The Economics of Consanguineous Marriages*

Quy-Toan Do† Sriya Iyer‡ Shareen Joshi§

5 June 2008

Abstract

The institution of consanguineous marriage - a marriage contracted between close biological relatives - has been a basic building block of many societies in different parts of the world. We argue that consanguinity is closely related to the practice of dowry, and both emerge from incomplete marriage contracts in developing countries. We present a theoretical model where the families of the bride and groom both invest continually in a marriage, but patrilocal residence creates an incentive for the bride's family to free-ride on the investments of their in-laws after the marriage is contracted. We show that dowry can alleviate this by transfering control rights over assets to the family with the highest incentives to invest at the time of marriage. Where dowries are unaffordable, consanguinity emerges as an alternative. A bride's family relies on trust among kin, rather than on upfront payments, in order to make credible commitments to future transfers to their daughter's household. Our model predicts that dowries are less likely to be observed in consanguineous unions, while bequests are more frequently expected. We also emphasize the effect of credit constraints on the relative prevalence of consanguinity and the timing of marital transfers. An empirical analysis using data from Bangladesh delivers results consistent with the predictions of the model.

JEL Classification Code: J1, I1, O1
Keywords: Marriage, consanguinity, dowry, bequests, credit constraints

*We would like to thank Gary Becker, Alan Bittles, Francis Bloch, Michael Bordo, Jishnu Das, Partha Dasgupta, Timothy Guinnane, Geoffrey Harcourt, Hanan Jacoby, Saumitra Jha, Lakshmi Iyer, Matthew Mason, Mushfiq Mobarak, David Newbery, Hashem Pesaran, Biju Rao, Hamid Sabourian, Azusa Sato, Paul Schultz and Chander Velu for helpful comments and discussions. All remaining errors are ours. The findings, interpretations, and conclusions expressed in this paper are entirely those of the authors. They do not necessarily reflect the view of the World Bank, its Executive Directors, nor the countries they represent.

†Development Economics Research Group. The World Bank. qdo@worldbank.org
‡Corresponding author: Faculty of Economics. University of Cambridge. Sriya.Iyer@econ.cam.ac.uk
§The School of Foreign Service. Georgetown University. sj244@georgetown.edu

1 Introduction

Consanguineous marriage, or marriage between close biological relatives who are not siblings, is a social institution that is, or has been, common throughout human history (Bittles, 1994; Bittles et al., 1993; Hussain and Bittles, 2000). Although in the western world consanguineous marriages constitute less than 1 percent of total marriages, this practice has enjoyed widespread popularity in North Africa, the Middle East and South Asia (Maian and Mushtaq, 1994; Bittles, 2001).[1] In Iraq for example, 46.4 percent of marriages are between first or second cousins (Al-Hamamy et al, 1986; Al-Hamamy and Al-Hakkak, 1989; also reported in the *New York Times*, September 23, 2003). In India, consanguineous marriages constitute 16 percent of all marriages, but this varies from 6 percent in the north to 36 percent in the south (IIPS and ORC Macro International, 1995; Banerjee and Roy, 2002). More widely, evidence from South Asia suggests that consanguineous marriage occurs in rural areas (Rao and Inbaraj, 1977; Reddy, 1993), and irrespective of religious groups and economic classes (Bittles, 2001; Iyer, 2002). Scientific research in clinical genetics documents a negative effect of inbreeding on the health and mortality of human populations, and the incidence of disorders and disease among the offspring of consanguineous unions (Bittles, 2001). To economists therefore, this contemporary incidence of consanguineous marriage is puzzling.

It is in this setting that this paper makes its contribution: to postulate that consanguinity is a rational response to a marriage market failure, rather than simply a consequence of culture, religion or preferences. The starting point of our analysis are the following two stylized facts commonly observed in large parts of South Asia and elsewhere: first, marriage celebrations are often associated with significant dowries, or transfers of assets from the bride's family to the groom's family. Second, enforcement mechanisms for informal contracts are stronger within kinship networks than outside of such networks. This paper is an attempt to combine these two insights into a simple explanation for consanguinity. We show that consanguinity and dowry are both mechanisms that lead to the establishment of credible commitments between families.

The crux of our model describes a marriage market characterized by positive assortative matching. A marriage is viewed as a contract in which two families make a long-term commitment to support their offspring through gifts, bequests and so forth. These also enhance the value of the match, and consequently the social status of each family. This need for joint commitment however, creates an *agency* or time-inconsistency problem: once links have formed and are costly to sever, each family may now prefer to invest in alternative opportunities, while free-riding on the other family's investments. To overcome this time-inconsistency, early transfers between families are viewed as an ex-ante alternative when ex-post investment commitments are not credible. In South Asia, where marriage is characterized by patrilocal exogamy, we postulate the commitment problem to be on the bride's side so that monetary transfers correspond to dowries. To this aspect, we add two extra features. First, the extent to which agents are time-inconsistent depends negatively on how closely related the partners are. Between

[1] Despite the popularity of consanguinity in Europe, the genetic implications of this practice was often derided in other continents: for example, on 5 March 1810 in a letter to the Governor of New Hampshire John Langdon, Thomas Jefferson wrote, 'The practice of Kings marrying only in the families of Kings, has been that of Europe for some centuries. Now, take any race of animals, confine them in idleness and inaction, whether in a stye, a stable or a state-room, pamper them with high diet, gratify all their sexual appetites, immerse them in sensualities, nourish their passions, let everything bend before them, and banish whatever might lead them to think, and in a few generations they become all body and no mind; and this, too, by a law of nature, by that very law by which we are in the constant practice of changing the characters and propensities of the animals we raise for our own purposes. Such is the regimen in raising Kings, and in this way they have gone on for centuries' (Bergh, 1907). For further information on consanguinity in earlier European generations, see Bittles and Egerbladh (2005).

cousins, ex-ante commitments are more credible arguably because informal contracts are easier to enforce within the extended family. Second, dowries are costly as they imply borrowing on the credit market in order to make payments at the time of marriage. Consequently, our model predicts that consanguinity and dowries substitute as instruments to overcome or mitigate the aforementioned time-inconsistency problem. The relative use of these two practices will depend on the associated costs. When marrying close kin, families forgo the benefits of gene diversification, risk hedging, or social network integration. On the other hand, costly dowry transfers are lost, hence not invested.

Our paper is closely related to the literature on dowry payments (see Anderson, 2007, for a thorough discussion). Much recent literature in economics argues that dowries may be one way of dealing with contracting problems in marriage markets (Caldwell, Reddy and Caldwell, 1983; Rao, 1993; Bloch and Rao, 2002; Jacoby and Mansuri, 2006; Botticini and Siow, 2003).[2] In addition, we emphasize that providing dowries is generally expensive.[3] If parents are unable to afford the cost, their only options may be to either delay their daughter's marriage (Anderson, 2008; Epstein, 1973:193), or else consider contracting a marriage with a relative with either reduced or non-obligatory dowry payments. Our model shows that it is this function — the alternative to high dowry payments in the presence of an agency problem— that plays a key role in motivating consanguinity in many parts of the world. Economic studies such as Becker (1981) for example, view these transfers as ex-ante compensations for ex-post loss of bargaining power. Building on this theory, Zhang and Chan (1999) argue that dowries have the exclusive property of increasing a wife's bargaining power by raising her threat point. This view however does not explain why such transfers should be taking place at the time of marriage, rather than later on during married life, and most importantly does not deliver predictions concerning observed patterns of consanguineous marriages. Our paper shares with Peters and Siow (2002) the property that an increase in spousal investment commitment increases the quality of the match. Our analysis however focuses on the time-inconsistency problem associated with the inability to pre-commit to such an investment. In depicting a negative correlation between consanguinity and the payment of a dowry at the time of marriage, our findings are entirely consistent with earlier observations made by sociologists and demographers (Centerwall and Centerwall 1966; Reddy 1993). Thus, it is pertinent to note that our model does not provide a theory of dowry per se nor does it attempt concretely to predict dowry amounts. Rather, it links dowries, bequests and consanguinity in a theory of the optimal *timing* of marital transfers.

Our data tests the central idea that consanguinity may be an inexpensive way for families to deal with the problem of dowry costs in rural marriage markets. We use data on 4,364 households from the 1996 Matlab Health and Socioeconomic Survey, conducted in 141 villages in Bangladesh. We find that women in consanguineous unions are, on average, 6-7 percent less likely to bring a dowry at marriage, after controlling for other attributes at the time of marriage, suggesting that consanguinity and dowry are substitutes. We also find that women marrying their cousins are on average 4 percent more likely to receive any form of inheritances. The negative relationship between dowry and consanguinity on the one hand, and the positive relationship between bequests and consanguinity on the other, for us is strong evidence in favor of consanguinity affecting the timing of marital transfers. In further analysis, we examine the determinants of consanguineous marriages and the role of socio-economic

[2] In the early literature on dowries, Caldwell, Reddy and Caldwell (1983) argue that in India, dowry payments 'order' a marriage market characterized by hypergamy (the practice of women marrying into wealthier families of the same caste), and that dowry serves as a compensation to the richer family for contracting the alliance (Caldwell, Reddy and Caldwell, 1983). A similar idea is stated in Rao (1993).

[3] Bloch and Rao (2002) provide evidence that in South Asia, the average dowry is six-times a families annual income. Anderson (2003) confirms this finding and also provides evidence that dowry payments are rapidly escalating in this area.

status. Regression results tend to confirm the hypothesis that more stringent credit constraints will lead to lower dowry payments and the higher prevalence of consanguinity.

We review important facts and findings related to consanguinity in Section 2. In Section 3, we carefully present and solve our model, as also discuss alternative economic and sociological explanations of consanguinity. Section 4 uses data from Bangladesh to test the main predictions of the theory. Section 5 concludes.

2 Consanguineous Marriages

In the field of clinical genetics, a consanguineous marriage is defined as "a union between a couple related as second cousins or closer, equivalent to a coefficient of inbreeding in their progeny of $F \geq 0.0156$" (Bittles, 2001).[4] This means that children of such marriages are predicted to inherit copies of identical genes from each parent, which are 1.56 percent of all gene loci over and above the baseline level of homozygosity in the population at large; the closer the parents, the larger the coefficient of inbreeding. A common concern is that consanguinity leads to higher levels of mortality, morbidity and congenital malformations in offspring due to the greater probability of inheriting a recessive gene (Schull, 1959, and Bittles, 1994). According to Bittles (2001), the highest level of inbreeding has been recorded in the South Indian city of Pondicherry, in which 54.9 percent of marriages were consanguineous, corresponding to a mean coefficient of inbreeding of 0.0449, considered very high by the standards of other populations. The existing research on consanguinity also shows that different kinds of consanguineous unions are favored by different sub-populations: for example, while Hindu women in South India typically marry their maternal uncles, Muslim populations favor first-cousin marriages (Iyer, 2002).[5] Amongst immigrant populations in the UK, those of Pakistani origin display a preponderance of consanguineous marriage, estimated to be as high as 50 to 60 percent of all marriages in this community (Modell, 1991).

Historically in Europe, consanguineous marriage was prevalent until the 20th century, and was associated with royalty and land-owning families (Bittles, 1994).[6] During the 19th and 20th centuries, consanguinity was practiced more in the Roman Catholic countries of southern Europe than their northern European Protestant counterparts (McCollough and O'Rourke, 1986). Since the 16th century in England, marriage between first cousins has been considered legal. The Marriage Act of 1949 laid down the kinds of marriage by affinity which are considered void, and this was modified by the Marriage (Prohibited Degrees of Relationship) Act of 1986. But close-kin marriages are not always legally permitted elsewhere. For example, in the United States, different states have rulings on unions between first cousins: in some states such unions are regarded as illegal; others go so far as to consider first-cousin marriage a criminal offence (Ottenheimer, 1996). Today in North America and Western

[4]The coefficient of inbreeding is the probability that two homologous alleles in an individual are identical by descent from a recent common ancestor.

