# Dowry and Bride Price: The Role of Network benefits

April 2010

**Abstract**

Marriage payments are broadly defined by which side pays as well as by recipient. Payments from the bride's side to the couple via the bride are classified as dowry and payments from the groom's parents to the bride's parents are classified as bride price. The research question for this paper is: what are the determinants of direction and recipient of marriage payments? A child's marriage benefits the parents in three possible ways. Both sets of parents obtain network benefits from being connected by marriage to the spouse's extended family and to the newly formed couple with their conjugal fund. In addition the parents that the couple lives with get location specific benefits from the couple's labor. The predictions of the model are as follows. To obtain both dowry and bride price, location benefits should be an important source of benefits. The difference between bride price and dowry societies in this paper is the composition of network benefits. Specifically the relative importance of the couple versus the spouse's extended family. If the value of the couple's conjugal fund is outweighed by the network benefits from the extended family, bride price is the resulting payment. If network benefits from the couple are important, dowry, broadly defined, is the result. The specific form of dowry systems depends on the impact of parental characteristics. Evidence for the model's predictions are provided from specific studies as well as empirical analysis using data from Murdock's Ethnographic Atlas.

## 1 Introduction

Marriages in most parts of the world have either had or still have associated payments made by one side to the other. Understanding the reasons behind the prevailing direction of these payments is important as it has implications for the wealth distribution across families and could possibly affect how parents view the birth of a daughter versus a son. Even though dowry and bride price and primarily defined by which side pays, there are

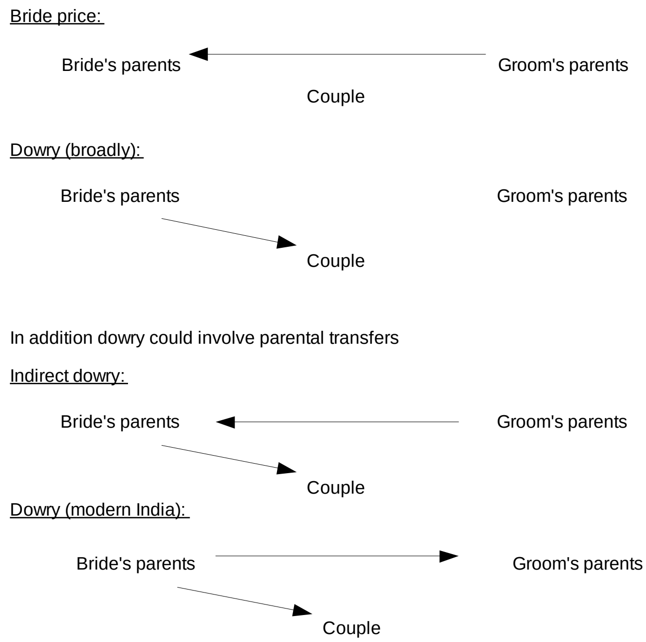



Figure 1: Patterns of payments by direction and recipient for patrilocal societies

systematic differences in the *recipient* (parents or couple) across dowry and bride price (Goody 1973)[1]. This is summarized in figure 1 for patrilocal societies, where the bride moves to the groom's family. Bride price involves payments from the groom's family to the bride's family. Dowry broadly defined consists of payments from the bride's family to the couple via the bride. These may be accompanied by transfers from the groom's parents to the bride's parents (what Goody calls indirect dowry) or no transfers at all (common in Europe) or even transfers from the bride's parents to the groom's parents (seen recently in India)[2]. The research question for this paper is, what are the determinants of *direction* and *recipient* of marriage payments[3]?

In this paper, parents of the bride and groom arrange marriages. Both sets of parents obtain network benefits from being connected by marriage to the spouse's extended family and the newly formed couple with their conjugal fund. In addition the parents that the couple lives with (the groom's family in patrilocal societies) get location specific benefits. Depending on the payoff from the marriage for the parents, they may have an incentive to make payments to maximize their payoff.

To obtain both dowry and bride price in this paper location benefits should be an important source of benefits to the parents the couple lives with. In this setting these can

[1] page 6 and Table 2 on page 21
[2] (Tambiah 1973) page 62
[3] This paper will not deal with the question of changing magnitudes holding fixed the direction of payments.

be thought of as benefits arising from having the couple's labor be a part of the family's production function. In addition this labor should come at a cost of the couple not working on their own separate household income streams.

