural shocks. According to Islamic law, Muslim marriage contracts require specifying a mehr, a monetary payment from the husband to the wife (Bianquis et al. (1996); Carroll (1986a)). In Bangladesh as well as other countries in the Indian subcontinent, a mehr is a deferred payment paid only in the event of a divorce (Amin et al. (1997); Kamal (2001); Huda (2006); Ambrus et al. (2010)).<sup>1</sup> A dowry, on the contrary, is a payment from the wife to the husband during marriage, which is common among both Muslims and non-Muslims, not only in Bangladesh and the Indian subcontinent, but also in most South Asian countries.<sup>2</sup>

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E-mail address: [shyamal.chowdhury@sydney.edu.au](mailto:shyamal.chowdhury@sydney.edu.au) (S. Chowdhury).<sup>1</sup> While Islamic law prescribes that a mehr be paid on the consummation of marriage, the practice is different in Bangladesh and the Indian subcontinent.<sup>2</sup> The institution of the dowry goes back to the Greek city states (800 to 3000 BCE) and Romans (around 200 BCE). While the dowry was then eclipsed by the Germanic system of a bride price, it was reinstalled by the Middle Ages. Further, it continued to be widespread during the Renaissance and early modern Europe, and is still widespread in South Asia (Anderson and Bidner (2015); Anderson (2007) (Tables 2 and 4)).

Despite being forbidden by law in India since 1961, in Pakistan since 1976, and in Bangladesh since 1980, paying a dowry persists in all three settings (see Rao, 1993 for India, Anderson 2003 for Pakistan, and Esteve-Volart 2004 for Bangladesh). Further, over the past few decades, there has been an increase in the incidence of dowry payments as well as substantial dowry inflation in these countries (Rao (1993); Amin et al. (1997); Anderson (2003); Esteve-Volart (2004)).<sup>3</sup> Although no systematic data on dowry-related violence and death exist, it is estimated that more than 200 women are killed every year in Bangladesh due to dowry-related violence.<sup>4</sup> Sekhri and Storeygard (2014) report that in India, on average, 12 women die in every district each year due to dowry-related violence and the trend, if anything, is increasing over time (there were 640 districts in India in 2011). Similarly, mehr, which is enshrined in Islamic law, continues to flourish in Muslim societies (Amin et al. (1997)).

A stylized fact about mehr and dowry in Bangladesh is that both have experienced large fluctuations since the 1960s (see Section 5). Further, Bangladesh has experienced three major economic (and political) shocks since the 1960s (described in greater detail in Section 2): (i) the introduction of new agricultural technologies in the 1960s, popularly known as the Green Revolution (GR), (ii) war of independence of 1971 (IW), and (iii) famine of 1974. The adoption of new technology during 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. By contrast, the IW and famine both acted as negative income shocks.

Our central thesis is that there is a causal link between these income shocks and changes in dowry and mehr. In tracing a link between the economic aspects of marriages and marriage market institutions, we follow Becker (1973, 1981) and Cherchye et al. (2017), who argue that gains from marriages play a critical role in understanding marriage markets, with such gains depending on particular unions, as well as the marriage market as a whole. While Cherchye et al. (2017) demonstrate that outside options play a critical role in deciding the share of household resources obtained by a spouse, Cherchye et al. (2016) show their effect on divorce probabilities as well. Our study contributes to this literature by bringing both dowry and mehr, two important marriage market institutions, into the picture.

We first develop a model of marriage markets that respects institutional realities; in particular, we consider societies in which norms and institutions favor men. One aspect of this bias is that in the event a marriage is not successful (as formalized later), the decision to divorce, if any, is taken by men.<sup>5</sup> Consequently, men may opt to divorce their wives even though the aggregate surplus of the couple would be higher if they stayed married rather than obtained a divorce. This possibility of inefficient divorce creates a role for mehr, as it is a cost that men have to incur in the event of a divorce, thus discouraging such divorces. Given that the divorce decision is taken by men, the optimal mehr thus equals the utility of men from divorce net of their utility from continuing in a marriage that is “average” (i.e., neither a success nor a failure, as formalized later). Dowry plays the role of a groom price, ensuring that the marriage market clears. In the equilibrium, dowry therefore equals the utility of men from remaining unmarried net of their *ex ante* utility from marriage. Along the equilibrium path, divorce happens if and only if it is efficient; moreover, mehr payments are made when the marriage is a failure.

Turning to the effect of various income shocks, we demonstrate that a positive income shock (e.g., the GR) leads to an increase in mehr. With social norms being biased in favor of men, divorce imposes a low cost on them (as formalized later). Hence, an increase in the income of men increases their utility from divorce to a greater extent than that from an average marriage, making divorce relatively more attractive. Hence, the level of mehr must increase to prevent inefficient divorces in such marriages. Similarly, the famine and IW, both interpreted as negative income shocks, make divorce less attractive. Therefore, these lead to a decline in mehr.

The effect of an income shock on dowry is similar to that on mehr; although the former is of a smaller magnitude, the rate of change in both dowry and mehr is the same. The result is intuitive. Dowry equals the utility of men from remaining *unmarried* net of the opportunity cost of doing so, whereas mehr equals the utility from divorce in a *failed marriage* net of the corresponding opportunity cost. The opportunity cost of remaining single is the expected utility from entering into a marriage, which may or may not fail. By contrast, the opportunity cost of divorce in a failed marriage is the utility from such a marriage. The result now follows given that the utility from a failed marriage which is the opportunity cost of getting a divorce is low.

We next consider several extensions of the baseline framework as robustness checks. Allowing for the fact that in patriarchal societies men may have property rights over the income of their wives (see Anderson and Bidner (2015)), we show that income shocks are positively correlated with mehr as long as their effects on men and women are similar and cause the same rate of change in mehr and dowry. We also extend the analysis to allow for income heterogeneity among men and women. We show that an equilibrium with positive assortative matching exists in which all the comparative statics predictions go through. Among other extensions, we consider a setup in which dowry is set via bargaining between the families of the groom and bride. Under certain additional conditions, the comparative statics results also go through qualitatively.

<sup>3</sup> Anderson and Bidner (2015) state that in Bangladesh “the total cash and goods involved are often so large that the transfer can involve impoverishment of the bridal family.” Similar points were made by Rao (1993) and Huda (2006), among others.

<sup>4</sup> See [http://khabarsouthasia.com/en\\_GB/articles/apwi/articles/features/2012/02/15/feature-02](http://khabarsouthasia.com/en_GB/articles/apwi/articles/features/2012/02/15/feature-02).

<sup>5</sup> 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)).

To take the model predictions to the data, we exploit the natural experiments of the GR, IW, and famine. We use two distinct household datasets collected in 2004–2005 and 2010–2011 in Bangladesh. For identification purposes, we rely on pre-post comparisons to argue that income shocks have a causal effect on fluctuations in mehr and dowry. We find that the value of (log) mehr increased significantly during the GR period, whereas it decreased in the IW/famine period compared with the respective previous periods. However, the changes in the values of dowry are not significant, although they do follow a pattern similar to that of mehr.

To check the robustness of our results, we analyze a third dataset from the Indian state of West Bengal, which is similar to Bangladesh in many respects and experienced an increase in agricultural productivity (which we call the GR) at the same time. Bangladesh and West Bengal are contiguous, sharing a common cultural and linguistic history. In British India, (united) Bengal was partitioned into East Bengal (now Bangladesh) and West Bengal, with East Bengal becoming a part of Pakistan and West Bengal becoming a part of India when the British left in 1947. We find that patterns of fluctuations in the values of dowry and mehr in the GR period are similar in Bangladesh and West Bengal. Over 1960–2000, several legal changes in Bangladesh aimed to restrict polygamy and curb the practice of dowry. Two of these legal changes, namely the Muslim Family Law Ordinance of 1961 (MFLO) and Registration of Muslim Marriages and Divorces Act of 1974 (MMDA), coincided with the advent of the GR and the occurrence of the famine, respectively. By contrast, there were no such legal changes in West Bengal, which was then part of India. Therefore, the fact that mehr and dowry showed similar patterns in Bangladesh and West Bengal are attributed to economic shocks rather than legal changes. This conclusion finds further support from the existing literature.<sup>6</sup> Finally, we do not find any support of the possibility that the increased mehr in the 1960s was a result of “missing women” caused by female infanticide and neglect of female children (Sen (1990)).

Finally, we interpret dowry as essentially a groom price rather than a bequest. While there is some evidence to suggest that pre-mortem bequest to daughters (i.e., *joutuk*) was a component of dowry in Bangladesh until the early 1970s, Arunachalam and Logan (2006) argue that, relative to groom price dowries, bequest dowries have decreased in prevalence and amount over time.<sup>7</sup> This is the position taken, among others, by Anderson and Bidner (2015). Another important driver seems to be whether women have a right to property, with bequest being more prevalent in societies where they do. We briefly discuss the implications of modeling dowry as a bequest in a remark in Section 4.

To the best of our knowledge, this is the first study that shows the effects of natural shocks on levels of mehr and dowry. In addition, our study is distinctive in the marriage market literature in several respects. The extant literature on marriage market transactions has mostly focused on dowry in assuming a competitive marriage market in which the dowry acts as a market-clearing groom price (Cole et al. (2001); Peters and Siow (2002); Anderson and Bidner (2015)).<sup>8</sup> While we also assume a competitive marriage market, our study differs significantly from this strand of the literature by considering a framework with both dowry and mehr. We show that mehr can play an important role in ensuring the efficiency of the marriage market. It is somewhat surprising that despite its universal practice in Muslim marriages, the institution of mehr has not received adequate attention in the literature.

One study that analyzes a competitive marriage market framework with both dowry and mehr is Ambrus et al. (2010). The authors argue that while the increase in both mehr and dowry in the 1960s can be traced to the MFLO, their declines in the 1970s can be traced to the MMDA. There are important differences between the two studies, however. First, while Ambrus et al. (2010) examine legal changes, they abstract from economic and political ones. By contrast, we consider both aspects and find support for the economic and political channels, using the events in West Bengal as a counterfactual to rule out the effect of legal shocks. Second, while Ambrus et al. (2000) argue that the MFLO increased mehr and dowry, our model predicts a decline in both mehr and dowry. Finally, we demonstrate that the empirical results reported in Ambrus et al. (2010) are sensitive to their empirical methodology.<sup>9</sup>

Another related study is Anderson and Bidner (2015), who model two marriage market institutions, namely dowry and parental investment in children (i.e. bequests). Among other interesting results, they demonstrate that women's rights over dowry tend to deteriorate with development. They also generate predictions for when marital transfers will disappear. Their formulation, however, does not allow for divorce. Moreover, while our extended model incorporates some elements of Anderson and Bidner (2015), namely men's property rights over spousal income, our results are not driven by these.

The rest of the paper proceeds as follows. In Section 2, we describe the economic and political shocks that Bangladesh has experienced since the 1960s. In Section 3, we present our theoretical framework, deriving some testable hypotheses. In Section 4, we extend the model in several dimensions. Next, in Section 5, we discuss the datasets and some of the key descriptive statistics. The identification and estimation strategies are explained in Section 6. In Section 7, we present our main empirical findings, and in Section 8, we rule out alternative explanations such as legal changes. Finally, we conclude in Section 9.

<sup>6</sup> Esteve-Volart (2004) uses a rural household survey conducted in a sub-district of Bangladesh (Matlab Health and Socio-Economic Survey) and finds no effect of the MMDA on the amount of dowry in Muslim marriages in the post-1974 period (Table 5).

<sup>7</sup> The datasets used for the empirical analysis prevent us from separating bequest dowry from total dowry. Although information about three types of dowry (cash and kind such as jewelry, land and animals, and their ownership) was collected, only the monetary value of total dowry was ascertained. Since marriages involve multiple types of dowries and their complex ownerships, the value of bequest dowry cannot be separated.

<sup>8</sup> Some earlier studies including Becker (1981); Rao (1993) also assume that the dowry is the groom price.

<sup>9</sup> See Section 8.1 and Appendix B for a more detailed discussion of the results in Ambrus et al. (2010)

## 2. Natural shocks during the 1960s and 1970s

### 2.1. Income shocks

Since the 1960s, Bangladesh has experienced several exogenous economic (and political) shocks, with the GR being one of the most significant. 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 in 1959, the government introduced chemical fertilizers (Hossain et al. (1994)) and mechanized irrigation at heavily subsidized rates (Falcon et al. (1970)). These inputs became readily and widely available in the early 1960s; over 1961–1970, the disbursement of chemical fertilizers increased by 35.5% per annum (Khan (1972), Table 5.8, p. 50). Other technological innovations included 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 et al. (1970), pp. 270, 288–298).

The adoption of these new technologies led to a substantial increase in agricultural productivity. During 1961–1970, 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% to 3.2%. In Bangladesh (then East Pakistan), the agricultural sector grew at 3% per annum on average over this period. Rice, which contributed 70% of the value added of all crops, grew at 3.4% per annum and Boro rice, which was a prime consumer of modern inputs, grew at 6.2% per annum (Falcon et al. (1970), Table 9.12, p. 293, Table 9.13, p. 295). These technologies increased demand for labor and consequently wages.<sup>10</sup>

We consider 1961 to be the commencement of the GR, as this is the earliest documented increase in agricultural income, although our results, presented in Section 7, are robust to the choice of an alternative commencement date. In particular, the analysis goes through qualitatively if we take the starting point to be 1967,<sup>11</sup> the year in which high-yielding variety seeds were introduced (David and Otsuka (1994)).

A second major event was the IW, which broke out abruptly in March 1971 and ended in December 1971 with the former East Pakistan separating from Pakistan and emerging as a new nation, Bangladesh. The war was extremely costly on several dimensions, most importantly in terms of the two to three million civilian lives lost (Riedel (2011)). Further, approximately 10 million people were forced to take refuge in neighboring India, with most 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. The IW 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 4% in 1975 (per capita GDP declined by about 6%). Taken together, the IW and famine were not only major negative income shocks, the effects persisted for some time, with GDP only returning to its pre-war level in 1977 (per capita GDP returned to pre-war levels only in 1989 because of the higher population growth rate. Fig. A.1 in Appendix A shows GDP, per capita GDP, and their growth).

Based on the income shocks discussed above, we define four distinct periods over which fluctuations in dowry and mehr follow different patterns: i) the pre-GR period (pre-1961), ii) the GR (1961–1970), iii) the IW/famine, and iv) the post-famine period. However, the duration of the impact of the IW/famine is difficult to ascertain in the absence of further shocks. Although the famine occurred in 1974, its negative effects were likely to have persisted in subsequent years. We thus choose the 1975 cut-off (i.e., the 1971–1975 interval) as the end of the IW/famine period since the last large GDP decline occurred in 1975.<sup>12</sup>

### 2.2. Legal shocks

Between 1961 and 2004, Bangladesh made the following five amendments to Muslim family laws governing marriage, dowry, and divorce as well as case law developments pertaining to these: (i) the MFLO, (ii) the MMDA, (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. The first legal change (i.e., the MFLO in 1961) coincided with the GR and the second legal change (i.e., the MMDA in 1974) coincided with the famine.