[5]In South India, until the 1950s bridewealth rather than dowry was the preferred marriage system, and in West Bengal as well this was the preferred wealth transfer at the time of marriage. We are grateful to Alan Bittles for highlighting this point to us.

[6]Intermarriage among the aristocracy that occurred in Europe in previous centuries was not always in order only to retain land. As Annan (1999) documents carefully in his book on the social history of academic dons in Cambridge, Oxford and elsewhere in the UK, for several centuries, British academia was dominated by a handful of families suggesting that there was levels of intermarriage on an unprecedented scale in order to preserve power and influence on intellectual ideas. As Annan writes, this was responsible for sustaining an 'intellectual aristocracy' that gave not only social benefits to its members but power and influence over the history of ideas.

Europe, only 0.6 percent of marriages occur between first cousins (Coleman, 1980; Bundey et al 1990). However this refers to white populations only. The overall prevalence of consanguineous marriage, especially in Western European countries like France, Germany, The Netherlands and the UK is now likely to be of the order of 1-3 percent or more.[7] Although in overall terms the influence of consanguineous marriage in the world is declining over time, it is particularly popular in Islamic societies and among the poor and less educated populations in the Middle East and South Asia (Hussain 1999, and Bittles, 2001).[8]

The popularity of consanguineous marriage in some societies may be attributed to religious sanction that is provided to it. In Europe, Protestant denominations permit first-cousin marriage. On the other hand, the Roman Catholic Church requires permission from a diocese to allow them. The general consanguinity prescriptions in Islam are similar to those of Judaism. Judaism permits consanguineous marriage in certain situations, such as for example, uncle-niece unions, but the general prescriptions are similar to those of Islam. For understanding consanguinity in Bangladesh (which is focus of Section 3 of this paper), Islam and Hinduism are important. According to the institutional requirements of Islam in the Koran and the Sunnah10, "a Muslim man is prohibited from marrying his mother or grandmother, his daughter or granddaughter, his sister whether full, consanguine or uterine, his niece or great niece, and his aunt or great aunt, paternal or maternal". However, the Sunnah depict that the Prophet Mohammad married his daughter Fatima to Ali, his paternal first cousin; this has led researchers to argue that for Muslims in practice, first-cousin marriage follows the Sunnah (Bittles, 2001, and Hussain, 1999).[9]

Consanguineous marriage among Hindus in India has continued to occur despite the Hindu Marriage Act of 1955 which prohibited uncle-niece marriages, subsequently altered by the Hindu Code Bill of 1984 (Appaji Rao et al., 2002). One reason for this is because consanguineous marriage is tolerated by the Hindu scriptures.[10] In South Asia more generally, consanguineous unions were very common in the past and are common even today (Caldwell et al., 1983, and Bittles et al., 1993). Consanguinity in South Asia has been documented in sample surveys of the population (Reddy, 1993). There are also a number of anthropological and biological surveys of consanguinity among selected communities in southern India (Dronamaraju and Khan, 1963, Centerwall and Centerwall, 1966, and Reddy, 1993). More recent evidence of the incidence of consanguineous marriage comes from the National Family Health Survey (NFHS) 1992-93, which collected data from 25 Indian states and interviewed 89,777 ever-married women aged 13-49. The data show that 16 percent of marriages in India are consanguineous marriages, but that this varies from 6 percent in the north to 36 percent in the south (Banerjee and Roy, 2002). The evidence from NFHS also shows that consanguinity is still widespread in Karnataka, Tamil Nadu and Andhra Pradesh (IIPS and ORC Macro International, 1995, Bittles,

[7] We are grateful to Alan Bittles for these estimates.

[8] Dowry is widely practiced in Turkey, although some studies do highlight that such payments were higher in consanguineous marriages. In reality, this is thought to be purely symbolic as the money or property paid stayed within the natal family.

[9] deeds of the Prophet Mohammad and their application to various situations.

[10] We are grateful to Srilata Iyer for alerting us to the following examples of consanguineous marriage in Hindu mythology: In the Hindu epic poem the Mahabharata, the Hindu god Krishna's niece Sasirekha (the daughter of Krishna's brother Balarama) is given in marriage to Abhimanyu, the son of Krishna's sister Subhadra. Krishna and Subhadra themselves were offspring of Vasudeva; Subhadra was married to the warrior hero of the Mahabharata, Arjuna, whose mother Kunthi was Vasudeva'a sister. Thus, in this example from Hindu mythology, in two generations of the same family - Arjuna and Subhadra, Abhimanyu and Sasirekha - all married their first cousins. In the epic poem the Ramayana, the Hindu god Rama was married to Sita. Subsequently, Sita's father's brother's daughters Urmila, Sutakirti and Mandavi were given in marriage to Rama's three brothers, Lakshmana, Shatrugna and Bharata, evidence of more consanguineous marriages contracted in Hindu folklore.

et al., 1993). The rates of consanguineous marriage are as high as 52 percent in Tamil Nadu and 37 percent in Andhra Pradesh and Karnataka.[11] The practice also seems to vary by religion. In India, 23.3 percent of all Muslim marriages are consanguineous, compared to 10.6 percent of all Hindu marriages, 10.3 percent of all Christian marriages, and 17.1 percent of all Buddhist marriages (Bittles, 2003).[12]

3 The Economics of Consanguinity

The model we present belongs to the class of "agency models of marriage". Families are viewed as agents that invest in a joint project, the marriage of their offspring. However, the institution of marriage is characterized by two features: (i) dissolution (divorce) is costly, and (ii) marriage contracts are incomplete. The combination of these two features undermines the credibility of some ex-ante commitments on the part of the families. For example, in Jacoby and Mansuri (2006), the marriage contract is incomplete because the groom cannot commit ex-ante not to be violent towards his wife. Once the marriage takes place, he has incentives to engage in violent behavior to, among other things, extract rents from his in-laws (Bloch and Rao, 2002). The institution of *watta-satta* then emerges to alleviate this market failure. In the same class of models, Botticini and Siow (2003) argue that in patrilocal societies, daughters cannot commit to manage parental assets with the same care as their male siblings do once they get married. This implies that parental transfers will optimally take the form of dowries for daughters and bequests for sons. Another illustration applies to societies in which women inherit land, as marriages often lead to loss of control over land - i.e. power - by the bride's family. Thus, it is widely believed that consanguineous marriages among the wealthy are used to keep land and other productive assets within the extended family (Goody, 1986, Agarwal, 1994, Bittles, 2001, *The New York Times,* 23 September 2003).

In our model, altruistic parents make transfers to their children once they are married, and this also enhances the value of the match. At the time of marriage however, they are unable to contract on such future transfers, and as marriages are costly to dissolve, ex-ante commitments are no longer credible. In a patrilocal society, where a bride migrates to the home of her husband after marriage, the incentive to renege is likely to be particularly strong for the bride's parents, since they may prefer to direct their transfers to co-resident sons. As in Botticini and Siow (2003), dowries (or bride-prices) then become the second-best solution to this time-inconsistency problem. Finally, our model also demonstrates that social distance between the families of the bride and the groom can significantly influence the terms of the marriage contract. On the one hand, we assume that *ceteris paribus* social distance enhances the outcomes of marriage: families can diversify genes, hedge risks, smooth consumption or simply integrate their social networks (Rosenzweig and Stark, 1989; La Ferrara, 2003). On the other hand, shorter social distance acts as social capital by making ex-ante contracting between families easier: close relatives have more (verifiable) information about each other, are more likely to exert effort in economic activities, are less likely to engage in opportunistic behavior and are likely to show higher levels of trust, cooperation and altruism to both their natal and marital families (Putnam, 2000; Durlauf, 2000; Dasgupta and Serageldin, 2000).

[11] The exception though is Kerala, where a predominantly Christian population does not practice consanguineous marriage.

[12] There are, however, strong regional differences between religions, for example in southern India, consanguinity is more common among Hindus whereas in the western and northern areas, consanguinity is more common among Muslims (Banerjee and Roy 2002, Bittles 2003).

Our model thus delivers prediction on the optimal timing of marital transfers (dowries versus bequests) rather than on their sizes. Note that our argument is also couched in terms of a discussion of *dowry* for the sake of simplicity. We do emphasize however that our model could easily be applied to making predictions about *bride-prices* as well. Given that we are primarily modeling marriage markets in South Asia however, we make our argument in terms of dowry as the main form of transfer during marriage. We now proceed to a formal description of the forces at play.

3.1 The Model

Consider a continuum of potential spouses. Grooms and brides are assimilated to their families and are labeled $i \in I$, and $j \in J$ respectively. Spouse $k \in \{i, j\}$ comes from a family endowed with wealth w_k. A pair (i, j) is characterized by social distance $d_{ij} \in [0, 1]$. To abstract from marriage market squeeze issues (Rao, 1993), we assume that brides' and grooms' families are in equal number and have identical wealth distribution. The support of the wealth distribution is the interval $(0, w_{\max}]$. For each individual with wealth w, there exists a potential match who is at distance d, for all $d \in [0, 1]$.[13]

The timing of the economy is as follows:
- $T = 0$: Families choose a partner for their offspring by first designating a desired match. Couples (i, j) form when two families have elected each other. A marriage contract is then signed between the respective families. Ex-ante transfers (D_i, D_j) respectively from i to j (bride prices) and j to i (dowries) are made.
- $T = 1$: Ex-post transfers (z_i, z_j) respectively from i to j and j to i are made. Such transfers can for example be wealth transfers during parents' lifetime or bequests. Families invest (K_i, K_j) in the marital production function, output is realized and consumption takes place.

We make the assumptions that (i) marriage is always preferred to remaining single, and (ii) at $T = 1$, separation is too costly to be considered. Before completing the description of the marriage economy, here is the intuition for what will be modeled subsequently. At $T = 1$, once the marriage is celebrated, families hold each other up, and have an incentive to free ride on one's in-laws to contribute to the marital production function. In other words, each family will prefer that the other family divert resources to the married couple, and that they themselves divert their own resources towards more attractive investment or consumption opportunities. Thus, when enforcement is imperfect, it is not credible to pledge future transfers (in the form of wealth support or bequests) at $T = 0$. We therefore perceive dowries and bride prices as $T = 0$ transfers that mitigate the effects of such hold-up problem. Thus, in this model, dowries and bride prices do not capture the entire value of the transaction, but only the fraction to be paid upfront.

Marital Production Function We make the simplifying assumption that a marriage is a joint project characterized by a constant-returns-to-scale technology in which both families invest:

$$R\left(K|w_i, w_j, d_{ij}\right) = A\left(w_i, w_j, d_{ij}\right) K,$$

where K is the aggregate amount invested. We assume that the productivity parameter $A\left(w_i, w_j, d_{ij}\right)$ is continuously differentiable and increasing in w_i and w_j with positive cross-partial derivatives (as

[13] Individuals and their families can be thought of as being densely distributed over a cylinder, such that the vertical axis represents individuals' wealth w, and the angle between two individuals measures their distance (normalized by 2π). The wealth interval is open on the left. This technical requirement is addressed in the Appendix.

in Becker, 1973) and increasing and concave with respect to d_{ij}. In addition to monetary transfers, parents transmit social status to their children, share their social networks and political connections, which we assume to have a direct effect on their offspring's productivity; this effect is captured by the positive dependence of $A(.)$ on parental wealth. Second, $A(.)$ being a function of d is central to our paper, and models the idea that when spouses are further away, they can diversify genes, hedge risks, integrate their social networks, and so forth. Finally, agents have access to a storage technology with returns normalized to 1. This storage technology proxies for all investment or consumption opportunities outside the marital production function.

Marriage Contracts and the Cost of Equity A marriage contract specifies an investment commitment (z_i, z_j) and prior transfers (D_i, D_j) between the parents of the bride and groom. When an investment commitment is made, it is binding. However, due to contract incompleteness, parents cannot commit beyond the amount $(1 - d_{ij}) w_k$ where we recall that d_{ij} is the social distance between i and j. Such an assumption captures the idea that depending upon social distance, wealth in family j can be more difficult to observe for family i, and hence more difficult to pledge. When spouses are close $(d_{ij} = 0)$, they can commit their entire wealth ex-ante, while when they are very far away $(d_{ij} = 0)$, no commitment is credible.