The difference between bride price and dowry societies in this paper is the composition of network benefits. Specifically the relative importance of the couple versus the spouse's extended family. The results, briefly, are the following: if location specific benefits are important, but the value of the couple's conjugal fund is outweighed by the network benefits from the extended family, bride price is the resulting payment. If both location benefits and the couple's conjugal fund are important, dowry, broadly defined, is the result. The specific form of dowry systems depends on the impact of parental characteristics. If the bride's family characteristics are strong determinant of the couple's conjugal fund, we obtain indirect dowry and the type of dowry seen in Europe. If they are not important relative to the groom's family's impact, we obtain dowry seen in India.

The main channels through which the model works are the impact of parental asset transfers to the couple and parental characteristics on the value of the marriage to the parents. Transfers between parents are a way of transferring benefits from one side to the other to attract the best spouse. Transfers to the couple affect their incentives. Couples face a time allocation decision between working on their own productive assets and working for the parents they live with. In the model, an asset transfer to the couple makes them more likely to allocate time to working on their conjugal fund. Both parents benefit from the couple's conjugal fund but only the groom's parents get location specific benefits. When location specific benefits and the couple are important this introduces an asymmetry between parents. The groom's parents would prefer a lower time allocation to marital assets than the bride's parents. This gives rise to a corner solution when only the bride's parents give asset transfers to the couple, which is dowry broadly defined. In addition there are the transfers to the parents to be considered, which are determined by competition for the best spouse. This is when the impact of parental characteristics matters. If the bride's family characteristics are strong determinant of the couple's productive abilities, we obtain indirect dowry and the type of dowry seen in Europe. If they are not important, we obtain dowry seen in India.

If the couple is not important, there is no incentive for the parents to make any asset transfers to them. However there is still an asymmetry between parents when location benefits are important. In this case since the groom's parents get a higher payoff than the bride's they make a transfer to them to induce a match which results in bride price. Two types of evidence provided for the results, first, anecdotal evidence for the model's predictions from specific studies are discussed. An objection could be raised as to the representativeness these studies. To deal with that and also to obtain a larger cross-society view, empirical analysis is provided using data from Murdock's Ethnographic Atlas. This is a large anthropological dataset that has information on various societal characteristics as well as marriage payment patterns.

The standard literature on marriage payments treats them as market clearing prices. (Becker 1991) focuses on the relative supply of brides and grooms. If there is a scarcity on either side and inflexibilities in sharing the surplus within the marriage, payments from one side to the other will arise. Differences in the relative supply could arise for many reasons. (Tertilt 2005) builds a model where the demand for women is tied to polygyny or monogamy in society. The other reason is the "marriage squeeze" explanation – men being able to marry younger women. See for example (Caldwell, Reddy, and Caldwell 1983), (Anderson 2007b), (Maitra 2006), (Rao 1993), (Edlund 2000). This type of argument is also used to explain changes in the magnitude of marriage payments by tying differences in relative heterogeneity between brides and grooms (Anderson 2003).

Dowry is also viewed as a daughter's inheritance received at the time of marriage. (Goody 1973) argues that in stratified societies the wealth of the couple becomes important and a daughter gets an inheritance (as dowry) to ensure the status of her household. To explain the timing of inheritances, (Botticini and Siow 2003) argue that the crucial factor is how the son's effort affects the parental estate. Making the son the residual claimant on his parent's property by giving the daughter her inheritance at the time of marriage reduces the incentive problem. However the primary reason for receiving an inheritance is still the same as (Goody 1973) which is increased stratification.[4]

The competition argument alone is insufficient to explain the direction of marriage payments because it does not usually distinguish between recipient when characterizing the direction of marriage payments and does not allow for the coexistence of payments from both sides. The incentives argument in (Botticini and Siow 2003) does not explain the prevalence of bride price in patrilocal societies, particularly African ones[5]. This paper is able to explain how even in patrilocal societies where the couple's labor is important for the parents they live with (similar to the setting in (Botticini and Siow 2003)) two different patterns of payments can be obtained – bride price and dowry. In addition, their explanation

[4]Marriage payments are also tied to the value of women's work. (Boserup 1970) argues that in societies where female labor is an important, the bride's family needs to be compensated for the loss of her labor if she moves to the groom's family, giving rise to bride price. However there is evidence that the value of women is endogenous (Singh 1973). (Nunn 2005) treats bride price as the way a man makes a credible commitment not to cheat. In a society where a woman's outside option is low, dowries create the right incentives to stop the man from cheating. However (Bishai and Grossbard 2006) show evidence that bride price payments do not have any effect on the tendency of grooms to engage in extra-marital affairs, but decrease the probability that the bride has an affair.