The main objective of the MFLO, which became effective in Bangladesh (then East Pakistan) in 1963,<sup>13</sup> was to restrict polygamy and arbitrary divorces. In a bid to reduce polygamy, it imposed the requirement that to allow a second marriage, the husband has to obtain the consent of his first wife as well as the written permission of the local government authorities at the residence of his second wife. In addition, the new marriage had to be “just and necessary” given the current wife’s condition and financial status of the husband. The MFLO empowered Union Councils to not only arbitrate on these matters,

<sup>10</sup> The GR had a large positive effect on wages, especially for men. Using village-level daily wage data from India, D’Agostino (2017) finds that the GR generated a 7% wage increase for male laborers in the 1960s and 1970s. Women substituted away from wage work and increased their unpaid own-farm work and home production.

<sup>11</sup> The results are available upon request.

<sup>12</sup> We thank an anonymous referee for suggesting this point.

<sup>13</sup> See [http://bdlaws.minlaw.gov.bd/print\\_fections\\_all.php?id=305](http://bdlaws.minlaw.gov.bd/print_fections_all.php?id=305), accessed February 29, 2012.

but also impose jail sentences on men violating these conditions. As to the second objective (i.e., discouraging arbitrary divorces), while the MFLO mandated that the husband inform local council officials of any *talaq*<sup>14</sup> pronouncements, this was never formally implemented in that there were no penalties for failure to comply or any explicit specification of maintenance payments. Thus, as far as implementation was concerned, the MFLO essentially acted to discourage polygamy, with little effect on divorce.

The main objective of the MMDA was to further restrict polygamy and arbitrary divorces by making marriage registrars widely available.<sup>15</sup> It established a system of physical registries for divorce registration and mandated that divorce can only be granted in courts. Taken together, these restrictions increased expected divorce costs for men since they raised the chances that men would have to pay maintenance and possibly mehr in the event of a divorce. Further, men who gave a verbal *talaq* without going before the courts could be penalized.

The main objective of the Dowry Prohibition Act and subsequent amendments in the 1980s was to reduce dowry by making both the giving and the receiving of dowry illegal.<sup>16</sup> Anti-dowry provisions were further strengthened by the Women and Children Repression Prevention Act of 2000, which, among other things, specified the penalties to be meted out in case of dowry-related violence and death. The two case law developments of 1990 and 1998 went against the *Maliki*<sup>17</sup> 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, thereby strengthening the importance of mehr.

### 3. The framework

We consider an economy that comprises two types of families, one 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  $N \leq 1$ .<sup>18</sup> For simplicity we assume that all agents are risk neutral.<sup>19</sup> Moreover, all men are identical, as are all women, with all men having the same income  $m$  and all women having the same income  $w$ .<sup>20</sup> We assume, as is realistic, that  $w < m$ , although the analysis does not depend on this assumption in any way. The two income measures  $m$  and  $w$  encapsulate several important elements in the context of marriages, including not only the economic potential of men and women, but also their personal characteristics such as age, beauty, and educational qualifications. In the event of a marriage, a woman (man) brings her income  $w$  (his income  $m$ ) to the marriage.

We assume marriages are monogamous.<sup>21</sup> Once a marriage takes place, it turns out to be one of three kinds, *successful*, *failed*, and *average*, with the probabilities  $\gamma_s$ ,  $\gamma_f$ , and  $\gamma_a$  respectively, where  $0 < \gamma_s, \gamma_f, \gamma_a < 1$  and  $\gamma_s + \gamma_f + \gamma_a = 1$ . A successful marriage has a positive effect on the aggregate surplus of the couple, denoted  $S[w + m]$ , in that  $S > 1$ .<sup>22</sup> On the contrary, the surplus is  $t_f[w + m]$  if the marriage fails and  $t_a[w + m]$  if the marriage is average, where  $t_f < t_a \leq 1$ .<sup>23</sup> In these societies, marriage is the social norm, and thus men and women who either get divorced or decide not to participate in the marriage market at all do worse than those in a successful marriage.<sup>24</sup> Under either eventuality, a man has a utility of  $\mu_m m$  and a woman has a utility of  $\mu_w w$ , where  $S > \mu_m, \mu_w$ .

We assume that social norms are biased in favor of men; hence, men take the divorce decision.<sup>25</sup> Moreover, either being divorced or remaining single is costlier for women (i.e.,  $\mu_m > \mu_w$ ).<sup>26</sup> In what follows, we maintain the following parametric

<sup>14</sup> *Talaq* is an Arabic/Islamic word for divorce. In the classical Islamic law, which is often followed in the Indian sub-continent, a Muslim man has the unilateral right to dissolve the marriage by simply pronouncing it (Awad and Mawla (2013)).

<sup>15</sup> See [http://bdlaws.minlaw.gov.bd/print\\_fctions\\_all.php?id=476](http://bdlaws.minlaw.gov.bd/print_fctions_all.php?id=476), accessed on February 29, 2012.

<sup>16</sup> [http://bdlaws.minlaw.gov.bd/sections\\_detail.php?id=607&sections\\_id=10780&vol=22](http://bdlaws.minlaw.gov.bd/sections_detail.php?id=607&sections_id=10780&vol=22), accessed on February 29, 2012.

<sup>17</sup> *Maliki* is one of four prominent schools of religious law within Sunni Islam, the dominant interpretation among Muslims in Bangladesh.

<sup>18</sup> The assumption that there are more men than women is realistic for many developing countries, including those countries that we study. In our data for Bangladesh, 99% of women get married between 10 and 25 years and 95% of men get married between 15 and 35 years. The total number of men (in the age bracket of 15 and 35) divided by the total number of women (in the age bracket of 10 and 25) has remained higher than 1 since 1951 (varying between 1.08 and 1.24).

<sup>19</sup> Assuming risk neutrality simplifies the exposition by abstracting from issues of insurance. It is straightforward to argue that the analysis goes through as long as agents are not too risk averse. The details are available upon request.

<sup>20</sup> In reality, there is heterogeneity among men and women, given that  $m$  and  $w$  capture not only income, but also age, education, and so on. In Remark 7, we allow for income heterogeneity among men and women, arguing that this would lead to positive assortative matching. We are indebted to an anonymous reviewer for this point.

<sup>21</sup> According to the 2011 Long Census data, the prevalence of polygamy among Muslims, Hindus, Buddhists, and Christians in Bangladesh is 5.85%, 2.39%, 1.25%, and 1.02%, respectively.

<sup>22</sup> Browning et al. (2014) argue that such gains can be traced to sharing public goods, or the division of labor within a marriage, among other things.

<sup>23</sup> We later extend the framework in various directions, finding that this does not affect the results qualitatively. Further, in Section 4, we allow for a scenario in which men have property rights over their spouse's income.

<sup>24</sup> Borker et al., 2017 assume that the social norm in India is that all women must marry.

<sup>25</sup> For example, see Brandt and Kaplan (1995–1996), who discuss husbands' rights to divorce their wives among Muslims in Bangladesh, Egypt, and Tunisia.

<sup>26</sup> Divorced women in Bangladesh and other South Asian countries are socially stigmatized and not accorded a status equal to that of married women (Dreze and Sen (1995); Esteve-Volart (2004)).



condition (that also incorporates some of the preceding considerations):

$$S > \mu_m > t_a > \max\{t_f, \mu_w\}, \quad (1)$$

which is a necessary condition for both mehr and dowry to be positive in the equilibrium, as we later argue.<sup>27</sup>

We next turn to the efficiency implications of divorce, namely how it affects the sum of the husband and wife's utility. Getting divorced is inefficient if a marriage is average, whereas it is efficient if it is a failure; formally,

$$t_f[w + m] < w\mu_w + m\mu_m < t_a[w + m]. \quad (2)$$

Given that men take the divorce decision, however, in certain situations men may, in their own interest, decide to divorce their spouses even though doing so is inefficient. We argue that this possibility of inefficient divorces creates a role for mehr.

Marriage contracts can involve two types of transfers, dowry (denoted by  $D$ ), which is an upfront payment from a woman's family to the groom, and mehr (denoted by  $M$ ), which is a conditional payment made by a man's family to the bride in the event of a divorce.<sup>28,29</sup> Given a marriage contract  $(D, M)$ , we can now specify the utility functions of men and women. The utility of a man equals

$$u^M = \begin{cases} Sm + D, & \text{if the marriage is successful and there is no divorce,} \\ t_fm + D, & \text{if the marriage has failed but there is no divorce,} \\ t_am + D, & \text{if the marriage is average but there is no divorce,} \\ \mu_m m + D - M, & \text{if there is divorce,} \\ \mu_m m, & \text{if the man remains single.} \end{cases} \quad (3)$$

Similarly, the utility of a woman is given by

$$u^W = \begin{cases} Sw - D, & \text{if the marriage is successful and there is no divorce,} \\ t_fw - D, & \text{if the marriage has failed and there is no divorce,} \\ t_aw - D, & \text{if the marriage is average but there is no divorce,} \\ \mu_w w - D + M, & \text{if there is divorce,} \\ \mu_w w, & \text{if the woman remains single.} \end{cases} \quad (4)$$

We next define the notion of the equilibrium for this society; we are only concerned with the utilities of the brides and grooms themselves. In reality, other considerations (e.g., the potential gain in status for the concerned families), can be expected to enter these negotiations. [Anderson and Bidner \(2015\)](#), for example, consider the utility of the parents as well. [Borker et al. \(2017\)](#), on the contrary, assume that the wealth of families is an important consideration. We, however, abstract from such considerations.

We follow [Rosen \(1974\)](#), [Peters and Siow \(2002\)](#), and [Anderson and Bidner \(2015\)](#), among others, by modeling the marriage market equilibrium competitively.<sup>30</sup> The equilibrium "price," denoted by  $(D^*, M^*)$ , comprises both dowry and mehr. A woman's strategy is optimal with respect to  $(D^*, M^*)$  if she participates in the marriage market if and only if doing so yields higher utility than not participating. Similarly, a man's strategy is optimal with respect to  $(D^*, M^*)$  if (i) he participates in the marriage market if and only if doing so yields higher utility than not participating and (ii) he opts to divorce his wife if and only if doing so yields him higher utility.

Let  $P_M(D^*, M^*)$  denote the number of men participating in the marriage market and  $P_W(D^*, M^*)$  denote the number of women, with the strategies of all agents being optimal given  $(D^*, M^*)$ .

We can now formally define the notion of an equilibrium.

**Definition 1.** A marriage market pricing rule  $(D^*, M^*)$  is an equilibrium if and only if the numbers of participating men and women are equal, namely  $P_M(D^*, M^*) = P_W(D^*, M^*)$ .

We are interested in equilibria that satisfy some additional properties, particularly that of efficiency.

<sup>27</sup> The new element in (1) is that  $\mu_m > t_a > \mu_w$ . It is straightforward to see that if, instead  $\mu_m, \mu_w > t_a$ , then the second inequality in (2) does not hold. Hence, even in the case of an average marriage, divorce is efficient and there is no scope for mehr in our framework. By contrast, if, instead,  $t_a > \mu_w, \mu_m$ , then given that  $S > \mu_m$ , (10) does not hold and dowry cannot be positive.

<sup>28</sup> The theoretical framework is consistent with the institutional realities in both Bangladesh and West Bengal (India). In our data, most women get married. Moreover, most marriages involve both mehr and dowry. According to all three datasets, both in Bangladesh and in West Bengal, all Muslim marriages involved mehr and all marriages in Bangladesh and most marriages in West Bengal involved dowry. The numbers are available from the authors upon request.

<sup>29</sup> [Brown \(2009\)](#) demonstrates that dowry plays a role in ensuring the upkeep of brides, essentially by increasing their bargaining power. This is an aspect from which we abstract.

<sup>30</sup> In [Section 4](#), we briefly consider a framework in which dowry is determined by bargaining between the bride's and groom's families, arguing that, subject to some additional parametric restrictions, the results are qualitatively similar.

**Definition 2.** An equilibrium  $(D^*, M^*)$  is efficient if and only if (a) the outcome involves no inefficient divorce and (b) for any man and woman, the aggregate ex ante surplus from marriage (followed by divorce if that is efficient) exceeds that from remaining single.

Turning to condition (a), it is straightforward to check that while divorce is inefficient in successful and average marriages, it is efficient in a failed marriage.<sup>31</sup> Turning to condition (b), the aggregate *ex ante* surplus from marriage (followed by divorce if the marriage fails), namely  $\gamma_s S[m + w] + \gamma_f [m\mu_m + w\mu_w] + \gamma_a t_a[m + w]$ , exceeds that from remaining single, namely  $\mu_m m + \mu_w w$ .<sup>32</sup> Thus, efficiency demands that all women get married.

We focus on equilibria that are not only efficient, but also under which the mehr  $M^*$  is at the minimum possible level consistent with efficiency. As we later show, doing so ensures partial consumption smoothing for men in that their utility from average and failed marriages is the same. Given the reality that social norms favor men, it is therefore natural to focus on this level of mehr.<sup>33</sup> For ease of exposition, we henceforth refer to efficient equilibria satisfying this minimum condition for mehr simply as equilibria.

Turning to the analysis of the equilibrium, in a successful marriage, the man's payoff from a stable marriage exceeds that in the case of a divorce:

$$Sm + D > \mu_m m + D - M. \quad (5)$$

Hence, divorce never takes place. However, depending on  $(D, M)$ , divorce may happen if the marriage is average or it fails. In particular, divorce happens if and only if  $t_i m + D < \mu_m m - M + D$ ,  $t_i \in \{t_f, t_a\}$  (i.e., if the mehr is small):

$$M < m[\mu_m - t_i]. \quad (6)$$

Eq. (6) shows that divorce decisions are not affected by the level of dowry. Thus, it must be mehr which ensures that no inefficient divorce can arise.<sup>34</sup>

We next solve for the equilibrium level of mehr, setting it so as to ensure that divorce is efficient. Recall that in the absence of mehr, divorce happens both when the marriage is average and when it is a failure, whereas divorce is efficient if and only if the marriage fails. From (6), the minimum level of mehr that prevents divorce in an average marriage is

$$M^* = m[\mu_m - t_a]. \quad (7)$$

Observe that for a mehr of  $M^*$ , divorce happens if the marriage fails (since  $t_f m + D < \mu_m m - M^* + D$ , given that  $t_a > t_f$ ), whereas divorce never happens in a successful marriage. Thus a mehr of  $M^*$  is the minimum mehr that ensures that divorce happens if it is efficient, i.e. if the marriage is a failure. Further, note that a man's utility in case of a failed marriage is  $m\mu_m - M^* + D^*$ , which, from (7), equals his utility in case of an average marriage, i.e.  $t_a m + D^*$ . Thus the equilibrium mehr  $M^*$  ensures that the utility of a man is the same irrespective of whether the marriage is average or a failure, so that there is partial consumption smoothing for men.