Thus, for each couple (i, j), a *feasible* marriage contract (z_i, z_j, D_i, D_j) must satisfy for $k \in \{i, j\}$,

$$\begin{cases} z_k \in [0, (1 - d_{ij}) w_k] \\ z_k + D_k \in [0, w_k] \end{cases} \tag{1}$$

We also assume that the payment of dowries is costly. If a positive amount D is transferred by family k, $\gamma(w_k) D$ is lost in the transaction. $\gamma(.)$ is a decreasing function of wealth. $\gamma(w)$ can be viewed as the interest rate charged when borrowing money to make a transfer. Richer families can pledge collateral more easily, hence they enjoy lower interest rates. We can think of (D_i, D_j) as mutual gift exchanges or dowry and bride prices, so consider the net transfer from j to i :

$$D_{ij} = D_j [1 - \gamma(w_j)] - D_i [1 - \gamma(w_i)].$$

At the beginning of time $T = 1$, families thus have total wealth equal to $w_k + D_{-k} [1 - \gamma(w_{-k})] - D_k$ that they can choose to either save, or invest in the marital production function.

Preferences We implicitly assume some form of altruism on the part of the parents who value their offspring's marital product. We could also relax that assumption and invoke alternative rationales whereby parents value marital output because higher output implies higher transfers from their children or higher social status. However, we postulate that families do not capture the same share of the marital output. We assume that the output is divided between brides' and grooms' families according to exogenous shares $(1 - \alpha, \alpha)$, that are identical for all brides and grooms. Alternatively, the assumption can be interpreted as a divergence between the two families on the perceived value of marriage. Patrilocality or matrilocality are plausible institutional reasons why there might be a divergence between how much brides' parents and grooms' parents value marital production output.

In sum, the important reduced-form assumption of this model is (i) parents value marital output, and (ii) brides' parents and grooms' parents value such output differently. To a large extent, this assumption is also at the heart of the existence of dowries in Botticini and Siow (2003).[14] We will write $\alpha_i \equiv 1-\alpha$, and $\alpha_j \equiv \alpha$. For a given match (i,j), transfers (D_i, D_j) are made, and parents choose $T=1$ investment levels (K_i, K_j) so that the payoffs are given by

$$U_k\left(K_i, K_j, D_i, D_j\right) = \alpha_k A\left(w_i, w_j, d_{ij}\right)\left(K_i + K_j\right) - K_k + \left\{w_k + D_{-k}\left[1-\gamma\left(w_{-k}\right)\right] - D_k\right\},$$

where $k \in \{i,j\}$ and $-k$ denotes $k's$ spouse. Families' utilities are linear in wealth. Each family k captures a share α_k of the marital output, while enjoying their endowment w_k net of investment K_k and transfers (received and made). Besides, we assume that

$$A(0,0,0)\left[1-\gamma(0)\right] > 1, \tag{2}$$

a sufficient condition for investment in the marital production function to be socially optimal.

3.2 Optimal and Constrained-Optimal Marriage Outcomes

In our economy, there is a potential divergence of preferences between the two families after the marriage is contracted: each family has the incentive to divert their own resources elsewhere and rely on their child's in-laws to make transfers instead. Contract incompleteness prevents the Coase theorem from holding. We therefore describe the first-best outcome of the economy. Then, we let agents invest according to their preferences at time $T=1$ and discuss the optimal matching profile with associated marriage contracts.

Optimal marriage outcome The first-best outcome maximizes aggregate payoffs of all the families. On the intensive margin, as $T=0$ transfers are costly, $D_i^* = D_j^* = 0$ and (2) implies that $K_k^* = w_k$ for every $k \in I \cup J$, so that $K_{ij}^* = w_i + w_j$. Any match (i,j) is therefore characterized by aggregate payoffs

$$U_i^*\left(w_i, w_j, d_{ij}\right) + U_j^*\left(w_i, w_j, d_{ij}\right) = A\left(w_i, w_j, d_{ij}\right)\left(w_i + w_j\right).$$

Individuals invest their entire endowment in the marital production function. Turning to the extensive margin, strategic complementarity implies that assortative mating is the first-best outcome. Every "first-best" couple (i,j) is characterized by $w_i = w_j$ and $d_{ij}^* = 1$.

Constrained-optimal marriage outcome We now restrict to outcomes for which investments are $T=1$ incentive compatible. To characterize the constrained-first-best outcome, we solve the game backward. We look at parental behavior at $T=1$, once couples have formed and signed a feasible marriage contract of the form (z_i, z_j, D_i, D_j). Parents invest an amount K so as to maximize their reduced form payoff

$$V_k(K) = \alpha_k A\left(w_i, w_j, d_{ij}\right)\left(K + K_{-k}\right) - K$$

subject to

$$z_k \leq K \leq w_k - D_k + D_{-k}\left[1-\gamma\left(w_{-k}\right)\right]$$

The second constraint is the budget requirement: agents can invest their endowment net of transfers made or received. The first constraint indicates that parental transfers need to be at least as large

[14] In Botticini and Siow (2003) however the divergence is between the bride's parents and their daughter (in the form of cost of effort). Viewed from that perspective, our model stipulates an agency problem between the two families without specifying whether it is between parents on both sides, or between parents and children.

as the committed amount z, determined at signature of the marriage contract. For $k = i, j$, full investment will take place if and only if

$$\alpha_k A\left(w_i, w_j, d_{ij}\right) \geq 1 \tag{3}$$

otherwise families will invest the minimum committed amount $K_k^{**} = z_k$. Thus, depending on the values of α, we potentially have the following cases:

- case I: the marital production function is attractive enough for both families to be willing to invest their entire wealth.
- case II: the groom's family invests all the endowment net of transfers received and made, while the bride's family is not willing to go beyond the pre-committed amount.
- case III: the reverse holds
- case IV: neither of the two families has any incentive to invest in the marital production function, so that investments are strictly equal to commitment levels.

The institutional setting we aim at describing is characterized by patrilocal virilocality, wherein brides live with, or close to, the family of their husbands after marriage. Therefore, brides' parents might not value or perceive marital output as much as the in-laws of their daughter. They may have a strong incentive to divert resources from their married daughters to their co-resident married sons. Presumably, this is because they have more control over the transfers to their co-resident sons and reap greater returns from these transfers. In terms of parameters of our model, this translates in relatively lower values of α. The specific institution of dowry will emerge when we assume that α is low enough, corresponding to case II.[15]

The optimal marriage contract thus consists of maximizing total investment by spouses. This implies that $D_i^{**} = 0$, $D_j^{**} = d_{ij} w_j$ and $z_j^{**} = \left(1 - d_{ij}\right) w_j$. Under such an arrangement, a net dowry $D_{ij} = d_{ij} w_j \left[1 - \gamma\left(w_j\right)\right]$ is transferred from the bride's family to the groom's family so that parental aggregate payoffs are given by

$$U_i^{**}\left(w_i, w_j, d_{ij}\right) + U_j^{**}\left(w_i, w_j, d_{ij}\right) = A\left(w_i, w_j, d_{ij}\right)\left[w_i + w_j - \gamma\left(w_j\right) d_{ij} w_j\right].$$

Constrained-optimal investment levels are characterized by full-investment in the marital production function, but as opposed to the first-best solution, transfer costs are lost when the dowry is paid to the groom's family. As $\gamma\left(.\right)$ is a decreasing function of wealth, assortative matching is still optimal. The institution of dowry is then seen as an instrument to overcome the limited commitment ability of families. However, as social distance now determines dowry amounts, the constrained-first-best is characterized by an optimal distance $d\left(w\right)$ such that for each couple $\left(i, j\right)$ with wealth levels $w_i = w_j = w$, we have,

$$d\left(w\right) \in \arg\max_{d \in [0,1]} A\left(w, w, d\right)\left[2w - \gamma\left(w\right) dw\right]$$

The first-order condition for an interior solution gives

$$\frac{\partial A\left(w, w, d\right)}{\partial d}\left[2 - \gamma\left(w\right) d\left(w\right)\right] = \gamma\left(w\right) A\left(w, w, d\right), \tag{4}$$

which is necessary and sufficient as the reduced-form payoff function is concave in d.

[15] Namely, $\left(1 - \alpha\right) A\left(0, 0, 0\right) \geq 1$ and $\alpha A\left(w_{\max}, w_{\max}, 1\right) \leq 1$.

3.3 Time-Inconsistency and the Rationale for Dowries

The outcomes described previously were essentially normative and serve as benchmarks for further discussion. We now turn to the equilibrium analysis of the marriage market. We will show that there exists one equilibrium of the marriage market which is *as if* each spouse k faced a matching function $W_k(x)$ where $W_k(x)$ is the marriage endowment level of $k's$ spouse, when k credibly contributes a total of x into the relationship. Contribution x is divided between a commitment z, and a ex-ante transfer D. We will show that such an equilibrium exists, but for now, we assume for simplicity that it does. For both the groom and the bride, the time-inconsistency problem is inherently the same, but it is just not binding for grooms as long as $W_i(.)$ is non-decreasing, which we assume for now, but will prove later on (see Proposition below). We thus pay attention exclusively to the optimization problem on the bride's side. To better convey our intuition, we further suppose that $W_j(.)$ is differentiable with respect to x and $\alpha\left[1-\gamma(w_j)+W_j'(x)\right] \geq 1$ in the neighborhood of $x_j = w_j$.[16]

At $T = 0$, brides' families take $W_j(.)$, and grooms' investment strategies as given, and propose a feasible marriage contract (z_j, D_j) to groom i such that

$$\{z_j, D_j\} \in \arg\max_{\substack{0\leq z\leq(1-d_{ij})w_j \\ 0\leq z+D\leq w_j}} \alpha A\left(W_j(z+D), w_j, d_{ij}\right)\left[W_j(z+D)+z+D-\gamma(w_j)D\right]-z-D$$

At the equilibrium point, i.e. when $W_j(w_j) = w_j$ and social distance $d(w_j)$ is optimally chosen, the first-order conditions for interior solutions can be written as

$$\underbrace{\alpha A_j\left[1-\gamma(w_j)\right]}_{\text{Intensive margin}} + \underbrace{\alpha W_j'(w_j)\left\{\underbrace{A_j}_{\text{Quantity effect}} + \underbrace{\left[2w_j-\gamma(w_j)D\right]\frac{\partial A_j}{\partial w_i}}_{\text{Quality effect}}\right\}}_{\text{Extensive margin}} = 1 \tag{5}$$

where $A_j \equiv A(w_j, w_j, d(w_j))$ for simplification. The optimal contribution level trades off the opportunity cost of storage (normalized to 1) against the benefits from being matched with a wealthier groom.[17] The left-hand side of (5) captures such benefit. The first term, $\alpha A_j\left[1-\gamma(w_j)\right]$, is the intensive margin effect, similar to (3) at the difference that there is an extra $\left[1-\gamma(w_j)\right]$ term because the marginal dollar transferred takes the form of a dowry. The second term, absent from (3), captures the extensive margin effect and the rationale underlying the existence of dowries: an increase in the overall contribution of the bride, allows her to increase the wealth of her match by $W_j'(w_j)$. The benefit is then direct through an increased investment $\alpha W_j'(w_j)A_j$ – a "quantity" effect, and indirect through an increased productivity coefficient $\alpha W_j'(w_j)\frac{\partial A_j}{\partial w_i}$ – a "quality" effect. Under the assumption that $\alpha\left[1-\gamma(w_j)+W_j'(w_j)\right] \geq 1$, the solution hits a corner, and brides want to pre-commit $z_j + D_j = w_j$, so that the investment is constrained-optimal.

Comparing with the $T = 1$ problem, we see that the bride's family would like to commit at $T = 0$ an amount that they will however not be willing to disburse at $T = 1$. To overcome this time-inconsistency problem, the bride's family at the time of marriage, transfers control rights of part

[16] $W_k(.)$ are generally not differentiable, but the proof of the Proposition in the appendix shows that the argument discussed here is still valid.