[5]See discussion in (Botticini and Siow 2003) page 1390

matches the patterns of dowry in Europe, but is unable to match the evolution of payments in India, which this paper is able to do.

This paper adds to the literature in several respects. It offers a single framework to identify both direction and recipient and allows for the coexistence of payments from both sides. It also offers a new reason to explain why only the bride's parents give gifts to the couple – the trade-off between location benefits and network benefits from the couple. The role of payments to the couple (via the daughter) here is to affect the time allocation decision of the couple. However this trade-off becomes only important when the couple becomes an important link in the parent's network. There are studies that argue that as economies get more sophisticated bride prices disappear and dowry starts to make an appearance (Owen Hughes 1978) (Quale 1988) (Anderson 2007a). By tying observed network and occupation structures in the economy this paper offers a different channel to explain the observed link between modernization and the transition to dowry. Here if modernization results in a breakdown of extended kin network[6] and a focus more on children for things like consumption smoothing etc. then it results in a transition from bride price to dowry as long as location benefits are important. What is also interesting is that disappearance of one type of payment does not automatically require or imply the appearance of the other. In addition, it is able to match the observation that bride prices tend to be constant which dowries vary by type within a society (Anderson 2007a).

There are limitations to the argument provided here. The model takes the location of the couple as given as does not allow for differences in location within a society. There is no intra-family bargaining here so it cannot deal with situations involving differential family compositions, for example, marriage payments in the presence or absence of sons etc. There is no notion of human capital here and so it cannot address the question of when marriage payments would be a substitute for human capital investments. This is also not the only motive for marriage payments. There are no differences in the relative supply of brides and grooms by assumption. Also dowries could affect the bargaining power of the woman in the household (Zhang and Chan 1999). This explanation can be considered complementary to the papers that focus on these other channels.

The model is laid out in section 2. Section 3 analyzes the equilibrium of the game. The next two sections discuss evidence with section 4 covering anecdotal evidence and section 5 empirical evidence. Section 6 concludes.

[6] see (Munshi and Rosenzweig 2007)

# 2 Model

Consider a model of a marriage market, where you have brides and grooms on opposite sides of the market. The objective of the marriage market is for one bride family to match with one groom family[7].

## 2.1 Primitives

There are two types of agents in this model: parents and the couple. Parents are the primary agents[8].

**Parents:** There is a continuum of bride and groom parents (denoted by $i, j$ respectively), each of measure $N$. The parents differ in a one-dimensional type $\gamma \in [\gamma_L, \gamma_H]$. This type is a proxy for wealth, status etc. The higher the $\gamma$ of the agent, the more valuable the agent is to the other side. Let $\eta$ be the distribution of these characteristics $[\gamma_L, \gamma_H]$. Assume $\eta$ has non-zero density over the entire convex support[9]. Both the bride and groom's parents have the same $\eta$ over the same $[\gamma_L, \gamma_H]$ though the impact of $\gamma$ on the payoffs are allowed to differ by side[10]. Increasing stratification (inequality) in society will be an increase in the support of $\gamma$ but the effect is the same on both sides of the market.

**Couple:** The brides and grooms are all identical[11] and have no choice about their partner as their parents actions decide who they are matched with. However once parents $i$ and $j$ are matched and couple $ij$ is formed, the couple makes an time allocation choice. This will be discussed in more detail below.

**Timing and information:**

This is a full information game. The game consists of three stages. At stage 1 parents on both sides make announcements of non-negative transfers they are willing to make to their match. Denote the net transfer made by bride parents $i$ to groom parents $j$ by $T_{ij}$. Based on the net transfers matching takes place according to the matching function $M(i) = j$. Each agent has the option of remaining unmatched and receiving their outside option. At stage

[7]Polygamy and an age structure of the population of brides and grooms are not present. This shuts down the demand and supply of potential brides channel that determines the type of transfers.

[8]The reason for focusing on the parents and not the children is because as (Becker 1991) points out if it is purely a question of surplus accruing to the spouses, a division of surplus within the marriage can be achieved (barring any inflexibilities in sharing) without payments being necessarily exchanged. Adding in the intra-household bargaining process between children and parents in the choice of the spouse is an interesting question but one that we abstract from.

[9]This will ensure differentiability of the matching function later on

[10]Differences in distributions are important for explanations of dowry inflation due to differences in the relative supply of high quality grooms. (Anderson 2005) for example focuses on this dimension to explain the rise in dowry payments. But the aim of the model is to explain direction and not growth in payments given direction.

[11]This could be relaxed for a richer story but the intuition would still remain the same.