Proposition 1 summarizes the preceding discussion.

**Proposition 1.** The equilibrium mehr  $M^*$  ensures that divorce happens if and only if doing so is efficient (i.e., the marriage is a failure). There is no divorce otherwise. Moreover, mehr payments happen in the equilibrium, particularly in the case of a failed marriage.

We next turn to solving for the equilibrium dowry, finding that it is determined by the willingness of men to get married (among other things). To be precise we define  $D^*$  as the level of dowry such that men are indifferent between remaining single and getting married, and then argue that this  $D^*$  is indeed the equilibrium dowry. The utility of a man from remaining single is  $\mu_m m$ . Next consider a man's utility from getting married (allowing for the fact that there would be divorce in case of a failed marriage). Using the fact that a man obtains  $Sm + D^*$  in case the marriage is successful,  $t_a m + D^*$  if it is average, and  $\mu_m m - M^* + D^* = t_a m + D^*$  in case it fails, a man's utility from getting married is

$$\gamma_s Sm + \gamma_f (\mu_m m - M^*) + \gamma_a t_a m + D^* = \gamma_s Sm + \gamma_f t_a m + \gamma_a t_a m + D^*. \quad (8)$$

Consequently,  $D^*$  must satisfy  $\mu_m m = \gamma_s Sm + \gamma_f t_a m + \gamma_a t_a m + D^*$ , so that

$$D^* = m[\mu_m - \gamma_s S - (1 - \gamma_s)t_a]. \quad (9)$$

$D^*$  is positive whenever men are not too badly off in the event of remaining single; formally,

$$\mu_m > \gamma_s S + (1 - \gamma_s)t_a. \quad (10)$$

<sup>31</sup> Divorce is inefficient in successful and average marriages since the surplus from marriage exceeds the surplus from divorce, namely  $S[m + w] > t_a[m + w] > \mu_m m + \mu_w w$  (see (2)). On the contrary, it is efficient in a failed marriage since  $t_f[m + w] < \mu_m m + \mu_w w$  (see (2)).

<sup>32</sup> The result follows since  $S[m + w] > t_a[m + w] > \mu_m m + \mu_w w$ , where the second inequality follows from (2).

<sup>33</sup> For the consumption smoothing argument to bite, one has to allow for risk aversion. In Remark 8 later we examine risk averse agents, finding that mehr ensures partial consumption smoothing for men.

<sup>34</sup> Consider a marriage that has either failed or is average. Given the preceding discussion (see (6)), it is clear that in the absence of mehr, the outcome will involve divorce (since  $\mu_m > t_i$ ,  $i = a, f$ ). Moreover, given (2), a divorce in case of a failed marriage will be efficient.

Since the dowry is positive and increasing for these societies over the relevant period (as discussed in the Introduction), we assume that (10) holds in what follows.

It is straightforward to see that  $(D^*, M^*)$  constitutes an equilibrium. In Proposition 2, we argue that all women participate in the marriage market. Thus, all women enter and  $P_W(D^*, M^*) = N$ . By contrast, given  $(D^*, M^*)$ , men are indifferent between staying single and entering the marriage market. Therefore,  $(D^*, M^*)$ , where (i)  $M^*$  is set to satisfy Proposition 1, (ii)  $D^*$  satisfies (9), (iii) all women and  $N$  of the men participate in the market, and (iv) men take the divorce decision optimally, constitutes an equilibrium.

**Proposition 2.** *There exists an equilibrium  $(D^*, M^*)$ , where all women participate,  $M^*$  is set at the minimum level that prevents inefficient divorce and the dowry  $D^*$  ensures that men are indifferent between entering the marriage market and remaining single. For  $N < 1$ ,  $(D^*, M^*)$  is the unique equilibrium.*

**Proof.** We prove this result in two steps.

*Step 1. All women participate:* It is sufficient to argue that all women prefer to get married rather than remain single. From Proposition 1, the equilibrium level of mehr ensures that divorce happens if and only if the marriage fails. Consequently, women's utility from participation equals  $\gamma_s Sw + \gamma_f[w\mu_w + M^*] + \gamma_a t_a w - D^* = \gamma_s Sw + \gamma_f[w\mu_w + m(\mu_m - t_a)] + \gamma_a t_a w - m[\mu_m - \gamma_s S - (1 - \gamma_s)t_a]$ . This exceeds women's utility from remaining single, namely  $w\mu_w$ , if and only if  $\gamma_s S(w + m) + \gamma_f(w\mu_w + m\mu_m) + \gamma_a t_a(w + m) > m\mu_m + w\mu_w$ ; that is, if and only if the *ex ante* surplus from marriage (allowing for efficient divorce if the marriage is a failure) exceeds the surplus from remaining single. This is true given (1) and (2).

*Step 2. Unique equilibrium:* Let  $N < 1$ . Clearly, in any (efficient) equilibrium, the amount of mehr must equal  $M^*$ . If the dowry exceeds  $D^*$ , then all men participate, while at most  $N$  women do, so that the marriage market cannot clear given that  $N < 1$ . Whereas if the dowry is less than  $D^*$ , then no man participates, while all women do.  $\square$

**Example.** To establish that the various assumptions are mutually consistent, consider the example in which  $S = 2$ ,  $t_a = 0.6$ ,  $t_f = 0.4$ ,  $\mu_m = 1$ ,  $\mu_w = 0$ ,  $\gamma_s = 0.25$  and  $w = m > 0$ . These parameter values satisfy the constraints (1), (2), and (10). Moreover, mehr and dowry are positive, and women prefer to participate in the marriage market rather than remain single.

### 3.1. Exogenous shocks: Income and legal

We next develop some testable hypotheses that we can take to the data. To this end, we examine the impact of income shocks on the equilibrium values of both mehr and dowry. We also examine the impact of legal changes, as some of these coincided with the income shocks.

#### 3.1.1. Income shocks

As discussed in Section 2, the GR in Bangladesh in the 1960s can be interpreted as a positive income shock, whereas the IW of 1971 and 1974 famine can be interpreted as negative income shocks. From (7), it is straightforward to show that the level of mehr is increasing in  $m$ .

**Proposition 3.** *Consider the effect of income shocks. The equilibrium mehr  $M^*$  increases if the shock is a positive one and decreases otherwise.*

Proposition 3 is intuitive. Recall that the role of mehr is to prevent inefficient divorces in the case of an average marriage. Given that the divorce decision is taken by men, mehr equals the utility of men from getting a divorce net of their utility from continuing in an average marriage. While a positive income shock, particularly an increase in  $m$ , raises the utility of a man both in the event of his getting a divorce as well as continuing in an average marriage, there is a greater increase in utility in the former than in the latter event. Thus, under a positive income shock, the incentive to divorce increases, necessitating an increase in mehr as well.

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

$$\frac{dD^*}{dm} = \mu_m - \gamma_s S - (1 - \gamma_s)t_a < \mu_m - t_a = \frac{dM^*}{dm}. \quad (11)$$

Since the opportunity cost of remaining single (i.e., a man's *ex ante* utility from getting married) exceeds the opportunity cost of a divorce in an average marriage (i.e., a man's utility from continuing in such a marriage), the result follows intuitively.

Finally, income shocks generate the same rate of change in mehr and dowry as shown by

$$\frac{d \log D^*}{dm} = \frac{1}{m} = \frac{d \log M^*}{dm}. \quad (12)$$

**Proposition 4.** *Both the level of dowry and the level of mehr increase at the same rate under a positive income shock.*

Propositions 3 and 4 together suggest the following testable hypotheses: both dowry and mehr increase during the GR in Bangladesh and India, whereas they decrease during the IW and famine in Bangladesh.



### 3.1.2. Legal shocks

During the study period, there were several changes in Muslim law, particularly the MFLO and MMDA. Importantly, the MFLO occurred around the same period as the GR and the MMDA occurred around the same time as the famine. Given these legal changes, we then examine whether the observed changes in mehr and dowry during this period could be attributed to these legal changes instead.

As discussed in Section 2.2, the MFLO aimed to restrict polygamy (while restrictions were imposed on arbitrary divorces as well, these were ineffective). In our framework, this can be expected to increase the utility from the first marriage, so that  $S$ ,  $t_f$ , and  $t_a$  should all increase. Thus, from (7) and (9), both mehr and dowry decrease.

The MMDA, on the contrary, aimed to reduce arbitrary divorces (as discussed in Section 2.2), which can be formalized as a reduction in  $\mu_m$ , since a decline in  $\mu_m$  makes divorce less attractive. Another objective was to reduce polygamy, which can be expected to increase  $S$ ,  $t_f$ , and  $t_a$ . From (7) and (9), it is straightforward that both mehr and dowry decrease.

Further, similar to the case of income shocks (Proposition 4), we examine whether legal shocks have a smaller absolute effect on dowry than on mehr. We consider a benchmark case in which both the MMDA and the MFLO affect  $S$ ,  $t_a$ , and  $t_f$  to the same extent, so that  $dS = dt_a = dt_f$ . It is then straightforward to see that

$$\frac{dD^*}{dt_a} = -m = \frac{dM^*}{dt_a}, \quad (13)$$

$$\text{and, } \frac{dD^*}{d\mu_m} = m = \frac{dM^*}{d\mu_m}, \quad (14)$$

so that the MFLO and MMDA have the same effect on both dowry and mehr.

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

- (i) Following the implementation of the MFLO, formalized as an increase in  $S$ ,  $t_a$ , and  $t_f$ , both mehr and dowry decrease.
- (ii) Following the implementation of the MMDA, formalized as a decrease in  $\mu_m$  as well as an increase in  $S$ ,  $t_a$ , and  $t_f$ , both mehr and dowry decrease.
- (iii) Following either the MFLO or the MMDA, dowry and mehr change by the same magnitude.

Thus, our framework predicts that, *ceteris paribus*, both the MFLO and the MMDA affect dowry and mehr in a similar fashion. In particular, the immediate effect of the MFLO would be to reduce the level of mehr and dowry, which is contrary to the empirical reality in Bangladesh. The predictions from the MMDA are, however, consistent with the changes in mehr and dowry during this period. Consequently, we argue that changes in mehr and dowry cannot be attributed to legal changes.

To check the robustness of our results, we examine several extensions. In Remark 6, we examine the situation in which women are refunded a part of their dowry in the case of divorce. In Remark 7, we allow for income heterogeneity among men and women.<sup>35</sup> While in Remark 8 we examine the case where the agents are risk averse.

**Remark 6.** We next relax the assumption that in the case of a divorce the husband keeps the entire dowry. In line with reality, suppose that in the case of a divorce women were refunded the proportion  $\alpha$  of the dowry, where  $0 < \alpha < 1$ . This is often true, for example, of any dowry given in the form of jewelry. We can mimic the analysis in the main text to demonstrate that the equilibrium mehr is

$$M^{**} = m \left[ (1 - \alpha)[\mu_m - t_a] + \alpha \gamma_s [S - t_a] \right]$$

and equilibrium dowry is

$$D^{**} = m[\mu_m - \gamma_s S - (1 - \gamma_s)t_a],$$

meaning that both are increasing in  $m$ . It is then straightforward to see that Proposition 5 goes through whenever  $S$  and  $t_a$  increase by the same extent because of the MFLO or MMDA (i.e.,  $dS = dt_a$ ).

**Remark 7.** We next allow for heterogeneity in the income levels of men and women using the simplest possible framework that captures some of the trade-offs. Assume that there are two men, with income  $m_1$  and  $m_2$ , where  $m_1 > m_2 > 0$ , and two women with income  $w_1$  and  $w_2$ , where  $w_1 > w_2 > 0$ . Let  $M(i, j)$  ( $D(i, j)$ ) denote the level of mehr (dowry) in a marriage between a man with income  $m_i$  and a woman with income  $w_j$ .

An equilibrium consists of a marriage market assignment<sup>36</sup> and the marriage market contracts  $(M(i, j), D(i, j))$ ,  $i, j = 1, 2$ , such that given these contracts, (a) all agents who are married obtain higher utility than if they do not enter the marriage market, (b) men take divorce decisions optimally, and (c) there exists no man  $m_i$  and woman  $w_j$ , such that  $m_i$  and  $w_j$  are not matched under the assignment; moreover, they strictly prefer to marry each other rather than follow the assignment.

<sup>35</sup> We are indebted to the anonymous reviewers for suggesting both these extensions.

<sup>36</sup> An example of such an assignment could be one in which there is *positive assortative matching*, with  $m_1$  ( $m_2$ ) getting married to  $w_1$  ( $w_2$ ); that is a high (low) income man marries a high (low) income woman.

It is then straightforward to argue that an equilibrium involves positive assortative matching and marriage market contracts such that (see Chowdhury et al. (2019))

$$M(i, i) = M(i, j) = m_i(\mu_m - t_a), \quad i, j = 1, 2, \quad (15)$$

$$D(i, i) = D(i, j) = m_i[\mu_m - t_a - \gamma(S - t_a)], \quad i, j = 1, 2. \quad (16)$$

From (15) and (16), it is clear that all our comparative statics predictions in Propositions 3 and 4 go through. Further, this equilibrium generates the prediction that both the mehr and the dowry levels of high income couples exceed that of low income couples.<sup>37</sup>

**Remark 8.** Let the utility function of men be  $u_m(\cdot)$ , and that of women be  $u_w(\cdot)$ , where both  $u_m(\cdot)$  and  $u_w(\cdot)$  are concave. It is straightforward to check that the equilibrium mehr remains unchanged at  $M^* = m(\mu_m - t_a)$ . Thus, the utility of a man from an average marriage is  $u_m(t_a m + D^*)$  which equals his utility from a failed marriage  $u_m(m\mu_m - M^* + D^*) = u_m(t_a m + D^*)$ . Thus there is partial consumption smoothing in these two states of the world for men. Further, the equilibrium dowry  $D^*$  solves

$$u_m(\mu_m m) = \gamma u(Sm + D^*) + (1 - \gamma) u(t_a m + D^*). \quad (17)$$

Let the utility functions of men satisfy CRRA, so that  $u_m(x) = \frac{x^\alpha}{\alpha}$ , where  $0 < \alpha < 1$ . One can then show that  $\frac{dD^*}{dm} > 0$  (see Chowdhury et al. (2019) for the details). Thus both mehr and dowry are increasing in  $m$ . Moreover,

$$\frac{dD^*}{dm} \Big|_{\alpha \rightarrow 1} = \mu_m - t_a - \gamma(S - t_a) < \mu_m - t_a = \frac{dM^*}{dm}. \quad (18)$$

Thus whenever the agents are not too risk-averse, i.e.  $\alpha$  is not too small, Propositions 3 and 4 go through.

Among other extensions, we allow for marriage shocks that vary continuously. We find that our comparative statics predictions go through under all these extensions.<sup>38</sup> Chowdhury et al. (2019) also analyze an alternative two-stage game in which a subgame perfect Nash equilibrium exists that coincides with that described above. Thus, in this game, efficiency follows as a result rather than being an assumption.