[17] The envelope theorem implies that the effect of changes in the choice of the optimal social distance is of second-order.

or all of their assets to the groom's family, as they cannot commit to make such a transfer after the marriage is celebrated. We therefore view dowries as an ex-ante transfer of control rights when ex-post investment incentives are distorted.

Proposition: There exists an equilibrium of the marriage market which is constrained-optimal, and such that off-equilibrium strategies support a reduced-form game in which families maximize payoffs, taking the matching functions $W_i(.)$ and $W_j(.)$ described above as given.

Though the matching function $W_j(.)$ is not generally differentiable in w_j, the Proposition shows that in the general case, any small reduction h in the aggregate contribution of bride j decreases the wealth of her match by at least βh, where β is a positive constant. The tradeoff captured by (5) hence applies similarly and leads to a corner solution when β is large enough.

3.4 Credit Constraints, Wealth and Consanguinity

Another dimension that needs investigation is social distance. The Proposition established that there exists an equilibrium such that the social distance $d(w)$ between spouses of wealth w is given by (4) :

$$\underbrace{\frac{\partial A(w,w,d)}{\partial d}\left[2-\gamma(w)\,d(w)\right]}_{\text{marginal cost of consanguinity}} = \underbrace{\underbrace{\gamma(w)}_{\substack{\text{dowry}\\ \text{transfer cost}}} \quad \underbrace{A(w,w,d)}_{\substack{\text{opportunity}\\ \text{cost of investment}}}}_{\text{marginal agency cost}} . \tag{6}$$

The left-hand side of (6) measures the marginal cost of consanguinity. By construction, we assumed that marrying close kin would have a direct negative effect on payoffs because families cannot diversify genes thus increasing the risk of congenital diseases, having more limited ability to hedge risks across families (Rosenzweig and Stark, 1989), or for example, by amalgamating their social networks for better access to credit or labor markets (La Ferrara, 2003). The right-hand side of (6) may be termed the agency cost. Wealth is imperfectly observed and thus it translates into an agency problem. Increasing the distance between spouses increases the agency problem, requiring a larger dowry to be paid. This implies a larger dowry transfer cost, which is not invested and which translates into an opportunity cost of investment.

In summary, we have so far described a marriage market failure for which consanguinity and dowries are two distinct mitigating practices that act as substitutes. Dowries are an ex-ante transfer of control over assets to palliate a lack of ex-post incentives to invest. Consanguinity is a practice that directly reduces the agency problem. In so doing, (6) determines the optimal tradeoff between the two. One immediate implication relates to the prevalence of consanguinity when credit constraints are more stringent. Applying the implicit function theorem to (6) shows that for every wealth level w, the equilibrium distance $d(w)$ verifies

$$sgn\left[\frac{\partial}{\partial\gamma(w)}d(w)\right] = -sgn\left[d(w)\frac{\partial A(w,w,d)}{\partial d} + A(w,w,d)\right] \leq 0. \tag{7}$$

The intuition underlying (7) is straightforward. When credit constraints are more stringent *ceteris paribus*, dowries are more costly relative to close-kin marriage, so that equilibrium social distance decreases with the cost of equity.

A second implication of the analysis conducted so far is a comparative statics exercise with respect to wealth. Related to result (7), our model predicts that at low levels of wealth, the dowry transfer cost is large because credit constraints are more stringent, making consanguineous marriage an attractive alternative to dowry payments. However, if we re-examine the right-hand side of (6) , the tension between costs and benefits is also driven by the *opportunity cost* of investment. To see this more formally, and given that the second-order condition holds, we can determine the slope of the correspondence between distance and wealth levels by applying the implicit function theorem to (6):

$$sgn\left[d'(w)\right] = sgn\left\{\varepsilon_\gamma(w)\left[1+\varepsilon_A^d(w,d)\right] - \varepsilon_A^w(w,d)\right\} \tag{8}$$

where the elasticities are defined by $\varepsilon_\gamma(w) \equiv -w\frac{\gamma'(w)}{\gamma(w)}$, $\varepsilon_A^w(w,d) \equiv w\frac{\sum_{k=i,j}\frac{\partial}{\partial w_k}A(w,w,d)}{A(w,w,d)}$, and $\varepsilon_A^d(w,d) \equiv d\frac{\frac{\partial}{\partial d}A(w,w,d)}{A(w,w,d)}$. $\varepsilon_\gamma(.)$ captures the aforementioned cost-of-equity effect, while $\varepsilon_A(w,d)$ measures the opportunity-cost effect at the equilibrium point.[18]

The relative importance of these two effects will shape the behavior of social distance along the wealth dimension. There are two cases of interest. First, when the elasticity $\varepsilon_A^w(w,d)$ of the productivity parameter is low enough and is dominated by $\varepsilon_\gamma(w)$, then equation (8) predicts that social distance increases with wealth.[19] The intuition here has been discussed on several occasions. When (6) is mostly driven by the dowry transfer cost, poorer people are assumed to face more stringent credit constraints, translating into a larger cost of equity. Thus, poorer families will opt for consanguineous marriages as a viable alternative to dowries. Second, an augmented scenario consists of assuming that the opportunity-cost-of-investment effect binds at higher levels of wealth.[20] Then, at low levels of wealth, (8) is mostly driven by ε_γ or cost of equity: poor families face very steep losses when raising cash to pay for the dowry, and thus the gains to marrying close relatives are large. On the other hand, when wealth levels increase, ε_A^w eventually dominates: even though the loss from dowry transfers is lower, it translates into large opportunity costs of investment that call for narrower social distance between spouses. Thus, consanguinity might be more prevalent at the two extremes of the wealth distribution suggesting that the relationship between social distance and wealth may be inverted-U shaped.

[18] To avoid any interference due to the interaction between d and w through $A(w,w,d)$, we assume that $A(.)$ is separable in d and w.

[19] A sufficient condition is for example $\varepsilon_\gamma(w) \geq \varepsilon_A^w(w,d)$ for every w and d.

[20] Sufficient conditions could for example be that $\varepsilon_A^d(.)$ is bounded, so that there exists (m,M) such that for any w and d, $\varepsilon_A^d(.) \in [m,M]$, and (i) $\lim_{w\to 0}\frac{\varepsilon_A^w(w,d)}{\varepsilon_\gamma(w)} < m$, uniformly with respect to d : the interest rate curve is relatively steeper at low levels of wealth, and (ii) $\lim_{w\to+\infty}\frac{\varepsilon_A^w(w,d)}{\varepsilon_\gamma(w)} > M$, uniformly with respect to d : the productivity curve is relatively steeper at high levels of wealth. Functions $\gamma(w) = \gamma_0/w^\gamma$, with $\gamma > 0$, and $A(w_i,w_j,d) = e^{w_i} + e^{w_j} + d^\theta$, $\theta < 1$, would satisfy such requirements.

3.5 Summary of Testable Implications and Alternative Explanations

We have presented and analyzed a general equilibrium model of the marriage market characterized by positive assortative matching. In this market, parents commit wealth, which determines spousal "market value". However marriage contracts are incomplete, so that wealth commitments might not be credible. Thus, the institution of dowry emerges as a solution to time-inconsistency: parents pay ex-ante in the form of dowry what they cannot commit to transfer ex-post in the form of gifts, or bequests, etc. Our agency theory delivers predictions not as much on the size of transfers between families, as on the timing of such transfers. Because we stipulate that contract incompleteness is less severe among close-kin, consanguineous marriages are a viable alternative when the payment of dowries comes at a high cost. Thus, our model predicts that dowry and consanguinity are substitutes:

- **PREDICTION 1:** Dowry levels are lower in consanguineous marriages.

Symmetrically, if ex-ante payments are lower in consanguineous marriages, we should expect larger ex-post transfers.

- **PREDICTION 2**: Bequests or gifts to daughters are larger when they marry close kin.

How well consanguinity substitutes for dowries in part depends on the cost of dowry transfers. If credit constraints are stringent, then one might expect the consanguinity option to be more attractive.

- **PREDICTION 3:** Consanguinity is more prevalent in environments with more severe credit constraints.

We concluded our analysis with an investigation of the relationship between consanguinity and wealth. At low levels of wealth, credit constraints bind so we should observe higher prevalence of consanguineous marriages. At high levels of wealth, the convexity of the aggregate marital function might induce families to seek consanguineous unions to mitigate the opportunity costs of investments.

- **PREDICTION 4:** At low levels of wealth, consanguineous unions are less prevalent as couples' wealth increases. This pattern might be reversed at high levels of wealth.

We have argued theoretically that agency-related explanations of consanguinity are crucial in explaining why this phenomenon continues to occur in poor countries. Yet we acknowledge that this explanation might not be the only reason why economists might value understanding and studying consanguinity more, and so we now outline these alternative channels and discuss their empirical implications.

A first explanation for consanguinity is that it is the outcome of personal preference that is mediated by the influence of religion or cultural practice. As discussed in Section 2, much of the literature from sociology and biological anthropology is predicated on this assumption about consanguinity. The argument here is that because consanguinity is a practice that has enjoyed much support historically in certain populations, it continues to be popular among these communities to the present day. The basis for this support for consanguinity is the religious sanction that is provided to it. Yet this explanation does not explain sufficiently why this practice should continue even with changes in religious and cultural practices concerning marriage, or why this practice is unaffected by recent scientific evidence that suggests that undertaking such a marriage can increase the likelihood of congenital birth defects in the children of such unions. Therefore something other than culture is having an appreciable impact in sustaining this phenomenon in present day developing societies.

A second explanation is a natural implication of Rosenzweig and Stark (1989), whereby marriage is driven by an insurance motive. In an incomplete marriage market setting, kinship might offer a larger set of insurance contracts than non-kin marriages. Alternatively, if shocks within the extended family are more likely to be correlated, risk diversification would suggest that more risk-averse households will seek mates at further social distance.

A third explanation for consanguinity is that it may be a favored form of marriage simply because it can significantly reduce the costs of searching for a suitable partner. The central idea here is that since the bride and groom are generally known to each other prior to marriage, consanguineous marriages do not require families to screen each other, or perform any sort of 'due diligence' on each other's socio-economic status, kinship networks and reputation in the community. In many rural societies, this process can take considerable time as well as resources (Sander, 1995). Moreover, parents in consanguineous unions know their future selves-in-law and their families, reducing the uncertainty about the compatibility of spouses and families.

These alternative stories have some appeal in explaining the prevalence of consanguinity, but are mute on the interaction between consanguinity, bequests and dowries altogether. More specifically, one would expect that these models would predict that a positive (or negative) relationship between consanguinity and dowries, should also predict a positive (or negative) relationship between consanguinity and bequests. These are the predictions that contrast with Predictions 1 and 2 taken together that emphasize that dowries and bequests are optimally-timed transfers: a negative relationship between consanguinity and dowries is associated with a positive relationship between consanguinity and bequests.

We now move to the empirical section to test the predictions of our model, and discuss whether the alternative mechanisms presented above can be ruled out.

4 Empirical Evidence from Bangladesh

In this section, we use data from Bangladesh to test the key predictions of the theoretical model. The data are drawn from the *1996 Matlab Health and Socioeconomic Survey* (MHSS).[21] We also supplement these data with that on climate data on annual rainfall levels in the Matlab area for the period 1950-1996.[22] The 1996 MHSS contains information on 4,364 households clustered in 2,687 *baris* in 141

[21] This survey is a collaborative effort of RAND, the Harvard School of Public Health, the University of Pennsylvania, the University of Colorado at Boulder, Brown University, Mitra and Associates and the International Centre for Diarrhoeal Disease Research, Bangladesh (ICDDRB).