#### 4. Extensions and discussion: Property rights over women's income

The baseline framework has been kept parsimonious to focus on the essential trade-offs. We now extend the analysis to allow for the fact that men typically have property rights over the income generated by their wives in patriarchal societies.<sup>39</sup> Formally, following a marriage, a man obtains the proportion  $\lambda$  of his wife's income, where  $0 < \lambda < 1$ ; here,  $\lambda$  denotes men's property rights over their wives' income (see Anderson and Bidner (2015)). Thus, the post-marriage effective income of a man is given by  $X[m + \lambda w]$ , while that of a woman is given by  $X(1 - \lambda)w$ , where  $X \in \{S, t_f, t_a\}$  depending on the nature of the marriage.

To focus on economies in which dowry is positive, remaining single must be attractive for men, formally

$$m\mu_m > m[\gamma_s S + (1 - \gamma_s)t_a] + \lambda w[\gamma_s S + (1 - \gamma_s)t_a], \quad (19)$$

where (19) is the analogue of (10) in the preceding section. Moreover, (19) also ensures that

$$m\mu_m > mt_a + \lambda wt_a, \quad (20)$$

so that a man prefers to divorce his wife rather than continue in an average marriage, ensuring that mehr is also positive.

One can mimic the earlier analysis to show that whenever a marriage is either successful or average, divorce is inefficient. Further, the aggregate *ex ante* surplus from marriage exceeds that from remaining single. Divorce never takes place if the marriage is a successful one, whereas in state  $t_i$ , divorce happens if and only if  $M < m[\mu_m - t_i] - \lambda wt_i$ . Recalling that mehr is set at the minimum level that prevents inefficient divorce if the marriage is average,

$$M^* = m[\mu_m - t_a] - \lambda wt_a. \quad (21)$$

Hence, given  $M^*$ , men are indifferent between divorcing their spouses and continuing in average marriages. The mehr  $M^*$  is positive given (20). Moreover, it is lower than that in the baseline model because in this framework staying married is more attractive to men since they obtain a share of their spousal income.

Next, the equilibrium dowry  $D^*$  is such that men are indifferent between remaining single and getting married, so that

$$D^* = m[\mu_m - \gamma_s S - (1 - \gamma_s)t_a] - \lambda w[\gamma_s S + (1 - \gamma_s)t_a]. \quad (22)$$

<sup>37</sup> We conjecture that if one allows for complementarity between income levels (e.g., if the aggregate surplus in the case of a marriage between  $m_i$  and  $w_j$  is given by  $X(m_i + w_j + m_i w_j)$ ,  $X \in \{S, t_f, t_a\}$ ), then there is a unique equilibrium assignment with positive assortative matching.

<sup>38</sup> We refer readers to Chowdhury et al. (2019).

<sup>39</sup> Men's rights over women's earnings in patriarchal societies such as Bangladesh is well recognized. Even in cases in which women borrow from MFIs such as the Grameen Bank that exclusively focuses on women, men often decide the loan's utilization as well as take the profit (Rahman (2008)).

We now examine the impact of various income and legal shocks on both mehr and dowry. From (21) and (22), it is straightforward to see that

$$dM^* = [\mu_m - t_a]dm - t_a\lambda dw, \quad (23)$$

$$\text{and, } dD^* = [\mu_m - \gamma_s S - (1 - \gamma_s)t_a]dm - \lambda[\gamma_s S + (1 - \gamma_s)t_a]dw. \quad (24)$$

Turning to the absolute effect of an income shock on mehr and dowry, while  $M^*$  is positively related to  $m$ , it is negatively related to  $w$ .

Given that the labor market for women is an imputed one, it is however difficult to empirically establish whether the changes in  $m$  are larger or smaller than those in  $w$ . We therefore focus on the benchmark case in which any income shock generates identical proportional changes in  $m$  and  $w$ , so that  $dw/w = dm/m$ . From (23) and (24),

$$dM^* = m(\mu_m - t_a)\frac{dm}{m} - wt_a\lambda\frac{dw}{w} = M^*\frac{dw}{w}, \quad (25)$$

$$dD^* = m\left[\mu_m - \gamma_s S - (1 - \gamma_s)t_a\right]\frac{dm}{m} - \lambda w\left[\gamma_s S + (1 - \gamma_s)t_a\right]\frac{dw}{w} = D^*\frac{dw}{w}. \quad (26)$$

Thus, both mehr and dowry increase with a positive income shock and decrease under a negative one whenever the proportionate changes in the income of men and women are similar.

We next compare the effect of income shocks on mehr relative to that on dowry. Following any income shock, the absolute value of the change in mehr exceeds that in dowry. Moreover, income shocks generate the same rate of change in mehr and dowry; formally,

$$\frac{d\log M^*}{dm} = \frac{1}{m} = \frac{d\log D^*}{dw}. \quad (27)$$

**Proposition 9.** Consider the effect of income shocks on mehr and dowry. Let the income shock lead to identical proportional changes in the income of men and women (i.e.,  $dw/w = dm/m$ ). Following a positive (negative) income shock, the equilibrium mehr and dowry increase (decrease) at the same rate.

We then consider the effects of the MFLO and MMDA. Mimicking the preceding analysis, we can show that Proposition 5 goes through, suggesting that the MMDA and MFLO have qualitatively similar impacts in this case.

Finally, 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 benefited during the GR, we expect the GR to raise the property rights of women in the long run (i.e., reduce  $\lambda$ ). Given (21) and (22), a fall in  $\lambda$  can be expected to increase both mehr and dowry in the long run. These long-term effects may counteract some of the negative income shocks during the IW and famine episodes.

Finally, we briefly discuss some of the other modeling decisions made in this study:

1. Motivated by the institutional realities in Bangladesh, 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 payable immediately on marriage and a deferred mehr paid in the case of a divorce (Rapoport (2000); Welchman (2000)). In Bangladesh, while the formal marriage contract (*kabin*) can involve both forms of mehr, typically most mehr is deferred rather than prompt (Kamal (2001); Huda (2006)). This is also verified by Ambrus et al. (2010), who find that none of the marriages in their sample had a prompt mehr exceeding \$1.
2. While we follow the literature in assuming that dowry acts as a groom price that clears the marriage market, it may be of interest to examine what happens if dowry also involves some negotiations between the two concerned families. Allowing for such inter-family bargaining may capture some elements of reality in these societies. Consider an alternative framework in which mehr is still set to prevent inefficient divorce, whereas dowry is settled through asymmetric Nash bargaining between the families. We find that a close connection between the dowry levels in this formulation and our baseline model. Moreover, under some additional conditions, the comparative statics results are qualitatively similar under both formulations and would thus yield similar testable hypotheses.<sup>40</sup>
3. For completeness, we briefly discuss the implications for our theoretical framework if dowry is indeed a bequest rather than a groom price. The theoretical prediction from this literature (Zhang and Chan (1999); Edlund (2000); Botticini and Siow (2003); Brown (2009)) is that dowry does not depend on the productivity of the groom and is decreasing in the income of the bride. Thus, in a framework under which mehr still serves to prevent inefficient divorce, whereas dowry is a pre-mortem bequest, a positive income shock has a positive effect on mehr, but no effect on dowry.

<sup>40</sup> The details are available in Chowdhury et al. (2019).

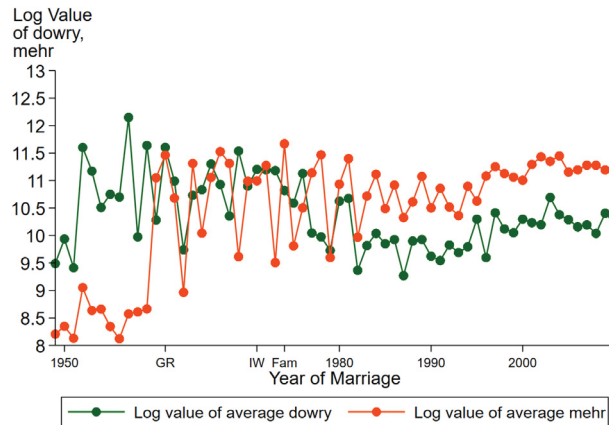


Fig. 1. Mean real value of mehr and dowry by year of marriage (based on the PKSf data).

## 5. Data and descriptive statistics

To test our model predictions, we used three household survey datasets; two of these 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 1820 households in 91 villages across all major geographical regions of Bangladesh between December 2010 and January 2011.<sup>41</sup> After employing the data-cleaning steps described below, the sample contained 1981 marriages in 1,457 households.

The second dataset was collected between December 2004 and January 2005 for the Bangladesh Rural Urban Linkage Survey (BRULS) by the International Food Policy Research Institute. It was a follow-up study to the Household Income and Expenditure Survey of 2000 conducted by the Bangladesh Bureau of Statistics in which 1360 rural households drawn from 68 villages (mouzas) in 16 districts of the Rajshahi Division were surveyed (BBS 2005). In 2004, the BRULS resurveyed 1271 households from the existing sample (6.5% attrition) as well as added 200 new households from 10 new villages in the same division; hence, the new sample had 1471 households drawn from 78 villages. After employing the same cleaning steps described below, the sample had 1367 marriages in 865 households.

The third dataset was collected from 2000 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 A Figs. A.2 and A.3), and all of them with the exception of one border Bangladesh. The survey was commissioned by the Indian Statistical Institute, Delhi and was conducted by the National Field Service of India between December 2014 and January 2015.

To create our working sample, we adopt the following cleaning procedure. First, only Muslim households are included; second, only first marriages are included; third, only relationships involving household heads, spouses, or sons/daughters are included; and finally, missing values of dowry and mehr are deleted. In both datasets from Bangladesh, the real values of dowry and mehr are calculated using the price deflator 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 are used to calculate the real values of dowry and mehr.

Fig. 1 shows the trends in the logarithmic values of 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 in Section 2, namely the GR, IW, and famine, are marked along the horizontal axis. Both dowry and mehr payments fluctuated considerably from the 1950s to 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 survivorship bias.<sup>42</sup> However, some patterns can be observed from the graph. Mehr increased in the GR period and then decreased in the IW-famine period; however, dowry decreased in both periods. Aside from fluctuations, the value of dowry was larger than that of mehr in the pre-GR period, while the trend reversed after the 1980s.

<sup>41</sup> These households were drawn from an earlier survey commissioned by the Palli Karma Shahayak Foundation (PKSF) and conducted by the Bangladesh Institute of Development Studies in 1997–1998.

<sup>42</sup> In our case, survivorship bias refers to the fact that only a small proportion of individuals who married in earlier periods were alive during the survey. In the BRULS, the percentages of observations in the pre-GR, GR, IW/famine, and post-famine periods are 0.59%, 3.29%, 3.51%, and 92.61%, respectively. By contrast, the respective numbers in the PKSf data are 4.04%, 9.19%, 6.92%, and 79.86%. One explanation is that the rural northwestern region in Bangladesh, where the BRULS was conducted, has historically been the poorest region in the country, with the highest incidence of poverty and shortest life expectancy. Therefore, the number of surviving individuals who married in earlier periods is smaller in the BRULS dataset. By contrast, the PKSf data cover all of Bangladesh, thereby reducing survivorship bias in the sample. In the West Bengal data, the percentages of observations in the pre-GR, GR, IW/famine, and post-famine periods are 1.53%, 4.43%, 3.70%, and 90.34%, respectively.

**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 (1971–1975) (4)	Regime IV Marriages (1976–2010) (5)
Value of mehr	9.102 (0.055)	8.334 (0.105)	8.984 (0.128)	8.476 (0.177)	9.209 (0.065)
Value of dowry	9.371 (0.032)	9.939 (0.163)	9.791 (0.117)	9.705 (0.145)	9.265 (0.034)
Education, bride	3.503 (0.085)	0.775 (0.208)	1.412 (0.190)	1.745 (0.236)	4.034 (0.097)
Education, groom	3.653 (0.090)	1.625 (0.336)	2.181 (0.268)	2.409 (0.321)	4.032 (0.101)
Age at marriage, bride	16.09 (0.068)	13.475 (0.391)	14.434 (0.201)	15.029 (0.257)	16.504 (0.072)
Age at marriage, groom	23.996 (0.108)	23.887 (0.616)	24.335 (0.413)	24.153 (0.442)	23.949 (0.117)
Bride's family richer	0.311 (0.010)	0.212 (0.046)	0.28 (0.033)	0.35 (0.041)	0.317 (0.012)
Groom's family richer	0.234 (0.010)	0.313 (0.052)	0.231 (0.031)	0.161 (0.031)	0.237 (0.011)
N (All female)	1981	80	182	137	1582

Figures in parentheses are standard errors.

Table 1 presents the descriptive statistics of the real values of dowry and mehr to clarify the trends in Fig. 1 as well as several bride/groom characteristics controlled for in the analysis. The logarithm of the real value of mehr (in taka) substantially increased from an average of 8.33 in the pre-GR period to 8.98 in the GR period (in absolute value, an increase from 18,009 taka to 56,759 taka). Then, it declined to 8.48 in the IW/famine period. In the absence of any further shock, it increased to 9.2 over the long horizon of the post-1975 (1976–2010) period. A similar trend is not observed in the case of dowry, which decreased over time. In the BRULS data, both mehr and dowry increased in the GR period and then decreased in the IW-famine period (Appendix A, Figs. A.4 and Table A.1). On the other hand, in the West Bengal data, both mehr and dowry increased in both the GR and IW-famine periods (Appendix A, Figs. A.5 and Table A.2).<sup>43</sup> In terms of bride and groom attributes, the average years of schooling of brides increased over time. In the PKSF data, for example, it increased to 4.03 in the post-famine period from 0.78 in the pre-GR period. Age at marriage also increased for brides over the same period (from 13.5 to 16.5 years), while that for grooms remained almost unchanged.

## 6. Estimation strategy

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

$$\ln M_{iy} = \alpha^M + \gamma^r + \beta^M \mu_y + \delta^M X_{iy}^M + \varepsilon_{iy}^M, \quad (28)$$

$$\ln D_{iy} = \alpha^D + \gamma^r + \beta^D \mu_y + \delta^D X_{iy}^D + \varepsilon_{iy}^D, \quad (29)$$

where  $\ln M_{iy}$  and  $\ln D_{iy}$  are the logarithms of the real value of mehr and dowry,<sup>44</sup> respectively for woman  $i$  married in year  $y$ , and  $\mu_y$  is a vector of three dummy variables for the following four periods in both equations: (i) pre-GR (pre-1961), (ii) GR (1961–1970), (iii) IW/famine (1971–1975), and (iv) post-famine (post-1975).  $\gamma^r$  is the set of regional (district) dummies to account for geographic variations in dowry and mehr. Both equations include marriage year (normalized to 1 in the first period of marriage in the data) and its square (to capture the non-linearity in the trend of the values of mehr and dowry).