[22] Delaware Air and Temperature Precipitation Data" are provided by the NOAA-CIRES Climate Diagnostics Center, Boulder, Colorado, USA, from their Web site at http://www.cdc.noaa.gov/.

villages.[23] Matlab is an Upazila (subdistrict) of Chandpur district, which is about 50 miles South of Dhaka, the capital of Bangladesh. 85 percent or more of the people in Matlab are Muslims and remainders are Hindus. Although it is geographically close to Dhaka, the area has been relatively isolated and inaccessible to communication and transportation. The society is predominantly an agricultural society, although 30 percent of the population reports being landless. Despite a growing emphasis on education and increasing contact with urban areas, the society remains relatively traditional and religiously conservative (Fauveau, 1994).

For the purpose of understanding the incidence of consanguineous marriage in the MHSS data, we rely on the section of the survey that asked men and women retrospective information about their marriage histories. The sample includes 5083 married men, and 6068 married women at the time of the survey. Information on first marriages was considered.[24] Descriptive summary statistics of the variables of interest are provided in Table 1. A quick glance at the table does not reveal systematic differences in characteristics between the male and female samples. Admittedly, when looking at individual characteristics, males are more educated, and by construction of the data set are older. Of all the married women in the survey, 622 women (12 percent of all marriages) reported that they had married a first-cousin and 1045 women reported that they had married any sort of relative (including first- and second-cousins). It is interesting that 30 percent of women and only 17 percent of men report the payment of a dowry at the time of marriage. We believe the difference is in psychological biases in the interpretation of gifts and transfers as "dowries" between the giver (the bride) and the receiver (the groom): Since women want their dowries to improve their status and acceptance in their new home, they will have a tendency to interpret all gifts given at marriage as dowry. Men on the other hand, do not want to interpret all gifts as dowry, since doing so would reduce their bargaining position with the new bride. For the remainder of this paper, we use the female sample to carry out our analysis, and thus include in our definition of the dowry, all transfers that were paid at the time of marriage.[25]

4.1 Consanguinity and Dowries

A first test of the theoretical model involves examining the simple correlations between the payment of dowries and first-cousin marriages (Prediction 1). We regress the dummy variable *Dowry* on the various measures of consanguinity that were considered previously and control for age, education, and socioeconomic status at the time of marriage. We also control for deviations of rainfall from average values when the woman was of marriageable age.[26] The results are presented in Table 2. The results

[23] The *bari* is the basic unit of social organization in Matlab (Fauveau, 1994). *Bari* literally means "homestead", but commonly refers to a cluster of households in close physical proximity. The households are generally located around a common yard and may share resources such as a tube-well, a cowshed, latrine, and/or several jointly owned trees.

[24] 15 percent of men and about 7 percent of women who reported that they have had more than one marriage. This difference is driven by the fact that while divorced and widowed men typically remarry, most women in these same circumstances do not (Joshi, 2004).

[25] The dowry question was asked in two ways. Respondents were asked whether or not they paid a dowry at the time of marriage(this is a binary variable) and whether this took the form of bride-wealth or gifts and transfers to the woman's in-laws. Respondents were also asked to provide an estimate of the dowry's value. In the analysis ahead, we use both the binary indicator as the logarithm of the dowry values. In constructing the series of the logarithm of the dowry value, we assign a value of 1 taka in cases where no dowry transfer is reported.

[26] The main rationale for including this variable is that even though the whole region remains at risk of flooding each year, the actual patterns of rainfall can be heterogeneous and some villages get more flooded than others, with greater damage to movable as well as immovable property that may impact the demand as well as supply of dowries. This heterogeneity is not completely absorbed by year-of-marriage or village fixed effects.

in Panel A indicate that compared to women who marry non-relatives, women who marry their first-cousins are 8 percentage points less likely to bring a dowry. When control variables are added to the regression, women who marry their first-cousins or other relatives are still 7 percentage points less likely to bring a dowry. Considering that in this population, about 30 percent of all women report the payment of a dowry at the time of marriage, this is a substantial and important difference. The results are similar if we expand the definition of consanguinity to include marriages between second-cousin and other types of marriages between relatives. It is interesting however that marriage to non-kin within a village is not related to the payment of dowry in any statistically significant way. This suggests that marriage to a non-relative within the same village and marriage to a cousin are rather different. The reduction in dowry has more to do with the particular form of social capital that is associated with kinship rather than just familiarity and trust that comes from residing in close proximity.

Alternatively, we use the logarithm of the dowry values as a dependent variable and obtain similar qualitative results for marriages between relatives (Table 2, Panel B). After controlling for individual, household characteristics and year of marriage fixed-effects, the results show 10 percent lower dowry values among consanguineous unions.

The relationship between dowry and consanguinity over time can be observed in Figure 1. Dowries in Matlab have been increasing, while the practice of consanguinity has been falling. Our model tells a story consistent with the observed trends: in a setting where improvements in transportation and communication allow individuals to search over greater geographic distances for matches at larger social distances, the problem of ex-ante commitment becomes greater, calling for the payment of higher levels of dowry in marriages between individuals who are outside the family network.

4.2 Consanguinity and Bequests

At the heart of our model, there is an intertemporal shift of transfers: what cannot be committed to be paid ex-post (in the form of gifts and bequests) will be transferred ex-ante (in the form of dowries). Thus, the model predicts higher bequests to women in consanguineous unions (Prediction 2). Table 3 (columns 1–4) reports the results of the regressions of inheritance measures on the consanguinity variable and a list of controls. The observations are restricted to the female sample. The positive and significant estimates are consistent with Prediction 2: women in consanguineous unions are more likely to receive or expect to receive transfers from their parents. On the contrary, when we focus on the male sample, these results do not hold (Table 3, columns 5–8). This asymmetry is consistent with our model that postulates a one-sided agency problem.

In Panel B of Table 3, we regress inheritance variables on a dowry variable. The relationship between inheritance and dowry is not as clear cut because wealthier families leave large bequests and are more likely to pay larger dowries, everything else remaining constant. The wealth effect suggests a positive correlation between dowries and bequests, while our theory predicts a negative correlation. The net effect is thus uncertain. The results in columns 1 to 4 actually suggest that women who bring higher levels of dowry into their marital homes do not necessarily receive lower levels of inheritances from their own parents. Panel B of Table 3 (columns 5–8) presents the results from the sample of adult men that indicate that the wealth effect dominates: larger dowries are associated with a higher likelihood of receiving bequests.

The two results obtained previously — the negative relationship between dowry and consanguinity, and the positive relationship between bequests and consanguinity — together provide strong support for our model. As we have emphasized several times in this paper thus far, the key implication of our model concentrates more on the timing of transfers rather than their overall magnitude. An agency-theory of marriage predicts that the negative relationship between dowry and consanguinity is associated with a positive relationship between bequests and consanguinity.

These two findings cannot be easily reconciled with other models of consanguinity. Recall the two alternative mechanisms we proposed at the end of Section 3: (i) consanguinity may be the outcome of preferences, cultural or religious norms; and (ii) consanguinity may help alleviate the search time and search costs in marriage markets. Both explanations may suggest that a bride's family may pay higher transfers (in the form of bequests or dowries) to a daughter who marries a cousin, presumably because they value the match more, or pass on the savings from reduced search costs. On the other hand, we could expect the same from the groom's family, making the total effect ambiguous. But even if the direction of the effect could be resolved, the prediction for consanguinity and transfers would apply to *total* transfers to the married couple, with no distinction between dowries and bequests. In other words, these two alternative theories could well predict a negative relationship between dowry and consanguinity (Prediction 1), but would then also predict a negative relationship between bequests and consanguinity, which contradicts Prediction 2 and the empirical findings supporting it. In that sense, the joint empirical relevance of Predictions 1 and 2 are a unique feature of agency theories of consanguineous marriages.

4.3 The Determinants of Consanguineous Marriages

Our next step estimates reduced form regressions of a dummy variable describing a consanguineous match on various measures of an individual and her family's socioeconomic status at the time of marriage. To understand the role of wealth and credit constraints in contracting consanguineous marriages, we begin by examining the bivariate relationships between consanguineous marriage, dowry and measures of wealth at the time of marriage. Since MHSS is a cross-sectional survey, information on pre-marital wealth levels is rather limited. Our first proxy is simply the value of father's landholdings. Since land markets in rural South Asia are known to be thin (UNDP, 2000), we rely on measures of current landholdings (or landholdings at the time of father's death) as a proxy for past landholdings. As an additional measure of socio-economic status, we also consider a measure of current household assets. For the sample of women, this is the measure of asset-holdings of the household that she currently resides in, i.e. her in-law's or husband's home. Since marriage contracts are likely to transfer assets between the two households, considering both measures provides a more comprehensive insight into the relationship between consanguinity and socio-economic status.

Bivariate relationships between consanguineous marriage (as defined by being married to a first-cousin) and measures of wealth are first examined. Smoothed kernel plots are depicted in Figure 2. Note that the relationship is non-monotonic: the practice of consanguineous marriage is higher at the two extremes of the wealth distribution than in the middle, as predicted by our theoretical model (Prediction 4). As a further test of the theory, we also examine the relationship between dowry and the same measures of wealth. These are depicted in Figure 3. Note that the relationship is again non-monotonic, and the practice of dowry is lower at the extremes of the distribution than in the middle.

The robustness of these relationships is econometrically explored in Table 4. The results in Panel

A of Table 4 confirm that the incidence of consanguineous marriage decreases with the increase in the value of father's farmland (the results are statistically significant at the 10 percent level). In other words, consanguineous marriages are more common among poorer (and likely credit-constrained) households (Prediction 3). Panel B estimates the same functional form, with dowry measures on the left-hand side instead. As expected, the coefficients have opposite signs, consistently with the negative association between consanguinity and dowry payments (Prediction 1). The non-monotonic relationship between dowry and assets is weaker, probably due to the wealth effect we mentioned in the previous section.

Taken together, the results of Table 4 suggest that as families get wealthier (starting from an initial condition of low levels of wealth), credit constraints may weaken and the family is able to search for a groom outside the kinship network by providing higher levels of dowries for their daughters. These results are also consistent with the results of Mobarak, Kuhn and Peters (2006), who use a difference-in-differences framework to postulate that the construction of an embankment in Matlab several years prior to the 1996 data created a positive wealth shock for some households, who were then able to pay higher dowries for their daughters and were less likely to enter into consanguineous marriages.

Table 4 also examines the relationship between cousin marriage, dowry and age at marriage. When marriage takes place at an early age, parents might face steeper cash constraints as they have had less time to accumulate assets. Prediction 3 suggests that a consanguineous union might be chosen instead. The results in Table 4, panel A and B are suggestive of the hypothesis: the coefficients for the variable "Age at Marriage" are negative though not significant in Panel A, and consistently positive and statistically significant in Panel B. Graphically, this hypothesis is presented in Figure 4, which presents the bivariate relationships between these variables: an increase in the age at marriage is associated with an increase in dowry payments and a decrease in the likelihood of cousin-marriage. Admittedly, age at marriage, dowry and consanguinity are joint decisions, so that the results need to be interpreted with caution. We attempted also to use the age at menarche as an instrument for the age at marriage, but the results are not robust, possibly because socio-economic factors that affect nutrition are likely to influence the onset of puberty, or because other things might be happening at the time of menarche (e.g. girls are withdrawn from school by their parents), invalidating the proposed instrumental variable.[27]

These empirical findings on the relationship between wealth and consanguinity are consistent with the observation cited previously that consanguineous marriages have often been favored by the wealthiest (and also poorest) segments of society. As mentioned in section 3, much research has speculated that consanguineous marriages are favored by wealthy families as a means of keeping assets within a single family, and thus enhancing the power and social status of the family. Our model also predicts such patterns under some mild structural assumptions (Prediction 4). In any case, our findings are consistent with the broader class of agency models of marriage, whereby consanguinity offers the social capital necessary to sign contracts that otherwise would not be enforced.

[27] We have also considered using rainfall data to construct an instrumental variable (rainfall shocks affecting wealth and credit access), but the lack of significance in the first stage did not allow us to pursue this strategy further. This is probably due to a lack of geographical variation and limited sample size.

5 Conclusion

This paper has argued that consanguinity is a response to a marriage market failure in developing countries. The starting point of our analysis is the recognition that dowries exist across many societies, and that consanguinity is also pervasive across many parts of the world. We propose a theoretical model of the marriage market to reconcile the existence of these two facts. We argue that these two social practices together address an agency problem between spouses' families and then provide empirical evidence that corroborates the central predictions of the model. By focusing on the economic underpinnings of consanguineous marriage, we help explain the seeming puzzle of why consanguineous marriage continues to take place in modern times in developing countries, despite the pervasive knowledge that such marriages may lead to a greater likelihood of congenital birth defects. In so doing, we encourage a reappraisal of marriage markets in such contexts.

6 References

1. Alchian A and H Demsetz (1972), 'Production, information costs and economic organization' *American Economic Review* 62.

2. Anderson, S. (2003) "Why Dowry Payments Declined With Modernization in Europe but are Rising in India", *Journal of Political Economy*, 111(2): 269–310.

3. Anderson, S. (2007), 'The Economics of Dowry and Brideprice' *Journal of Economic Perspectives*, 21(4): 151-174.

4. Anderson, S. (2008), 'Why the marriage squeeze cannot cause dowry inflation?' *Journal of Economic Theory*, forthcoming.

5. Annan, N. (1999) *The Dons: Mentors, Eccentrics and Geniuses.* Chicago: University of Chicago Press.

6. Appaji Rao N, HS Savithri and AH Bittles (2002), "A genetic perspective on the South Indian tradition of consanguineous marriage" In *Austral-Asian Encounters* (eds. C Vanden Driesen and S Nandan), 326-341. Prestige Books: New Delhi.

7. Banerjee SK and TK Roy (2002), "Parental consanguinity and offspring mortality: The search for possible linkage in the Indian context", *Asia-Pacific Population Journal* 17 (1): 17-38.

8. Bardhan, P (1984) *Land, Labor and Rural Poverty: Essays in Development Economics* London: Oxford University Press.

9. Becker, G (1973) "A Theory of Marriage: Part I", *Journal of Political Economy* 81(4): 813-46.

10. Becker, G (1981) *A Treatise on the Family.* Cambridge: Harvard University Press.

11. Bergh, AE ed. (1907) *The Writings of Thomas Jefferson, Vol. XII*, The Thomas Jefferson Memorial Association of the United States, Washington DC.

12. Berham J., and M. Rosenzweig (2006), "Parental Wealth and Adult Children's Welfare in Marriage", *Review of Economics and Statistics,* 88 (3): 496-509.

13. Besley, T and Coate, S (1995) 'Group lending, repayment incentives and social collateral', *Journal of Development Economics*, February, 46(1): 1-18.

14. Bittles AH (2003), "Endogamy, consanguinity and community genetics", Centre for Human Genetics Working Paper, Edith Cowan University, Perth.

15. Bittles AH (2001), "Consanguinity and its relevance to clinical genetics", *Clinical Genetics,* 60: 89-98.

16. Bittles, AH (1994), "The Role and Significance of Consanguinity as a Demographic Variable", *Population and Development Review*, 561-584.

17. Bittles AH, JM Cobles and N Appaji Rao (1993), "Trends in consanguineous marriage in Karnataka, South India, 1980-1989", *Journal of Biosocial Science* 25(1): 111-116.

18. Bittles AH, WM Mason, J Greene and N Appaji Rao (1993), "Reproductive behavior and health in consanguineous marriages", *Science New Series* 252(5007): 789-794.

19. Bloch, F and V Rao (2002), "Terror as a Bargaining Instrument: A Case Study of Dowry Violence in Rural India", *The American Economic Review* 92(4): 1029-1043.

20. Botticini M, and A Siow (2003), "Why Dowries?", *The American Economic Review* 93(4): 1385-98.

21. Caldwell JC, PH Reddy and P Caldwell (1983), 'The causes of marriage change in South India', *Population Studies* 37(3): 343-361.

22. Centerwall WR and SA Centerwall (1966), "Consanguinity and congenital anomalies in South India: A pilot study", *Indian Journal of Medical Research* 54: 1160-67.

23. Coleman, DA (1980), "A note on the frequency of consanguineous marriages in Reading, England in 1972-73", *Human Heredity* 30(5): 278-285.

24. Dasgupta, P (1993), *An Inquiry into Well-being and Destitution,* Oxford: Clarendon Press.

25. Dasgupta, P. and I. Serageldin (2000), *Social Capital: A Multifaceted Perspective,* Washington DC: The World Bank.

26. Dronamaraju, KR and P. Meera Khan (1963), "The frequency and effects of consanguineous marriages in Andhra Pradesh", *Journal of Genetics* 58:387-401.

27. Durlauf, S. (2000), 'On the Empirics of Social Capital', *The Economic Journal,* 112 (483), pp.459-479.

28. Epstein, T. Scarlett (1973). *South India: Yesterday, Today and Tomorrow.* London: Macmillian.

29. Fauveau, V. ed. (1994), "Matlab: Women, Children and Health ", International Center for Diarrhoeal Disease Research, Bangladesh.

30. Galor, O and J Zeira (1993), "Income distribution and Macroeconomics", *Review of Economic Studies* 60(1): 35-52.

31. Hussain, R (1999) "Community perceptions of reasons for preference for consanguineous marriages in Pakistan", *Journal of Biosocial Science* 31: 449-461.

32. Hussain, R and AH Bittles (2000), "Sociodemographic correlates of consanguineous marriage in the Muslim population of India", *Journal of Biosocial Science* 32: 433-442.

33. International Institute of Population Sciences, Mumbai, and ORC Macro International (1995) *National Family Health Survey 1992-93.* Mumbai: IIPS

34. Iyer, S (2002), *Demography and Religion in India*. Delhi, Oxford and New York: Oxford University Press.

35. Jacoby, H and G Mansuri (2006), “Watta Satta: Exchange Marriage and Women’s Welfare in Rural Pakistan”, manuscript, The World Bank.

36. Joshi, S (2004) “Female Household-Headship in Rural Bangladesh: Incidence, Determinants and Impact on Children’s Schooling” Growth Center Discussion Paper #94, Yale University.

37. La Ferrara, E (2003) “Kin Groups and Reciprocity: A Model of Credit Transactions in Ghana”, *The American Economic Review* 93(5): 1730-51.

38. Lewis, W. A. B. (1954), ’Economic Development with Unlimited Supplies of Labor’, *The Manchester School,* 22, May: 139-191.

39. Maian A and R Mushtaq (1994), “Consanguinity in population of Quetta (Pakistan): A preliminary study”, *Journal of Human Ecology* 5: 49-53.

40. McCullough JM and O’Rourke DH (1986), “Geographic distribution of consanguinity in Europe”, *Annals of Human Biology* 13: 359-368.

41. Modell, B (1991) “Social and genetic implications of customary consanguineous marriage among British Pakistanis”, *Journal of Medical Genetics* 28: 720-723.

42. Mobarak, A. M., R Kuhn and C Peters (2006), “Marriage Market Effects of a Wealth Shock in Bangladesh”, manuscript, Yale University.

43. Ottenheimer, M (1996), *Forbidden relatives – the American Myth of Cousin Marriage*. Chicago: University of Illinois Press.

44. Peters M, and A Siow (2002), “Competing Premarital Investments”, *Journal of Political Economy* 110(3): 592-608.

45. Putnam, R. (2000), *Bowling Alone: The Collapse and Renewal of American Community.* Connecticut New York: Simon abd Schuster.

46. Rao, V (1993), “The Rising Price of Husbands: A Hedonic Analysis of Dowry Increase in Rural India”, *Journal of Political Economy* 101(3): 666-77.

47. Rao, PSS and SG Inbaraj (1977), “Inbreeding in Tamil Nadu, South India”, *Social Biology* 24: 281-288.

48. Reddy, PG (1993), *Marriage practices in South India*, Madras: University of Madras.

49. Rosenzweig, M and O Stark (1989), “Consumption Smoothing, Migration, and Marriage: Evidence from Rural India”, *Journal of Political Economy* 97(4): 905-26.

50. Sander, W (1995), *The Catholic Family,* Boulder: Westview Press.

51. Schull WJ (1959), “Inbreeding effects on man”, *Eugenics Quarterly* 6:102-109.

52. Udry, C (1990), ‘Credit markets in northern Nigeria: Credit as insurance in a rural economy’ *World Bank Economic Review* 4/3.

53. United Nations Development Program (2000), *Poverty and Distribution of Land*, by Keith Griffin, Azizur Rahman Khanand Amy Ickowitz.

54. Walker TS and JG Ryan (1990), *Village and Household Economies in India's Semi-arid Tropics.* Baltimore: Johns Hopkins University Press.

55. Zhang J and W Chan (1999), "Dowry and Wife's Welfare: A Theoretical and Empirical Analysis", *Journal of Political Economy* 107(4): 786-808.

Appendix

Before we outline our proofs, we first formally define the game, the strategies and the equilibrium concept. As we require equilibria to be subgame perfect, we only consider the $T = 0$ reduced-form game, as sub-game strategies have been discussed at length previously.
Timing and Strategies: Each family i and j announce a choice $j(i)$ and $i(j)$ respectively, and a couple (i, j) forms when $i = i(j)$ and $j = j(i)$. Each family k proposes a contract profile $\{z_k, D_k\}_{k \in I \cup J}$, where z_k is the amount committed by k, and D_k is the transfer made from k to $-k$. By convention, when no offer is made, we write $\{z, D\} = \varnothing$. We furthermore restrict ourselves to feasible contracts defined by (1) only. If an individual fails to find a spouse, his or her payoff is set to $-\infty$. Once marriage is celebrated, transfers (D_i, D_j) take place but spouse k only receives $D_{-k}[1 - \gamma(w_{-k})]$ as a result of transaction costs. Payoffs for each couple (i, j) are then

$$U_i(z_i, z_j, D_i, D_j | d_{ij}, w_i, w_j) = \alpha_i A(w_i, w_j, d_{ij})[w_i + z_j + D_j(1 - \gamma(w_j)) - D_i], \tag{9}$$

and

$$\begin{aligned} U_j(z_i, z_j, D_i, D_j | d_{ij}, w_i, w_j) &= \alpha_j A(w_i, w_j, d_{ij})[w_i + z_j + D_j(1 - \gamma(w_j)) - D_i] \\ &\quad + D_i[1 - \gamma(w_i)] + (w_j - z_j - D_j). \end{aligned} \tag{10}$$

Equilibrium definition: A match profile $\{(i, j)\}_{i \in I, j \in J}$ with associated marriage contract profile $\{(z_k, D_k)\}_{k \in I \cup J}$ is an equilibrium if there exists $\upsilon > 0$, such that there is no pair of couples (i, j) and $(\hat{\imath}, \hat{\jmath})$ respectively characterized by wealth endowments (w_i, w_j) and $(w_{\hat{\imath}}, w_{\hat{\jmath}})$, social distance d_{ij} and. $d_{\hat{\imath}\hat{\jmath}}$, who signed a feasible contract $\{(z_k, D_k)\}_{k=i,j}$ and $\{(z_{\hat{k}}, D_{\hat{k}})\}_{\hat{k}=\hat{\imath},\hat{\jmath}}$ and: (i) either $\hat{\imath}$ proposes to j a feasible contract $\left\{\left(\hat{z}_k, \hat{D}_k\right)\right\}_{k=\hat{\imath},j}$ such that

$$\left|\hat{z}_j + \hat{D}_j - (z_j + D_j)\right| < \upsilon \text{ and } \left|\hat{z}_{\hat{\imath}} + \hat{D}_{\hat{\imath}} - (z_{\hat{\imath}} + D_{\hat{\imath}})\right| < \upsilon,$$

$$U_{\hat{\imath}}\left(\hat{z}_{\hat{\imath}}, \hat{z}_j, \hat{D}_{\hat{\imath}}, \hat{D}_j | d_{\hat{\imath}j}, w_{\hat{\imath}}, w_j\right) \geq U_{\hat{\imath}}(z_{\hat{\imath}}, z_{\hat{\jmath}}, D_{\hat{\imath}}, D_{\hat{\jmath}} | d_{\hat{\imath}\hat{\jmath}}, w_{\hat{\imath}}, w_{\hat{\jmath}}),$$

and

$$U_j\left(\hat{z}_{\hat{\imath}}, \hat{z}_j, \hat{D}_{\hat{\imath}}, \hat{D}_j | d_{\hat{\imath}j}, w_{\hat{\imath}}, w_j\right) \geq U_j(z_i, z_j, D_i, D_j | d_{ij}, w_i, w_j)$$

with one inequality holding strictly, (iii) or the reverse: $\hat{\jmath}$ proposes i a feasible contract such that $\left|\hat{z}_{\hat{\jmath}} + \hat{D}_{\hat{\jmath}} - (z_{\hat{\jmath}} + D_{\hat{\jmath}})\right| < \upsilon$ and $\left|\hat{z}_i + \hat{D}_i - (z_i + D_i)\right| < \upsilon$, and that does not make any them worse-off, while making one of the two strictly better-off.