Given the exogeneity of the shocks, our identification relies entirely on pre-post comparisons. To understand the effect of a particular shock, we compare the values of mehr and dowry after the shock with their respective values in the previous period. Specially, we compare 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.<sup>45</sup>

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 emergence of marriage-related payments. Moreover, the nature

<sup>43</sup> The values of dowry and mehr among Muslims are substantially lower in West Bengal than in Bangladesh after adjusting for the exchange rate. This difference, although an interesting topic in its own right, is beyond the scope of the current investigation.

<sup>44</sup> As the steps outlined to select the working sample retain only positive values of dowry and mehr, logarithmic transformation does not decrease the sample size in our analysis. Given the large fluctuations in dowry and mehr, such a transformation is also useful for accounting for heteroskedasticity.

<sup>45</sup> Eqs. 28 and 29 are estimated independently. However, SURE estimations provide qualitatively similar results. See Ambrus et al. (2010), who also estimate the mehr and dowry equations independently.



and direction of such payments are often affected by socioeconomic factors such as the relative economic status of the two families and income-earning potential of the groom and bride (Anderson (2003)). Other spousal attributes include income (Botticini (1999)) and education (Deaolalikar et al. (1998); Dalmia and Lawrence (2005)). Empirical evidence pertaining to both developed (Hitsch et al. (2010)) and developing countries (Rao (1993); Edlund (2000)) usually supports the existence of preferences for spousal attributes.

These bride and groom characteristics are uncorrelated with the natural shocks. Nonetheless, as robustness checks, we control for a rich set of variables to account for these characteristics. The vectors  $X^M$  and  $X^D$  both contain a set of brides and grooms' attributes including the age and education differences between the bride and groom and their squares, two dummies for the relative wealth of brides' and grooms' families<sup>46</sup> 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 bride's education and age (at the time of marriage) in the regression. Similarly, in the case of dowry, the estimation equation includes the groom's education and age (at the time of marriage) in the regression.<sup>47</sup>

Other changes over time might be spuriously correlated with the natural shocks. For example, regime shifts from the bride price to dowry as well as any associated or subsequent dowry inflation are associated with a transition to more complex societies (see Hughes (1985) for Greece and Quale (1988) for Mesopotamia). However, such regime shifts are historical processes occurring over a long period, perhaps several centuries. Gradual changes in both mehr and dowry for reasons not related to natural shocks are reflected in their trend values, which are accounted for by including (non-linear) time trends. The modernization of agricultural production including the introduction of heavy machinery changes demand for female labor as well as causes greater wealth and income dispersion among men, leading to women competing for more affluent men (Quale (1988); Anderson (2003)). These changes in turn lead to changes in marriage market payments. Our first natural shock is the GR, which is indeed related to changes in the production process in the agricultural sector. However, agricultural production in Bangladesh involves only light machinery gradually introduced since the 1980s, during and after which there is no considerable change in the values of dowry and mehr in our data.

We apply our empirical estimation strategy to the PKSf and BRULS data. The PKSf dataset is more representative than the BRULS data given its sample area coverage and larger sample size. We also construct a combined dataset by merging these two datasets. This merging is justified, as the information used in the analysis is the year of marriage as well as 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 the bride and groom's attributes at the time of marriage.

## 7. Empirical results

Before presenting the results, it is worth reiterating the predictions of the model developed in Section 3.1.1 that the GR (IW/famine) increases (decreases) the value of mehr and dowry similarly relative to their respective previous levels. We compare the values of mehr and dowry in the GR period relative to the pre-GR period as well as in the IW/famine period (1971–1975) relative to the GR period. The standard errors are clustered at the region and marriage-year levels because the effects of shocks may not be uniform over time and across regions; for example, there may be regional variations in the timing of the implementation of the GR and severity of the war and famine.

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

### 7.1. Results from the PKSf (2010) data

Table 2 presents the regression results for this dataset. The (log) values of mehr and dowry in each period are reported relative to the previous period. Column 1 presents the results for mehr, without controlling for the attributes of brides and grooms. The value of mehr increases significantly during the GR relative to the previous period; the coefficient is 0.97 (with a t-value of 2.66), suggesting that value of mehr is 97% higher in the GR period relative to the previous period. It then declines by 53% in the IW/famine period (1971–1975) compared with the GR level, although only significant at the 11% level (t-value is -1.61). Finally, the change in the post-famine period from the IW/famine period is not significant.<sup>48</sup> These results support our model predictions that the value of mehr increases in the GR period and decreases in the IW/famine period compared with the respective previous period before stabilizing in the post-famine period. These results are robust to controlling for bride and groom attributes (column 3).

<sup>46</sup> Relative wealth is categorized into three groups depending on whether the bride's family is (i) economically richer, (ii) poorer, or (iii) equal relative to the groom's family.

<sup>47</sup> Other attributes related to the appearance of the bride and groom such as skin tone and height (Billig (1992); Banerjee et al. (2013)) are not controlled for in the regression as such data were not collected. Rao (1993) finds that dowry practices vary across caste groups; however, the caste system is absent among Muslims.

<sup>48</sup> The results are robust if the IW/famine period is defined as 1971–1974. Please see the working paper version of this paper (Chowdhury et al. (2019)).

**Table 2**  
Impact of exogenous shocks on the real values of mehr and dowry (PKSF 2010 data).

	Log of Mehr (1)	Log of Dowry (2)	Log of Mehr (3)	Log of Dowry (4)	Log of Mehr (5)	Log of Dowry (6)
GR coefficient relative to pre-GR	0.970*** (0.365)	0.267 (0.291)	0.851** (0.358)	0.184 (0.286)	0.834** (0.363)	0.166 (0.282)
IW-famine relative to GR	-0.534 (0.332)	0.052 (0.206)	-0.531 (0.323)	0.027 (0.199)	-0.514 (0.323)	0.046 (0.197)
Post-famine relative to IW-famine	-0.289 (0.354)	-0.400** (0.198)	-0.173 (0.332)	-0.322* (0.186)	-0.186 (0.337)	-0.346* (0.183)
Observations	1,981	1,981	1,981	1,981	1,981	1,981
R-squared	0.177	0.200	0.209	0.244	0.209	0.247
Bride and groom characteristics	No	No	Yes	Yes	Yes	Yes
Interaction between region and year of marriage	No	No	No	No	Yes	Yes
p-value for $\chi^2$ test for the equality of coefficients for dowry and mehr:						
GR relative to pre-GR		0.120		0.151		0.150
IW-famine relative to GR		0.065		0.079		0.080
Post-famine relative to IW-famine		0.709		0.609		0.606

Robust standard errors clustered at the region and marriage year level are in parentheses; \*\*\*  $p < .01$ , \*\*  $p < .05$ , \*  $p < .1$ . All regressions control for region fixed effects, marriage year and marriage year squared, and a constant not reported in the table. Bride and groom characteristics include their age and education, differences in their age and education, dummies for relative wealth of the two families at the time of the marriage, and a dummy if the marriage was an arranged or chosen by the bride or groom.

Columns 2 and 4 (Table 2) present the results for the value of dowry. The estimated coefficients for the GR compared with pre-GR and for the IW/famine compared with the GR are not significant.<sup>49</sup> Combining the results for fluctuations in the values of mehr and dowry, we thus find partial support for our model predictions.

To check if any events other than the shocks considered also influence fluctuations in dowry and mehr, we include the interaction of regions and years as an additional control. The results for mehr and dowry presented in columns 5 and 6, respectively, remain strongly robust.

We test the equality of the coefficients of logarithms of mehr and dowry and report the chi-square statistics for the null hypothesis that they are equal.<sup>50</sup> The comparison of the results (columns 1 vs. 2; columns 3 vs. 4; columns 5 vs 6) indicates that the null is rejected (at the 10% level) only for the IW/famine period. It may seem surprising that the magnitudes of the two coefficients for the GR period differ by a wide margin even though the null of equality is not rejected. The reason may be the small number of observations in this period (number of reported marriages in the earlier period) due to survivorship bias. We therefore do not stress this point further.

One might question if our results are driven by the employment of women in the garment sectors in the 1990s and female secondary school stipend programs in 1994. We re-estimate the equations restricting the sample period to 1989 (i.e., the post-famine period is defined as 1976–1989). The results, including the effects of GR, remain qualitatively similar to those reported in Table 2 (see Appendix A, Table A.3 for the PKSF data); in addition, the value of dowry does not significantly decline in the post-famine period relative to the IW-famine period, which is consistent with our model prediction.

## 7.2. Results from the BRULS (2004–2005) data

Column 1 in Table 3 presents the regression results for mehr when bride and groom attributes are excluded from the regression. The value of mehr increases during the GR compared with the pre-GR period and decreases in the IW-famine period relative to the GR period, but the differences are not statistically significant in either case. The value of dowry follows a similar trend, but again, the coefficients are not statistically significant (column 2). The results remain qualitatively unchanged after controlling for bride and groom attributes, and the region-year interaction.

The insignificance of the results in this dataset may be due to the smaller sample size leading to larger survivorship bias; moreover, the BRULS dataset comes only from the northern region of Bangladesh. To exploit the larger sample size, our final exercise in the next section involves merging the PKSF and BRULS datasets.

<sup>49</sup> When the post-famine period is compared with the IW-famine period, the value of dowry significantly decreases. However, this result is driven by the long-term trend in dowry in the post-famine period. In our robustness check later in this section when the post-famine period is restricted to 1989, this coefficient becomes insignificant.

<sup>50</sup> To test the equality of the coefficients, we jointly estimate the mehr and dowry equations allowing the residuals of the two equations to be correlated. The results are strongly robust; indeed, the standard errors of the estimated coefficients slightly decrease.

**Table 3**  
Impact of exogenous shocks on the real values of mehr and dowry (BRULS 2004–2005 data).

	Log of Mehr (1)	Log of Dowry (2)	Log of Mehr (3)	Log of Dowry (4)	Log of Mehr (5)	Log of Dowry (6)
GR coefficient relative to pre-GR	2.103 (1.418)	1.284 (1.158)	1.728 (1.463)	0.641 (1.169)	1.756 (1.440)	0.668 (1.172)
IW-famine relative to GR	-0.052 (0.428)	-0.130 (0.365)	-0.189 (0.422)	-0.241 (0.354)	-0.193 (0.423)	-0.246 (0.355)
Post-famine relative to IW-famine	-0.011 (0.368)	-0.399 (0.295)	-0.047 (0.361)	-0.413 (0.283)	-0.044 (0.363)	-0.411 (0.284)
Observations	1,367	1,367	1,364	1,364	1,364	1,364
R-squared	0.116	0.079	0.193	0.225	0.193	0.225
Bride and groom characteristics	No	No	Yes	Yes	Yes	Yes
Interaction between region and year of marriage	No	No	No	No	Yes	Yes
p-value for $\chi^2$ test for the equality of coefficients for dowry and mehr:						
GR relative to pre-GR		0.2714		0.1896		0.195
IW-famine relative to GR		0.828		0.883		0.884
Post-famine relative to IW-famine		0.184		0.215		0.215

Robust standard errors clustered at the region and marriage year level are in parentheses; \*\*\*  $p < .01$ , \*\*  $p < .05$ , \*  $p < .1$ . All regressions control for region fixed effects, marriage year and marriage year squared, and a constant not reported in the table. Bride and groom characteristics include their age and education, differences in their age and education, dummies for relative wealth of the two families at the time of the marriage, and a dummy if the marriage was an arranged or chosen by the bride or groom.

### 7.3. Results from the merged (PKSF and BRULS) data

Table 4 presents the regression results for the merged dataset. In all the regressions, we include a dummy for the two datasets as well as control for the (non-linear) trend of the values of mehr and dowry in each dataset. Columns 1 and 3 show the results for mehr without and with the inclusion of the bride and groom attributes, respectively. Columns 5 additionally controls for the region-year interaction. Columns 2, 4 and 6 present the corresponding results for dowry. All the results are qualitatively similar to those obtained using the PKSF data with the exception that the coefficient on mehr in the IW-famine period now becomes significant.

To summarize, the results indicate that the value of mehr increases during the GR period and then declines during the IW/famine. More specifically, the GR has a positive effect and the IW/famine has a negative effect on mehr. While the corresponding changes in dowry are not significant, they otherwise follow a trend similar to that of mehr with a change of a smaller magnitude. Therefore, we find partial support for our theoretical predictions summarized in Section 3.1.1.

Our final robustness check involves addressing the survivorship bias (i.e., the lower number of observations in earlier periods). It is important to mention that in our context, the survivorship bias is not likely to cause sample selection

**Table 4**  
Impact of exogenous shocks on the real values of mehr and dowry (PKSF and BRULS merged data).

	Log of Mehr (1)	Log of Dowry (2)	Log of Mehr (3)	Log of Dowry (4)	Log of Mehr (5)	Log of Dowry (6)
GR coefficient relative to pre-GR	1.157*** (0.363)	0.394 (0.299)	0.992*** (0.354)	0.227 (0.288)	0.982*** (0.358)	0.213 (0.288)
IW-famine relative to GR	-0.418 (0.275)	0.013 (0.189)	-0.457* (0.268)	-0.029 (0.183)	-0.447* (0.268)	-0.014 (0.182)
Post-famine relative to IW-famine	-0.233 (0.276)	-0.434** (0.174)	-0.164 (0.263)	-0.361** (0.164)	-0.170 (0.264)	- (0.163)
Observations	3,348	3,348	3,345	3,345	3,345	3,345
R-squared	0.233	0.158	0.267	0.229	0.267	0.231
Bride and groom characteristics	No	No	Yes	Yes	Yes	Yes
Interaction between region and year of marriage	No	No	No	No	Yes	Yes
p-value for $\chi^2$ test for the equality of coefficients for dowry and mehr:						
GR relative pre-GR		0.053		0.056		0.056
IW-famine relative to GR		0.095		0.097		0.099
Post-famine relative to IW-famine		0.403		0.413		0.413

Robust standard errors clustered at the region and marriage year level are in parentheses; \*\*\*  $p < .01$ , \*\*  $p < .05$ , \*  $p < .1$ . All regressions control for region fixed effects, marriage year and marriage year squared, and a constant not reported in the table. Bride and groom characteristics include their age and education, differences in their age and education, dummies for relative wealth of the two families at the time of the marriage, and a dummy if the marriage was an arranged or chosen by the bride or groom.

bias.<sup>51</sup> Nonetheless, to address any such bias, we add the total number of marriages recorded in each year in the sample as an additional control in three datasets (PKSF, BRULS and the merged data); the results (not reported) remain robust.

## 8. Other plausible explanations

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

### 8.1. Natural shocks or legal changes?

As discussed in Section 3, two legal changes in Bangladesh after 1960 aimed to restrict polygamy among Muslims as well as to curb the practice of dowry that coincided with the natural shocks, namely the MFLO in 1961 and MMDA in 1974. Our theoretical predictions contradict those of Ambrus et al. (2010), who theorize that the MFLO increases both dowry and mehr (see Section III.C). They argue that the MFLO, by increasing the abandonment costs for men, caused a shift from polygamy to monogamy, which in turn raised both mehr and dowry. Given that the link between the MFLO and a decrease in polygamy is not clear,<sup>52</sup> we abstract from polygamy, as well as abandonment, and instead capture any possible effect of the MFLO as an increase in utility from marriage, finding that the MFLO causes a decline in both mehr and dowry. In contrast, both our framework as well as Ambrus et al. (2010) suggest that the MMDA decreases both dowry and mehr. Given that both income shocks and legal changes occurred at the same time, 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 in West Bengal. In Appendix B, we also demonstrate that the empirical results reported by Ambrus et al. (2010) are sensitive to their empirical methodology.

#### 8.1.1. Evidence from West Bengal: Another natural experiment

In 1947, (United) Bengal was partitioned by the British into two regions; while the eastern region became a part of Pakistan (East Pakistan, now Bangladesh), 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 were introduced in Bangladesh and West Bengal almost simultaneously. However, being parts of two 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 are driven by the GR and not by legal changes.

To examine West Bengal, we follow an approach similar to Banerjee et al. (2002), who take the agricultural sector of Bangladesh as a valid counterfactual for that in West Bengal and find 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 method). They rely 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 whether agricultural growth was the same in Bangladesh and West Bengal between 1961 and 1970. We regress agricultural value added over 1961–1970 against year dummies and an indicator that tracks whether the district is in Bangladesh.<sup>53</sup> Similar to Banerjee et al. (2002), the hypothesis is rejected, as the coefficient of the Bangladesh is not significantly different from zero.<sup>54</sup>

Unlike the IW or famine in Bangladesh, there is no evidence of such negative economic shocks in West Bengal, although this region may have indirectly suffered from the IW shock in neighboring Bangladesh. About 1.5 million refugees from Bangladesh took shelter in bordering Indian regions including West Bengal. While a few West Bengal districts also suffered from flooding in 1974 (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. Flooding is a natural event that occurs frequently in this part of West Bengal and Bangladesh. Therefore, the events in the 1971–1975 period can at most be characterized as a period of economic hardship, but not as shocks.

We choose the same cut-off periods for West Bengal as in Bangladesh: (i) pre-GR (pre-1961), (ii) the GR (1961–1970), (iii) the IW (1971–1975), and (iv) post-famine (post-1975). Based on our theoretical framework, we expect mehr and dowry to have increased in the GR period relative to the pre-GR period. In the absence of any further shocks, the values of dowry and mehr would then have stabilized or decreased (because of economic hardship) in the post-1970 period.

Columns 1 and 2 in Table 5 present the benchmark results for mehr and dowry, respectively. The value of mehr increases significantly (about 130%) in 1961–1970, but there are no significant changes in the subsequent periods compared with the

<sup>51</sup> Dowry related death of women is not a concern in our case. In our data, all marriages are recorded as long as one of the spouses is alive.

<sup>52</sup> The effectiveness of the MFLO in increasing mehr is doubtful given that (a) the government failed to provide sufficient funds for its implementation and (b) it is unclear whether polygamy decreased after the MFLO.

<sup>53</sup> For Bangladesh, the growth data are calculated from agricultural value added in constant LCU. The data source is the World Development Indicators of the World Bank. For West Bengal, growth is calculated from the agricultural yield data for six districts (Cooch Behar, Malda, Murshidabad, Nadia, North Dinajpur, and South Dinajpur) from where we collected our marriage market data. The data are sourced from various issues of the Statistical Abstract of the West Bengal Government.

<sup>54</sup> The coefficient of the Bangladesh is -3.73 with a t-statistic of -0.59.

**Table 5**  
Impact of exogenous shocks on the real values of mehr and dowry in West Bengal.

	Log of Mehr (1)	Log of Dowry (2)	Log of Mehr (3)	Log of Dowry (4)	Log of Mehr (5)	Log of Dowry (6)
GR coefficient relative to pre-GR	1.310* (0.783)	-0.319 (2.107)	1.018 (0.795)	-1.029 (2.105)	0.888 (0.792)	-1.097 (2.106)
IW-famine relative to GR	0.147 (0.352)	-1.178 (0.887)	0.000 (0.347)	-1.428 (0.879)	-0.017 (0.341)	-1.439 (0.873)
Post-famine relative to IW-famine	-0.379 (0.338)	-1.430* (0.797)	-0.431 (0.333)	-1.454* (0.792)	-0.471 (0.328)	-1.470* (0.784)
Observations	1,158	1,186	1,158	1,186	1,158	1,186
R-squared	0.200	0.133	0.232	0.216	0.254	0.218
Bride and groom characteristics	No	No	Yes	Yes	Yes	Yes
Interaction between region and year of marriage	No	No	No	No	Yes	Yes
p-value for $\chi^2$ test for the equality of coefficients for dowry and mehr:						
GR relative to pre-GR		0.437		0.329		0.340
IW-famine relative to GR		0.119		0.100		0.100
Post-famine relative to IW-famine		0.185		0.205		0.219

Robust standard errors clustered at the region and marriage year level are in parentheses; \*\*\*  $p < .01$ , \*\*  $p < .05$ , \*  $p < .1$ . All regressions control for region fixed effects, marriage year and marriage year squared, and a constant not reported in the table. Bride and groom characteristics include their age and education, differences in their age and education, dummies for relative wealth of the two families at the time of the marriage, and a dummy if the marriage was an arranged or chosen by the bride or groom.

previous period. Further, there are no significant changes in the value of dowry in either 1961–1970 or 1971–1975 relative to the previous period. However, dowry decreases in the post-1975 period relative to 1971–1975. The results for the effects of the GR are similar to those obtained for Bangladesh while the results for IW-famine are not and thus support our argument that natural shocks but not legal changes explain the changes in the value of mehr.

## 8.2. Missing women and marriage squeeze

We now examine whether the increased mehr in the 1960s was a result of missing women, a term coined by Sen (1990). The gender ratio (i.e., the number of males per 100 females) at birth in Bangladesh is similar to that in countries where prenatal discrimination is not observed or reported (UNFPA (2012)) (Appendix A, Table A.4).

Bangladesh, however, has a high female mortality rate (Kabeer et al. (2013)). In addition, the age-specific sex ratio and marriage rates need to be considered while examining whether missing women and marriage squeeze were happening in Bangladesh. Table A.4 in Appendix A shows the gender ratios at different age groups for 1951–2011 collected for various census years. The gender ratio at birth in Bangladesh remained unchanged in the 1950s and 1960s. Further, missing women and the abnormal rise in the proportion of male births in India (West Bengal) and other developing countries are mostly post-1970s phenomena owing to the availability of prenatal sex determination technologies (Sen (1990); UNFPA (2012)).

However, the male-female ratio for the 15–24 age group is lower than that for the 10–14 age group. One plausible explanation of this phenomenon is the high age specific migration of men from Bangladesh, both internally and internationally. This trend has been observed since the 1950s, however, and did not change significantly over the sample period. Hence, the male-female ratio of these particular age groups are unlikely to be confounded with either natural shock.<sup>55</sup>

## 9. Conclusion

In this study, we explain the fluctuations in 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 is to ensure that the marriage market clears and the role of mehr is to ensure the efficiency of the marriage market. Our comparative statics results suggest that mehr and dowry are both increasing (decreasing) in shocks that raise (lower) income.

To test the model predictions, we exploit several natural experiments. In Bangladesh, the introduction of modern agricultural technologies in the 1960s (the GR) increased agricultural productivity substantially. Subsequently, the country was subject to several negative shocks, first the devastating IW of 1971, followed in 1974 by a famine that primarily affected rural households. Our empirical results show that the value of mehr increased significantly during the GR period and decreased in the IW/famine period. However, the changes in dowry in the corresponding periods are not significant. These results therefore provide partial support for our model predictions.

To check the robustness of our results, more specifically to rule out legal changes as an alternative explanation, we exploit another natural experiment from the Indian state of West Bengal (bordering Bangladesh). Given that West Bengal

<sup>55</sup> The combined effects of IW and famine on gender ratio for the marriageable age group are trivial given that the (young) male were most affected during the IW, while the female (and children) were most affected during the famine.



experienced a similar GR but was not subject to any of the legal changes that occurred in Bangladesh (being part of India), these results suggest that the effects on mehr can be traced to income rather than legal shocks.

In our analysis, we account for gradual economic changes that might conceivably affect the trend values of dowry and mehr. For example, agricultural productivity increased gradually in the post-1980 period. This increase may be attributed to cumulative experiences gained over time since the GR shock (e.g., the innovation of newer rice varieties and increasing role played by NGOs in the agricultural sector). However, neither of these can be regarded as a shock. Another important aspect of the development process in Bangladesh is that while aggregate growth in the 1960s was driven mainly by the agricultural sector, the same in the post-1980 period was driven by the non-agricultural sector in urban areas. There were no major economic and political shocks in Bangladesh during our study period other than those considered in this work. Further, there were no sharp changes in the values of mehr after the last shock during the famine, which is consistent with the partial support of our model.

To conclude, our results suggest that economic and political shocks in Bangladesh influenced marriage market payments, more prominently mehr. As a broader point, natural shocks affect social institutions, an insight that may well be true beyond the specific example studied herein. It will not be surprising that the recent COVID-19 pandemic will have impact on many aspects of social institutions in the future. [Statistics\) \(2005\)](#)

#### Acknowledgments:

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#### Appendix A. Additional Figures and Tables

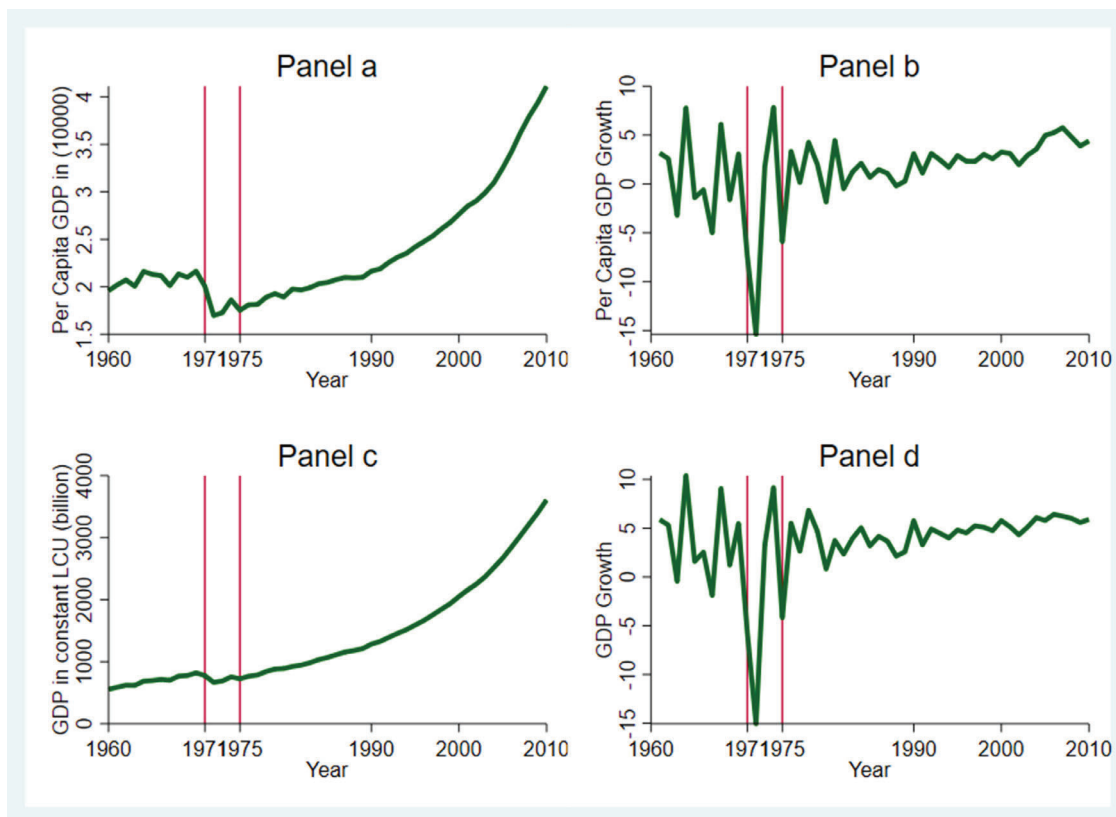


Fig. A1. GDP of Bangladesh and its growth: 1960–2010.

## Data collection regions in Bangladesh and India

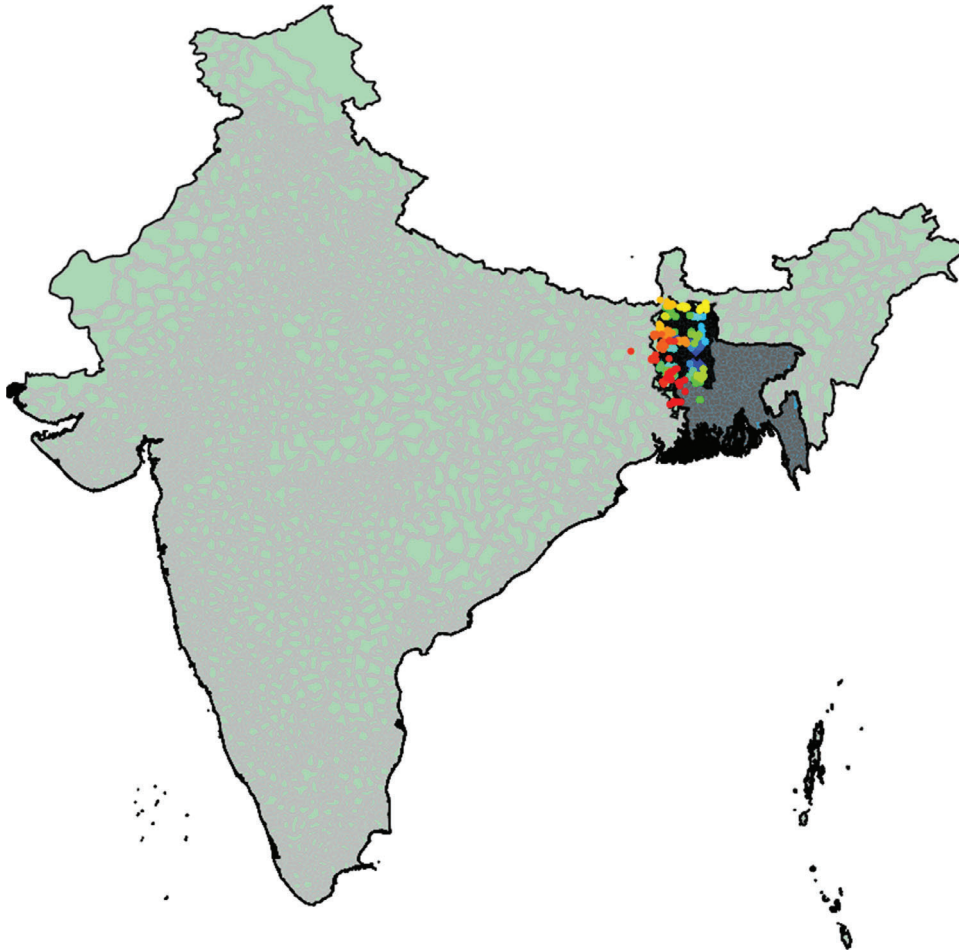


Fig. A2. Data collection regions in Bangladesh and India.