In other words, an outcome is an equilibrium if it is locally optimal for every agent in the economy. We finally define for each w, $d(w)$, the solution to $\max_{d\in[0,1]} A(w,w,d)[2w-\gamma(w)dw]$. Concavity with respect to d implies that $d(w)$ is well-defined and $d(w)\in(0,1)$.

Proof of Proposition: Let's consider the following strategies. Every groom $i\in I$, chooses $j(i)$ such that $w_i=w_{j(i)}$ and $d_{ij(i)}=d(w_i)$ as defined by (4). Similarly, j chooses $i(j)$ such that $w_j=w_{i(j)}$ and $d_{i(j)j}=d(w_j)$. On and off equilibrium transfers are given by $\{z_i,D_i\}=\{(1-d_{ij})w_i,0\}$ and $\{z_j,D_j\}=\{(1-d_{ij})w_j,d_{ij}w_j\}$ for grooms and brides respectively. Such strategy profile leads to a constrained-optimal marriage outcome as described in section 3.2. To see that this is an equilibrium, let's characterize brides and grooms response functions. First, if the distance between the two families is not characterized by (4) there are strict Pareto gains to form different pairs. Moreover, contracts are not binding as far as grooms are concerned. However, if we suppose that grooms can credibly commit to invest less in a relationship than their entire wealth, for every groom $i\in I$, we define $W_i(x)$ the wealth of i's match if i ends up investing x in the relationship.

$$\Gamma_i(x)=\{j\in J,\ A(w_i,w_j,d_{ij})[x+w_j-[1-\gamma(w_j)]]\geq A(w_j,w_j,d(w_j))[2w_j-[1-\gamma(w_j)]d(w_j)w_j]\}$$

is such that

$$\Gamma_i(x)\subseteq\Gamma_i(x')\text{ if and only if }x\leq x'$$

so that $W_i(x)$ is non-decreasing. Furthermore, we have $W_i(w_i)=w_i$. The maximization of (9) subject to matching function $W_i(.)$ implies that a groom's family always announces the highest possible commitment. Now take a bride $j\in J$, with wealth w_j. The case we need to consider is when a bride j with wealth w_j prefers to marry of groom i with wealth $w_i<w_j$ but in exchange can obtain a lower level of marital commitment. Suppose that j decides to reduce her commitment by an amount $0<h<w_j$, so that her contribution is now $x=w_j-h$. As $w_j\in(0,w_{\max}]$, h exists. This reduction will be a reduction in the dowry, as it is relatively more expensive. For any potential $i\in I$, the net investment made in the relationship is equal to

$$w_i+w_j-\gamma(w_j)d_{ij}w_j-h[1-\gamma(w_j)]. \tag{11}$$

We want to determine β such that groom i with wealth $w_i=w_j-\beta h>0$ will refuse an offer from j. First, we can see that $\beta<1$, so that such groom i is well-defined. Second, the equilibrium payoff of family i is given by $U^{eq}(w_j,\beta,h)=A^{eq}(w_j,\beta,h)K^{eq}(w_j,\beta,h)$, where $A^{eq}(w_j,\beta,h)=A(w_j-\beta h,w_j-\beta h,d(w_j-\beta h))$, and $K^{eq}=2w_j-2\beta h-\gamma(w_j-\beta h)d(w_j-\beta h)(w_j-\beta h)$, while the payoff of family i if she accepts the offer from j is $U^{dev}(w_j,\beta,h)=A^{dev}(w_j,\beta,h)K^{dev}(w_j,\beta,h)$, where $A^{dev}(w_j,\beta,h)=A(w_j-\beta h,w_j,d(w_j,\beta,h))$ and $K^{dev}(w_j,\beta,h)=2w_j-\beta h-h-\gamma(w_j)(d(w_j,\beta,h)w_j-h$ in which $d(w_j,\beta,h)$ is the optimal distance between i and j. A Taylor expansion around w_j gives
$K^{eq}(w_j,\beta,h)=K^{dev}(w_j,\beta,h)+h[1-\beta-\gamma(w_j)(1-\beta d(w_j-\beta h))+\beta\gamma'(w_j)d(w_j-\beta h)w_j]+o(h)$,
where $o(h)$ is a continuous function of h such that $\lim_{h\to0}\frac{1}{h}o(h)=0$. Note that the envelope theorem implies that $d(w_j,\beta,h)=d(w_j-\beta h)+o(h)$. Similarly, looking at the productivity coefficient,
$A^{eq}(w_j,\beta,h)=A^{dev}(w_j,\beta,h)-h\left[\beta\frac{\partial}{\partial w_j}A^{eq}(w_j,\beta,h)\right]+o(h)$.
Combining these equalities, we obtain
$U^{eq}(w_j,\beta,h)=U^{dev}(w_j,\beta,h)+h\left[A^{dev}(w_j,\beta,h)\Theta(\beta)-\beta\frac{\partial A(w_j,\beta,h)}{\partial w_j}K^{dev}(w_j,\beta,h)\right]+o(h)$
where $\Theta(\beta)=1-\beta-\gamma(w_j)[1-\beta d(w_j-\beta h)]+\beta\gamma'(w_j)d(w_j-\beta h)w_j$.
An additional Taylor expansion around w_j yields
$U^{eq}(w_j,\beta,h)=U^{dev}(w_j,\beta,h)+h\left[A(w_j,w_j,d(w_j))\Theta(\beta)-\beta\frac{\partial A(w_j,w_j,d(w_j))}{\partial w_j}(2w_j-\gamma(w_j)d(w_j)w_j)\right]+$
$o(h)$

Thus,

$$U^{eq}\left(w_j,\beta,h\right)>U^{dev}\left(w_j,\beta,h\right)$$

if and only if

$$\beta<\beta_j\equiv\frac{1-\gamma\left(w_j\right)}{w\frac{\frac{\partial A\left(w_j,w_j,d\left(w_j\right)\right)}{\partial w_j}}{A\left(w_j,w_j,d\left(w_j\right)\right)}\left(2-\gamma\left(w_j\right)w_j\right)+1-\gamma\left(w_j\right)d\left(w_j\right)-\gamma'\left(w_j\right)d\left(w_j\right)w_j}.$$

Thus, for every $j\in J$, $\lim_{h\to 0}\frac{W_j(w_j)-W_j(w_j-h)}{h}\leq\beta_j$. From the expression above, we can see that $\beta_j>0$ for all $j\in J$ and $\lim_{w_j\to 0}\beta_j>0$. The tradeoff captured in (5) can now be written given that the bride's family chooses h to maximize (10) so that

$$\max_{h>0}\max_{d\in[0,1]}\alpha\left[A\left(W_j\left(w_j-h\right),w_j,d\right)\left(W_j\left(w_j-h\right)+w_j-h-\gamma\left(w_j\right)\left[dw_j-h\right]\right)\right]+h$$

A sufficient condition for the constrained-optimal outcome to be an equilibrium is that for any $\varepsilon>0$, there exists $\eta>0$ such that for any $h\leq\eta$,

$$\alpha A\left(w_j,w_j,d\left(w_j\right)\right)\left[1-\gamma\left(w_j\right)\right]+\alpha\beta_j\left[A\left(w_j,w_j,d\left(w_j\right)\right)+\frac{\partial A\left(w_j,w_j,d\left(w_j\right)\right)}{\partial w_i}\right]\geq 1+\varepsilon$$

The marginal benefit of investing h outside the relationship needs to be higher than the rate of savings normalized to 1; we therefore make the sufficient assumption on α that for every $j\in J$, $\alpha\left[1-\gamma\left(w_j\right)+\beta_j\right]>1$, which implies that the optimal solution for j is to choose $h=0$. QED.■

Tables and Figures

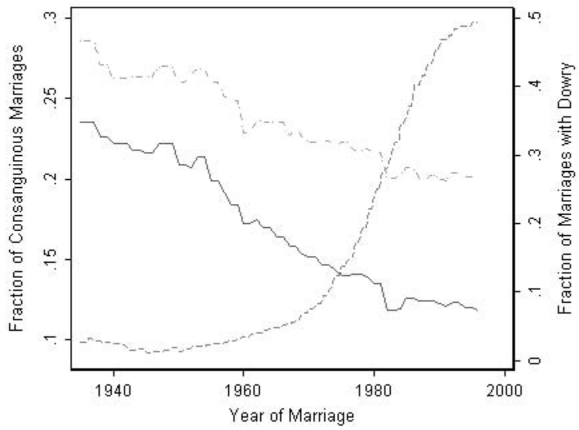

Figure 1: Prevalence of cousin marriage (solid line), relative marriage (dotted line) and dowry (dashed line) over time (1935-2000). Results are based on the sample of adult women.

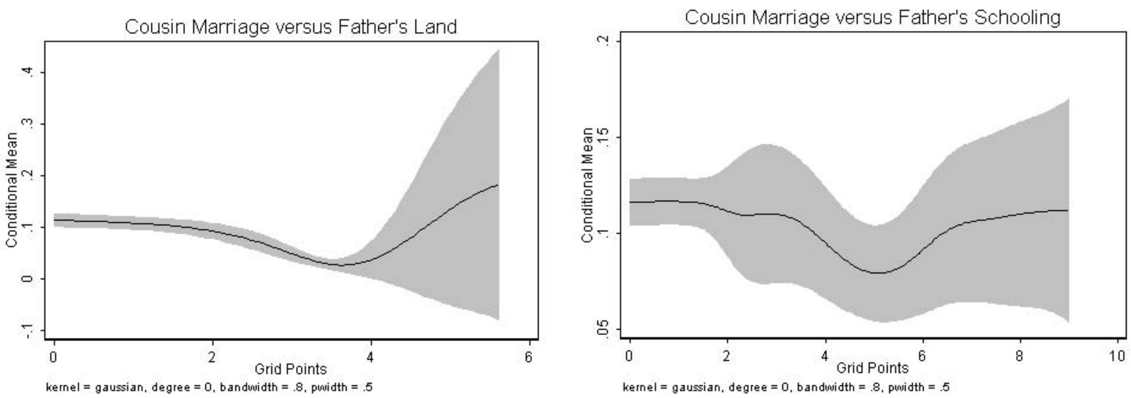

Figure 2: Bivariate relationship between consanguinity and father's farmland (left graph) and consanguinity and father's number of years of education (right graph). Notes: (i) Results are based on the sample of adult women; (ii) The solid line depicts the smoothed values of the kernel-weighted local polynomial regression; (iii) The shaded area depicts 95% confidence intervals.