**Table A1**

Summary statistics (BRULS (2004–2005) data).

	All Marriages over the period (1)	Regime I Marriages (before 1961) (2)	Regime II Marriages (1961–1970) (3)	Regime III Marriages (1971–1975) (4)	Regime IV Marriages (1976–2004) (5)
Log value of mehr	10.317 (0.034)	9.615 (0.999)	10.825 (0.295)	10.437 (0.283)	10.299 (0.033)
Log value of dowry	9.674 (0.030)	10.659 (1.086)	10.746 (0.235)	10.199 (0.202)	9.609 (0.029)
Education, bride	3.113 (0.102)	1.125 (0.743)	1.289 (0.389)	1.625 (0.430)	3.247 (0.107)
Education, groom	3.754 (0.107)	3.429 (1.478)	2.733 (0.522)	2.792 (0.517)	3.829 (0.112)
Age at marriage, bride	15.739 (0.075)	12.375 (1.117)	13.822 (0.364)	14.396 (0.396)	15.879 (0.076)
Age at marriage, groom	22.636 (0.108)	21.75 (0.861)	22.622 (0.564)	22.542 (0.706)	22.646 (0.112)
Bride's family richer	0.345 (0.013)	0.5 (0.189)	0.356 (0.072)	0.271 (0.065)	0.346 (0.013)
Groom's family richer	0.296 (0.012)	0.5 (0.189)	0.356 (0.072)	0.292 (0.066)	0.293 (0.013)
N (All female)	1367	8	45	48	1266

Figures in parentheses are standard errors.

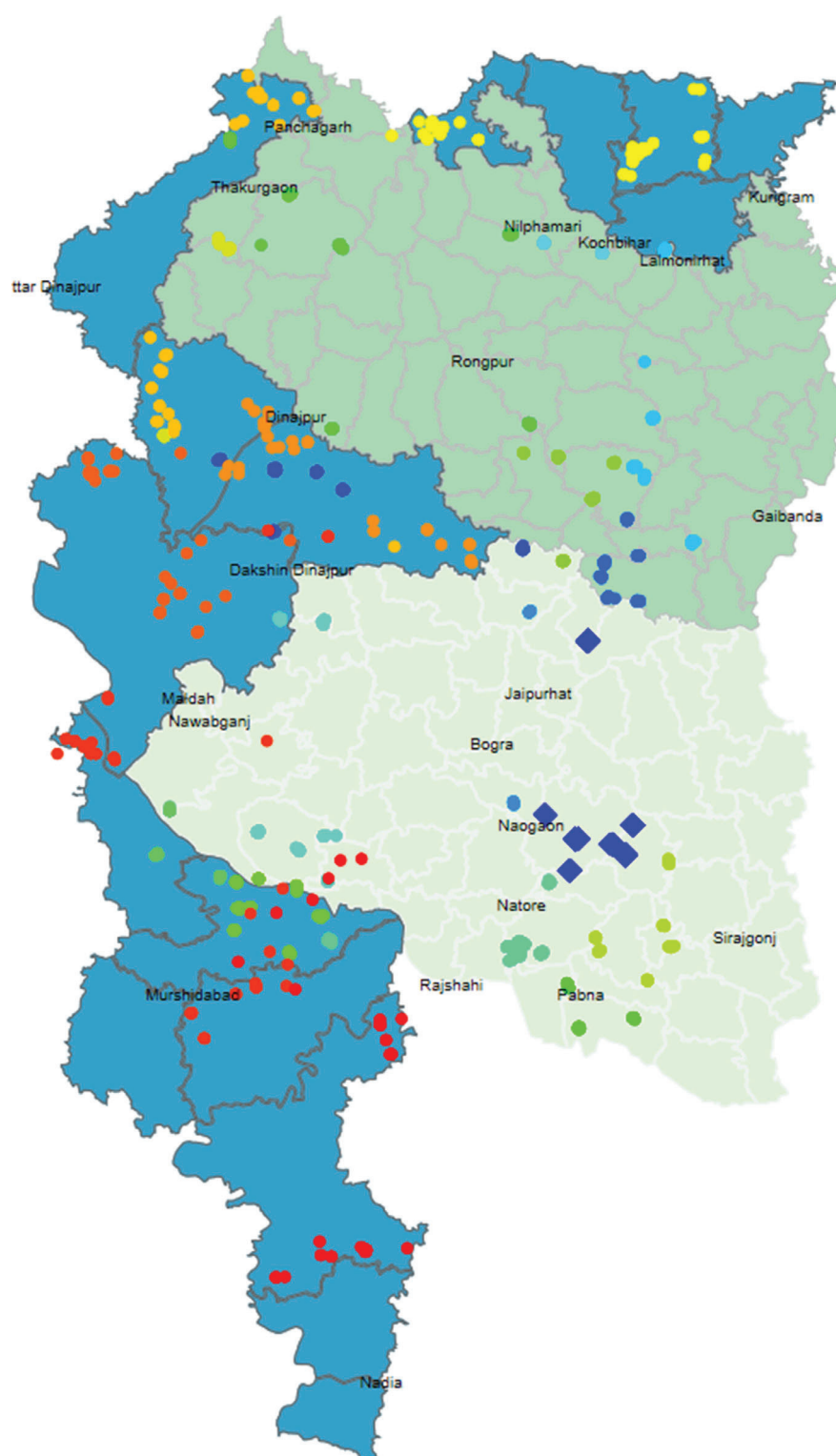


Fig. A3. Location of study villages in Bangladesh (BRULS 2004–2005 data) and West Bengal.

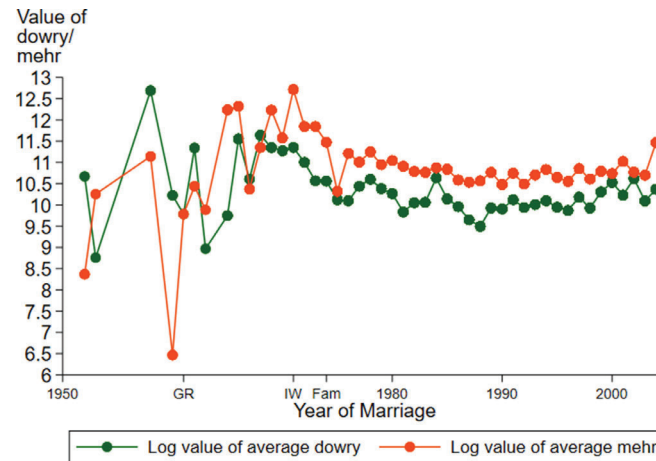


Fig. A4. Mean real value of mehr and dowry by year of marriage (BRULS 2004–2005 data).

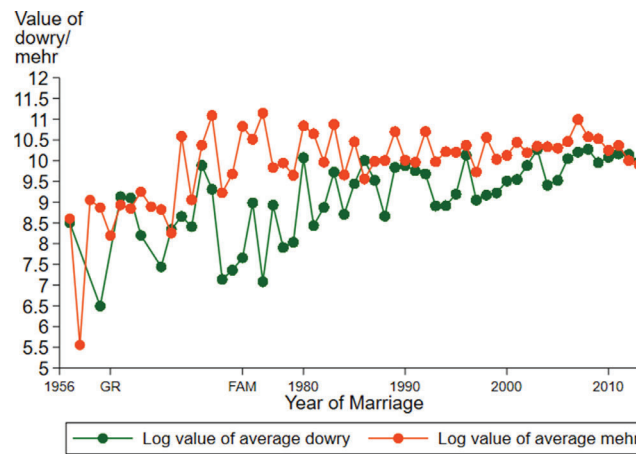


Fig. A5. Mean real value of mehr and dowry by year of marriage (West Bengal 2014–2015 data).

Table A2

Summary statistics (West Bengal (2014–2015) data).

	All Marriages over the period (1)	Regime I Marriages (before 1961) (2)	Regime II Marriages (1961–1970) (3)	Regime III Marriages (1971–1975) (4)	Regime IV Marriages (1976–2014) (5)
Log value of mehr	9.101 (0.052)	7.52 (0.806)	8.875 (0.158)	9.241 (0.242)	9.111 (0.055)
Log value of dowry	7.499 (0.106)	3.377 (2.071)	5.143 (0.573)	5.695 (0.596)	7.713 (0.107)
Education, bride	3.644 (0.118)	0.158 (0.158)	0.655 (0.287)	1.435 (0.315)	3.94 (0.126)
Education, groom	3.677 (0.121)	0.316 (0.230)	1.891 (0.401)	2.978 (0.584)	3.85 (0.129)
Age at marriage, bride	16.502 (0.097)	12.737 (0.704)	13.764 (0.324)	15.087 (0.557)	16.758 (0.099)
Age at marriage, groom	23.184 (0.141)	23.421 (1.283)	21.818 (0.497)	21.435 (0.514)	23.318 (0.150)
Bride's family richer	0.359 (0.014)	0.421 (0.116)	0.309 (0.063)	0.37 (0.072)	0.36 (0.014)
Groom's family richer	0.37 (0.014)	0.263 (0.104)	0.327 (0.064)	0.326 (0.070)	0.376 (0.014)
N (All female)	1242	19	55	46	1122

Numbers in parentheses are standard errors.

**Table A3**

Robustness of the results if the data are restricted to 1989 (PKSF 2010 data).

	Log of Mehr (1)	Log of Dowry (2)	Log of Mehr (3)	Log of Dowry (4)
GR coefficient relative to pre-GR	1.265*** (0.430)	0.220 (0.379)	1.180*** (0.424)	0.256 (0.374)
IW/famine relative to GR	-0.415 (0.307)	0.096 (0.216)	-0.450 (0.307)	0.088 (0.215)
Post-famine relative to IW/famine	-0.265 (0.360)	-0.238 (0.204)	-0.208 (0.335)	-0.223 (0.196)
Observations	1,023	1,023	1,023	1,023
R-squared	0.083	0.200	0.134	0.240
Bride and groom characteristics	No	No	Yes	Yes
p-value for $\chi^2$ test for the equality of coefficients for dowry and mehr:				
GR relative to pre-GR		0.060		0.109
IW-famine relative to GR		0.087		0.077
Post-famine relative to IW-famine		0.931		0.962

Robust standard errors clustered at the region and marriage year level are in parentheses; \*\*\*  $p < .01$ , \*\*  $p < .05$ , \*  $p < .1$ . All regressions control for region fixed effects, marriage year and marriage year squared, and a constant not reported in the table. Bride and groom characteristics include their age and education, differences in their age and education, dummies for relative wealth of the two families at the time of the marriage, and a dummy if the marriage was an arranged or chosen by the bride or groom.

**Table A4**

Gender ratio (male divided by female) by age group, 1951–2011.

Age Group	1951	1961	1974	1981	1991	2011
0–4	0.990	0.978	0.993	1.014	1.029	1.029
5–9	1.038	1.045	1.012	1.030	1.070	1.053
10–14	1.263	1.281	1.189	1.148	1.145	1.073
15–24	0.973	0.943	1.059	0.976	0.947	0.981
25–34	1.060	1.043	0.969	1.015	0.975	0.892
35–44	1.207	1.188	1.148	1.110	1.178	1.016
45–59	1.306	1.263	1.238	1.209	1.160	1.145
60+	1.227	1.229	1.299	1.277	1.200	1.135

## Appendix B. Replication of Ambrus et al. (2010) using the BRULS data

In the following, we compare and contrast the present study with that by 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. In contrast to Ambrus et al. (2010) we examine legal changes, as well as economic and political ones. Further, we find support for the economic and political channels, using additional survey data from West Bengal to rule out the effect of legal shocks.

We first compare our theoretical framework with theirs, before turning to some important differences in the estimations and results. Apart from the difference in focus, the theoretical framework developed in the present study also generates results that differ from those in Ambrus et al. (2010). In particular, our analysis suggests that the legal shock in the 1960s (i.e., the MFLO) would cause a decline in mehr and dowry rather than an increase, as in Ambrus et al. (2010). As far as the effect of the MMDA is concerned, the theoretical predictions in the two studies do coincide in that both suggest that mehr and dowry would be adversely affected, at least in the short run. We next discuss why the comparative statics predictions in the two frameworks differ.

As discussed in the introduction, as well as footnote (52) earlier, the argument in Ambrus et al. (2000) relies on several institutional assumptions, in particular that (i) the MFLO caused an increase in the social cost of abandonment for men, and that (ii) there was a shift from polygamy to monogamy. None of these institutional assumptions appear to be realistic. Additionally, in our framework, an income shock has a smaller effect on dowry relative to that on mehr, while dowry and mehr co-move in Ambrus et al. (2015). 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) provide an institutional justification for this assumption, pointing out that negative mehr is forbidden in the *Qur'an*, so that religious courts do not enforce contracts with negative mehr.

Before replicating the estimation by Ambrus et al. (2010), it is imperative to note that these authors used the BRULS dataset but employed a different and extensive cleaning procedure to construct their working data. This 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 in their main results. Our (BRULS) data construction and working



**Table B1**

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*** (3.824)	18,213.205** (2.037)	34,515.82 (1.051)	18,732.050** (2.421)	33,751.36 (1.037)	18,618.318** (2.39)
Married post-1974	-85,571.043*** (-3.932)	-14,834.380* (-1.853)	-63,312.803*** (-3.340)	-7,301.05 (-1.301)	-61,322.529*** (-3.264)	-6,977.55 (-1.239)
Married post-1990	12,418.632* (1.662)	5,782.05 (1.373)	12,955.63 (1.575)	5,772.283* (1.913)	13,626.43 (1.626)	5,885.806* (1.941)
Married post-1998	42,639.01 (1.218)	13,874.05 (1.46)	33,743.861* (1.665)	17,998.046*** (3.117)	29,165.96 (1.53)	17,364.569*** (3.068)
Year of marriage	-3,194.735** (-2.077)	453.963 (0.632)	-1,491.513* (-1.961)	-217.231 (-0.919)	-1,932.312** (-2.361)	-283.507 (-1.187)
Age at the time of the first marriage					3,966.032** (2.525)	586.026 (1.53)
Age difference between spouses					-3.337 (-0.005)	18.174 (0.061)
Bride's family wealthier than groom's					5,214.61 (0.782)	1,431.62 (0.588)
Eight-year dummies	Yes	Yes	No	No	No	No
Bride and groom's characteristics	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. \*\*\*  $p < .01$ , \*\*  $p < .05$ , \*  $p < .1$ . Columns 1 and 2 use the exact specification of Ambrus et al. and their data. In columns 3 to 6, the seven eight-year dummies are dropped. In columns 5 and 6, we add the three characteristics (age at the time of the first marriage, age difference between spouses, bride's family wealthier than groom's) found in Ambrus et al.'s data and used as dependent variables in their analysis (Ambrus et al. (2010) Table III, columns 4 to 6).

sample selection, discussed in Section 5, do not involve any such cleaning as the imputation of missing values or changing the recorded values.

Ambrus et al. (2010) estimate the same equations as (28) and (29) with the exceptions that the values of dowry and mehr are not expressed in logarithm and the attributes of brides and grooms are 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 divide the entire period into seven equal (eight-year) sub-periods and include these sub-period dummies as additional controls in their regressions. We show below that their results crucially depend on the inclusion of these ad hoc dummies. As stated in their paper, these dummies are included to account for non-linearity in the trends of dowry and mehr. However, the movements in the values of dowry and mehr in Fig. A.4 do not suggest cyclical patterns repeating every eight years as in the business cycle literature. Moreover, the pattern of business cycle fluctuations of GDP in Bangladesh (Appendix A, Figs. A.1) is different from that in developed countries, especially in the United States (see Baxter and King (1999) for business cycle patterns in the United States). Therefore, the inclusion of these dummies cannot be justified on the grounds of controlling for fluctuations in aggregate economic activity in Bangladesh. These dummies rather confound the interpretation of the 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 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, what the dummies for legal changes capture is unclear.

We first replicate Ambrus et al. (2010) benchmark results (see Table II on p. 1384 in their paper) using their cleaned data (<http://sites.duke.edu/ericafeld/data/> (accessed March 19, 2014)). Despite minor differences in magnitudes, we can replicate their benchmark results in Table B.1 (columns 1 and 2). The two legal changes, the MFLO and the MMDA, are represented by post-1963 and post-1974, respectively. Post-1990 and post-1998 represent two other legal changes. As found by Ambrus et al. (2010), the first two legal changes had a statistically significant impact on both mehr and dowry.

We now verify whether the above results are due to the inclusion of the ad hoc eight-year sub-period dummies. Columns 3 and 4 respectively present the results for mehr and dowry excluding these dummies. For the value of mehr, the magnitude of the coefficient of the MFLO (the first legal change) is not statistically significant and much smaller. Similarly, for 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 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 until 2004. Table B2 presents the results. 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 the reasons discussed earlier. In both cases, we find no impact of any legal changes on the values of mehr or

**Table B2**

Impact of legal changes on the real values of mehr and dowry (PKSF and BRULS merged data) alternative specification.

	Value of Mehr (1)	Value of Dowry (2)	Value of Mehr (3)	Value of Dowry (4)
Post-1963	-11,834.074 (47,184.544)	-18,108.566 (20,633.244)	48,618.348 (30,036.072)	16,723.283 (19,503.022)
Post-1974	-58,680.678 (57,298.499)	-30,113.342 (22,991.317)	8,399.336 (32,263.341)	-24,034.828 (17,278.404)
Post-1990	-47,682.420 (57,124.396)	-25,948.558 (24,354.543)	8,880.165 (35,869.189)	-18,563.292 (18,509.604)
Post-1998	-29,380.522 (58,094.028)	-12,113.438 (25,312.391)	31,342.721 (40,397.891)	-1,912.990 (20,098.421)
Observations	2,996	2,996	2,996	2,996
R-squared	0.077	0.069	0.071	0.065
Eight-year dummies	Yes	Yes	No	No

Robust standard errors clustered at the household level are in parentheses; \*\*\*  $p < .01$ , \*\*  $p < .05$ , \*  $p < .1$ . All regressions control for the dummies for relationship with the household head, marriage year, dummies for regions, seven eight-year period dummies, and a constant. Columns 3 and 4 do not include the seven eight-year period dummies.

**Table B3**

Impact of exogenous shocks on the real values of mehr and dowry (BRULS data cleaned by Ambrus et al. (2010)).

	Log of Mehr (1)	Log of Dowry (2)
GR coefficient relative to pre-GR	0.274 (0.540)	1.563** (0.759)
IW-famine relative to GR	0.001 (0.337)	-0.330 (0.329)
Post-famine relative to IW-famine	-0.298 (0.306)	-0.383 (0.335)
Observations	1,367	915
R-squared	0.095	0.102
p-value for $\chi^2$ test for the equality of coefficients for dowry and mehr:		
GR relative to pre-GR		0.133
IW-famine relative to GR		0.438
Post-famine relative to IW-famine		0.819

Robust standard errors clustered at the region and marriage year levels are in parentheses; \*\*\*  $p < .01$ , \*\*  $p < .05$ , \*  $p < .1$ .

dowry. To summarize, the results in Ambrus et al. (2010) are not robust to an alternative data-cleaning procedure, modest changes in specification, or using alternative data.

The 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). Table B.3 presents the results. It is important to reiterate that Ambrus et al. (2010) replace many recorded (and missing) values by 0s in the cleaning procedure; therefore, logarithmic transformation reduces the effective sample size by about 30% in the dowry equation, which is a non-trivial change in the data. Nonetheless, the results again partially support our model predictions; however, this time the results are significant in the case of dowry, unlike in the case of mehr reported in Tables 2, 3, and 4.

## Appendix C. Additional Material on the Theoretical Framework

We present a series of additional results that extend the parsimonious model examined in Sections (3) and (4) in various directions.

■ *The marriage shock  $t$  varies continuously:* Next, letting  $t$  denote the productivity of a marriage, we analyze the situation in which  $t$  is distributed continuously over  $[\underline{t}, \bar{t}]$  with distribution  $G(t)$ , where  $\underline{t} < 1 < \bar{t}$ . Thus,  $t = \bar{t}$  denotes a successful marriage, whereas a failed marriage has  $t = \underline{t}$ . Let the parameter values be such that

$$\underline{t}m < m\mu_m < \bar{t}m, \quad (\text{C.1})$$

$$\text{and, } \underline{t}(w + m) < w\mu_w + m\mu_m < \bar{t}(w + m). \quad (\text{C.2})$$

Equation (C.1) implies that there exists  $t^{**}$ , where  $\underline{t} < t^{**} = \mu_m < \bar{t}$ , such that in the absence of any mehr, divorce happens when  $t < t^{**}$ , but not otherwise. By contrast, (C.2) ensures that there exists  $t^* = \frac{w\mu_w + m\mu_m}{w+m}$ , where  $\underline{t} < t^* < \bar{t}$ , so that divorce is efficient whenever  $t \leq t^*$ , but not otherwise. Further, note that  $t^* < t^{**}$ . This implies that with 0 mehr, if  $t \leq t^*$  or if  $t > t^{**}$ , divorce happens if and only if it is also efficient. On the contrary, whenever  $t^* < t < t^{**}$ , men opt to divorce their spouses even though doing so is inefficient, creating a role for mehr. Thus, mehr is set at the minimum level that resolves this potential inefficiency.

Define  $M(t) = m[\mu_m - t]$ , so that  $M(t)$  is decreasing in  $t$ . Setting mehr at the level  $M^* = M(t^*)$  prevents inefficient divorce in the case of  $t \geq t^*$ . Further, given that  $M(t)$  is decreasing in  $t$ , in the case of  $t \leq t^*$ , divorce will happen and consequently mehr payments will be made in the equilibrium. Given that mehr is paid, the payoff of a man that divorces his wife is  $m\mu_m - M(t^*) = t^*m$ . Finally, there will be no divorce in the case of  $t \geq t^*$  (since  $M(t^*) \geq M(t)$ ).

We then solve for the equilibrium dowry  $D^*$ . Define  $\tilde{t} = t^*G(t^*) + \int_{t^*}^{\bar{t}} t dG(t)$ , where  $\tilde{t} > t^*$ . Then, mimicking our earlier argument, we can show that  $(D^*, M^*)$ , where

$$D^* = m[\mu_m - \tilde{t}],$$

and,  $M^* = m[\mu_m - t^*],$

can be sustained as an equilibrium. As in the baseline framework, in this equilibrium, men are indifferent between entering the marriage market and remaining single, and there is no inefficient divorce.

Next, turning to the effect of income shocks,

$$\frac{dD^*}{dm} = \mu_m - \tilde{t} - m \frac{d\tilde{t}}{dm} = \mu_m - \tilde{t} - mG(t^*) \frac{dt^*}{dm},$$

and,  $\frac{dM^*}{dm} = \mu_m - t^* - m \frac{dt^*}{dm}.$

It is straightforward to check that  $\frac{dM^*}{dm} > 0$  whenever  $m > 1$ . We then note that  $\frac{dD^*}{dm} < \frac{dM^*}{dm}$  whenever  $\tilde{t} - t^* - m(1 - G(t^*)) \frac{dt^*}{dm} > 0$ . This holds whenever divorce is efficient in only a small proportion of cases (i.e.,  $t^*$  is close to  $\underline{t}$ ).<sup>56</sup>

■ *Dowry is determined through Nash bargaining:* Thus far, dowry has been interpreted as a groom price that clears the marriage market. We now examine a related framework in which dowry is instead determined through Nash bargaining. Such a framework may not be too farfetched given that marriages in these societies often involve negotiations between two families. 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 to abstract from issues related to matching. Doing so also abstracts from any competitive forces operating here.

Further, for ease of exposition, we assume two types of marriages, successful and average, with the marriage being successful with the probability  $\gamma_s$  and average with the probability  $1 - \gamma_s$ . The marriage parameter is  $S$  for a successful marriage and  $t$  for a failure. We assume that if the marriage is average, then it is efficient that divorce does not happen; however, in the absence of mehr, men have an incentive to get divorced, namely

$$m\mu_m + w\mu_w < t(m + w), \quad \mu_m > t.$$

We argue that there is a close and intuitive connection between the dowry in this case and that in the baseline framework. For ease of exposition, we also assume that men do not have any property rights over their wife's income.

The timeline is as follows:

- *Stage 1:* The man and woman bargain over the surplus. If they reach an agreement, then the 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 woman realize if the marriage is a success or failure, and the man decides whether to get divorced. In the case of divorce, the man pays the woman the agreed upon mehr  $M$ .

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 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 Nash bargaining between the man and woman.

We next turn to solving for the equilibrium mehr and dowry. One can mimic the argument in the main text to argue that Proposition 1 holds in this case as well. Further, given  $\mu_m > t$ , mehr is positive.

Turning to dowry, we then solve for the Nash bargaining game between the man and woman, where the bargaining power of the man is  $\beta$  and that of the woman is  $1 - \beta$ ,  $0 < \beta < 1$ .

Straightforward analysis (see Chowdhury et al. (2019)) shows that the dowry is

$$D^* = m(\mu_m - \gamma_s S - (1 - \gamma_s)t) + \beta[(\gamma_s S + (1 - \gamma_s)t)(m + w) - m\mu_m - w\mu_w], \quad (C.3)$$

<sup>56</sup> This follows since  $\lim_{t^* \rightarrow \underline{t}} [\tilde{t} - t^* - m(1 - G(t^*)) \frac{dt^*}{dm}] = \int_{\underline{t}}^{\bar{t}} t dG(t) - \underline{t} > 0$ .

where recall that  $m[\mu_m - \gamma_s S - (1 - \gamma_s)t]$  equals the dowry in our baseline framework whenever  $t = t_a$  and  $\gamma_f = 0$ . Thus, we get back the competitive dowry in the limit as the bargaining power of the groom's family vanishes (i.e.,  $\beta$  goes to zero).

All the comparative statics results go through as long as  $\beta$  is not too large. Whether  $\beta$  is large or small is an empirical question and depends on multiple factors. On the one hand, the fact that societal norms are biased in favor of men suggests that  $\beta$  will not be too small; on the other hand, the competitive forces arising from the fact that men are more numerous than women suggest that  $\beta$  cannot be too large.<sup>57</sup> A more realistic model may have elements of both marriage market competition and inter-family bargaining. That must await future work though.

■ *Risk-averse agents*: Let the utility function of men be  $u_m(\cdot)$  and that of women be  $u_w(\cdot)$ , where both  $u_m(\cdot)$  and  $u_w(\cdot)$  are concave. It is straightforward to check that the equilibrium mehr remains unchanged at  $M^* = m(\mu_m - t_a)$ , while the equilibrium dowry  $D^*$  solves

$$u_m(\mu_m m) = \gamma u(Sm + D^*) + (1 - \gamma_s)u(t_a m + D^*). \quad (C.4)$$

Let the utility functions of men satisfy CRRA, so that  $u_m(x) = \frac{x^\alpha}{\alpha}$ , where  $0 < \alpha < 1$ . One can then show that  $\frac{dD^*}{dm} > 0$  (see Chowdhury et al. (2019) for the details). Thus, both mehr and dowry are increasing in  $m$ . Moreover,

$$\frac{dD^*}{dm} \Big|_{\alpha \rightarrow 1} = \mu_m - t_a - \gamma(S - t_a) < \mu_m - t_a = \frac{dM^*}{dm}. \quad (C.5)$$

Thus, whenever agents are not too risk averse (i.e.,  $\alpha$  is not too small), Propositions 3 and 4 go through.

■ *Non-cooperative formulation*: Consider a two-stage game in which, in stage 1, all men simultaneously make anonymous marriage offers, with the  $i$ -th man making an offer of  $(D_i, M_i)$ . Then, in stage 2, the women sequentially decide which of the remaining offers to accept, if at all. We look for the subgame perfect Nash equilibria of this game, arguing that the outcome where all men make an offer of  $(D^*, M^*)$  in stage 1 can be sustained as a subgame perfect Nash equilibrium. Clearly, in stage 2, any woman considers the set of offers still on the table, accepting the one that yields her the highest utility (breaking ties randomly), as long as there is one offer that yields her at least  $\mu_w w$ . Otherwise, she rejects all offers. We then argue that given that every man offers  $(D^*, M^*)$ , no man has an incentive to deviate from  $(D^*, M^*)$ .  $(D^*, M^*)$  maximizes the aggregate expected surplus from any marriage since a mehr of  $M^*$  ensures that divorce happens if and only if it is efficient. Consequently, under any deviant offer  $(D', M')$ , the aggregate surplus cannot be any higher, whereas for this offer to be acceptable to women, they must be offered at least as much utility as they obtain under  $(D^*, M^*)$ . Hence, the utility of the concerned man cannot be any higher than what he would obtain under  $(D^*, M^*)$ .

## Supplementary material

Supplementary material associated with this article can be found, in the online version, at [10.1016/j.euroecorev.2020.103510](https://doi.org/10.1016/j.euroecorev.2020.103510)

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<sup>57</sup> Suppose  $\beta = \frac{1}{2}$  and an income shock causes identical proportionate changes in the income of men and women. Then,  $dM^* - dD^* = \frac{1}{2}[\mu_m + \mu_w - 2t]\frac{dw}{w}$ . Thus, an income shock causes a greater change in mehr whenever  $\mu_m + \mu_w - 2t > 0$ .

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