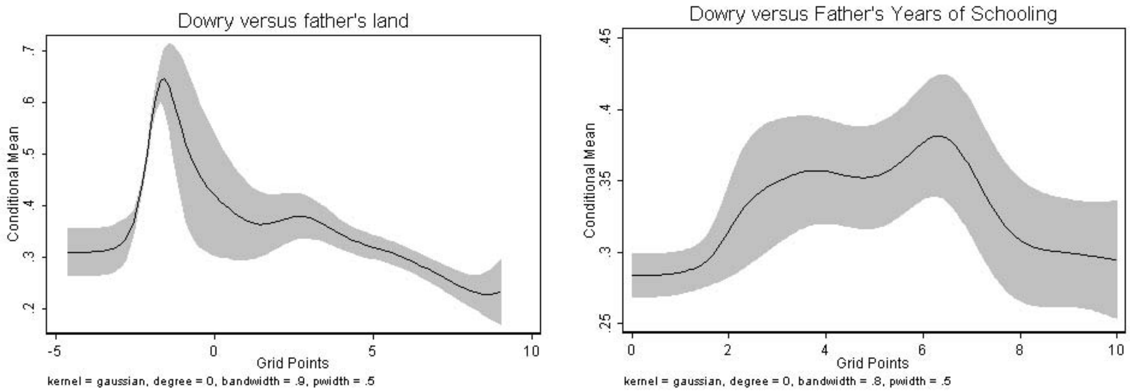

Figure 3: Bivariate relationship between dowry and log of father's farmland (left graph) and dowry and father's number of years of education (right graph). Notes: (i) Results are based on the sample of adult women; (ii) The solid line depicts the smoothed values of the kernel-weighted local polynomial regression; (iii) The shaded area depicts 95% confidence intervals.

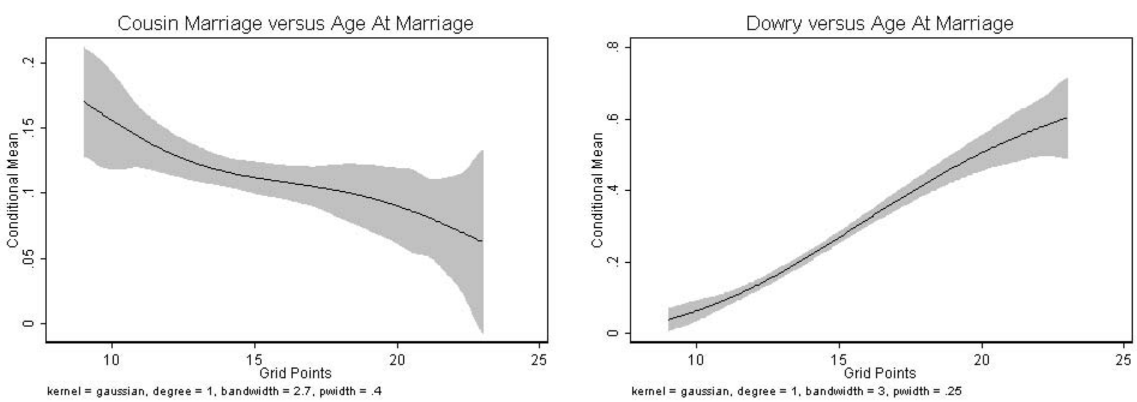

Figure 4: Bivariate relationship between age at marriage and consanguinity (left graph) and age at marriage and dowry (right graph). Notes: (i) Results are based on the sample of adult women; (ii) The solid line depicts the smoothed values of the kernel-weighted local polynomial regression; (iii) The shaded area depicts 95% confidence intervals.

Table 1: Summary statistics of variables used in the regressions

	Female Sample			Male Sample		
Variable	**N**	**Mean**	**Std. Dev**	**N**	**Mean**	**Std. Dev**
Married a first-cousin	5329	.1137	.3175	5083	.1128	.3164
Married any relative	5329	.1925	.3943	5083	.1951	.3964
Married a non-relative in the same village	5329	.1295	.3358	5083	.1027	.3036
Age (in years)	6068	39.3006	15.8984	5083	41.2538	17.9067
Age at marriage (in years)	3728	14.3712	4.3649	2539	23.7148	5.6809
Estimated value of dowry (in tens of thousand taka)	5334	.2524	.6490	3781	.1284	.4162
Paid a dowry at time of marriage	5334	.3015	.4589	3781	.1761	.381
Muslim	6068	.8906	.3122	5083	.8924	.3099
Attended a religious school	6068	.033	.1785	5083	.0216	.1455
Years of schooling	6022	2.3487	3.19	5046	3.8886	3.9651
Mother ever attended school	6068	.0493	.2165	5083	.099	.2986
Father ever attended school	6068	.3746	.4841	5083	.339	.4734
Father completed primary school	5701	.087	.2819	4443	.0858	.28
Father's years of schooling	5701	2.1951	3.5032	4443	1.3968	2.7931
Value of father's farmland (in millions of taka)	2331	1.2753	1.9573	3877	1.2359	1.8582
Father alive at the time of first marriage	6068	.7212	.4485	5083	.4733	.4993
Mother alive at the time of first marriage	6068	.7986	.4011	5083	.6307	.4827
Number of brothers alive at the time of first marriage	3783	1.0533	1.2660	3783	1.1533	1.4717
Sex-ratio of siblings	6068	.9401	.9373	3602	1.5703	1.2195
Inherit anything or expect to inherit anything from either parent	6068	.2144	.4104	5083	.5727	.4947
Inherited farmland	6068	.0686	.2527	5083	.4385	.4963
Inherited livestock	6068	.0013	.0363	5083	.0332	.1793
Inherited money	6068	.0132	.1141	5083	.01	.0997
Inherited anything else	6068	.0036	.0601	5083	.015	.1214
Father's farmland (in thousands of decimals)	3554	.4551	2.9647	4101	.4207	3.4906
Deviation from average rainfall the year a woman was 11 (in inches)	5072	2.0708	.3797			
Deviation from average rainfall the year a woman was 12 (in inches)	5160	2.0751	.3761			
Deviation from average rainfall the year a woman was 13 (in inches)	5227	2.0834	.3783			

Table 1: Note: Deviation from average rainfall the year was 11, 12 and 13 respectively correspond to the deviation from average rainfall in the years that a woman was of marriageable age (i.e. the mean age of marriage in the population as well as one year before and after).

Table 2: Relationship between dowry and social distance

	(1)	(2)	(3)	(4)
Panel (A): Dependent Variable: *Any Dowry Paid at Marriage*				
Married a cousin	-.0810	-.0744	-.0733	-.0741
	(.0306)***	(.0300)**	(.0300)**	(.0300)**
R-squared	.29	.34	.34	.34
Married a relative	-.0757	-.0642	-.0625	-.0632
	(.0245)***	(.0240)***	(.0240)***	(.0240)***
R-squared	.29	.33	.34	.34
Married a non-relative in the same village	.0025	-.0206	-.0267	-.0260
	(.0271)	(.0263)	(.0263)	(.0263)
R-squared	.28	.32	.33	.34
Panel (B): Dependent Variable: *Log of Dowry Value*				
Married a Cousin	-.1444	-.1034	-.0997	-.1001
	(.0684)**	(.0679)	(.0680)	(.0681)
R-squared	.29	.33	.33	.33
Married a relative	-.1699	-.1252	-.1202	-.1209
	(.0547)***	(.0543)**	(.0544)**	(.0545)**
R-squared	.30	.33	.33	.33
Married a non-relative in the same village	-.0212	-.0519	-.0642	-.0634
	(.0607)	(.0598)	(.0598)	(.0598)
R-squared	.29	.32	.32	.32
Controls (for Panels (A) and (B)):				
Individual Characteristics	No	Yes	Yes	Yes
Parental Characteristics	No	No	Yes	Yes
Rainfall at Marriageable Age	No	No	No	Yes
Year of marriage fixed-effects	Yes	Yes	Yes	Yes

Table 2: Notes: (i) Results are based on the sample of adult ever-married women; (ii) The dependent variable in Panel (A) is a dummy variable; (iii) The dependent variable in Panel (B) assumes a dowry value of 1 taka if no dowry was paid; (iv) Controls for individual characteristics include age, years of schooling, attendance at a religious school, age at marriage and religion; (v) Controls for parental characteristics include parents' schooling, and number of sons and daughters; (vi) Rainfall at marriageable age is defined as deviations from average rainfall when a woman was at the mean age of marriage in the population (rainfall one year before and after are also included); (vii) Standard errors—shown in parentheses—are clustered at the bari-level, * denotes significance at 10% level, ** significance at 5% level; and *** significance at 1% level.

Table 3: The relationship between dowry, consanguinity and inheritances

	Female Sample				Male Sample			
	Any	Type of Inheritance			Any	Type of Inheritance		
	Inheritance	Farmland	Home	Money	Inheritance	Farmland	Home	Money
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel (A):								
Married a Cousin	.0343	.0538	.0338	.0098	-.0104	-.0314	-.0130	-.0119
	(.0180)*	(.0116)***	(.0087)***	(.0054)*	(.0217)	(.0240)	(.0231)	(.0058)**
N	5278	5278	5278	5278	3722	3722	3722	3722
R-squared	.11	.07	.04	.03	.18	.19	.17	.06
Panel (B):								
Log of Dowry Value	.0035	.0039	-.0003	-.0008	.0428	.0327	.0418	-.0016
	(.0073)	(.0047)	(.0035)	(.0021)	(.0106)***	(.0117)***	(.0113)***	(.0028)
N	5283	5283	5283	5283	3723	3723	3723	3723
R-squared	.11	.06	.04	.026	.19	.19	.18	.06
Controls (for Panels (A) and (B)):								
Individual Characteristics	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Parental Characteristics	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year of marriage fixed-effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table 3: Notes: (i) Results are based on the sample of adult ever-married women; (ii) All dependent variables are dummy variables; (iii) The independent variable "Married a cousin" is a dummy variable; (iv) Controls for individual characteristics include age, years of schooling, attendance at a religious school, age at marriage, and religion; (v) Controls for parental characteristics include parents' schooling, and number of sons and daughters; (vi) Standard errors—shown in parentheses—are clustered at the bari-level, * denotes significance at 10% level, ** significance at 5% level; and *** significance at 1% level.

Table 4: Relationship between dowry, consanguinity, assets and age at marriage

	(1)	(2)	(3)	(4)
Panel (A): Dependent Variable: *Married a Cousin*				
Age at Marriage	-.0049	.0008	.0007	.0008
	(.0031)	(.0039)	(.0039)	(.0039)
Log Father's Farmland	-.0035	-.0049	-.0043	-.0043
	(.0019)*	(.0020)**	(.0020)**	(.0020)**
N	2313	2313	2313	2313
R-squared	.02	.04	.04	.05
Panel (B): Dependent Variable: *Any Dowry Paid at Marriage*				
Age at Marriage	-.0065	.0145	.0150	.0154
	(.0042)	(.0079)*	(.0080)*	(.0078)**
Log Father's Farmland	.0063	.0088	.0085	.0086
	(.0043)	(.0041)**	(.0041)**	(.0041)**
Log Father's Farmland Squared	-.0022	-.0018	-.0018	-.0018
	(.0009)**	(.0009)**	(.0009)**	(.0009)**
N	1460	1460	1460	1460
R-squared	.34	.36	.37	.37
Controls (for Panels (A) and (B)):				
Individual Characteristics	No	Yes	Yes	Yes
Parental Characteristics	No	No	Yes	Yes
Rainfall at Marriageable Age	No	No	No	Yes
Year of marriage fixed-effects	Yes	Yes	Yes	Yes

Table 4: Notes: (i) Results are based on the sample of adult ever-married women; (ii) The dependent variables in Panels (A) and (B) are dummy variables; (iii) Controls for individual characteristics include age, years of schooling, attendance at a religious school, age at marriage and religion; (iv) Controls for parental characteristics include parents' schooling, and number of sons and daughters; (v) Rainfall at marriageable age is defined as deviations from average rainfall when a woman was at the mean age of marriage in the population (rainfall one year before and after are also included); (vi) Standard errors—shown in parentheses—are clustered at the bari-level, * denotes significance at 10% level, ** significance at 5% level; and *** significance at 1% level; (vii) The coefficients for "Log Father's Farmland" and "Log Father's Farmland Squared" were jointly significant at the 1% level in all regressions in Panel (B).