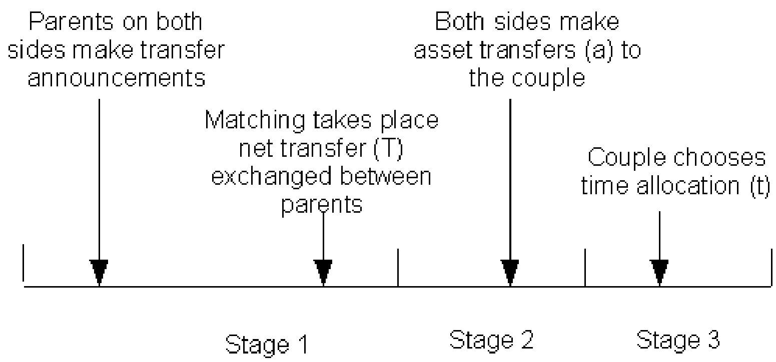



Figure 2: Timing of the game

2 both the bride and groom's parents make asset transfers denoted by $a^s \geq 0, s = \{B, G\}$ to the couple following which, at stage 3 the couple chooses their time allocation denoted by $t$ (figure 2). The justification for the timing is based on the observations that payments exchanged between parents are usually made at the time the match is arranged and before the actual marriage ceremony. For the gifts on the other hand, these are usually taken by the bride and groom to their marital home which takes place after the marriage. Although they could potentially be negotiated before the marriage takes place the actual payment takes place after the marriage (Goody 1973).

The payoff to the *parents* from the marriage of their child is assumed to have two components: network benefits and location specific benefits.

**Network benefits:**

Social networks are important for the larger family unit because they provide help with things like consumption smoothing in the presence of bad shocks, a source of credit, a means of searching for jobs, better information etc. For example in (Watson 1981) a marriage creates a link between all the women of the bride and groom's parent's households who perform functions like providing labor in times of need etc. (Dekker and Hoogeveen 2002) for example consider bride price payments in rural Zimbabwe and find that networks are an important source of insurance against risk. (Rosenzweig and Stark 1989) find evidence that families use marriages as risk sharing, consumption smoothing strategies. Network benefits, by assumption, do *not* depend on the location of the couple and the parents/extended family.

Network benefits are further broken down into two components. The marriage of a child expands the parent's network by adding two links. The first link is to the new couple and the second link is to the child's spouse's parents and extended family. Denote by function $f\left(\gamma^B, \gamma^G\right)$ the value created by family $\gamma^B$ linking to the extended family of $\gamma^G$. This is a function of the types of the parents. Assume in addition that this function is the same for the bride and the groom's parents. That is, the value of the network for a given set of types $(\gamma^B, \gamma^G)$ is the same regardless of whether it is the bride's parents who incur these benefits or whether it is the groom's parents who incur these benefits.

The networks benefits from the couple are proportional to the marital surplus of the couple. Denote by $X(\gamma^B, \gamma^G, t, a)$[12] the marital surplus of the couple. This surplus is assumed to be a function of the parent's types and the couple's starting assets which are the total asset transfers received $(a = a^G + a^B)$. In addition the couple chooses how to allocate their time. Denote by $t \in [0, 1]$ the time the couple allocates towards working on their own household assets. The rest $1 - t$ they allocate towards the location specific benefits (discussed below). Parameter $c \geq 0$ denotes the relative importance of the couple. A higher $c$ corresponds to the couple as becoming a more important link in the expanded network created by the marriage relative to the link created to the spouse's extended family. This makes the total network benefits from the match to the parents[13]

$$\text{Total network benefits} = f + cX$$

**Location specific benefits:**

Having the couple live with one set of parents rather than another may bring additional benefits to those parents. This paper will focus on a particular source of location benefits: having the couple *work for* the parents they live with. This captures the idea that labor supply by the couple is an important benefit for the parents they live with. Think of some joint family production function (e.g. family farm or business) that benefits from having additional labor by the couple. The beneficiaries of this labor are not just the couple but also the parents they live with. The joint production function of the parents and the couple for location specific benefits is denoted by $L(\gamma^G, 1 - t)$ for the groom's family[14]. It is assumed to be a function of the parental characteristics and the allocation of time the couple puts towards increasing the location specific benefits $(1 - t)$. Denote by $\mu = \{0, 1\}$ the absence $(= 0)$ or presence $(= 1)$ of a joint production function and hence location specific benefits for a given $\gamma$ and $t$. These benefits are assumed only to accrue to the parents that have the couple living and working with them. The intuition being that if the couple works for you geographic closeness matters and they can only work for the family business of one set of parents no matter how geographically close the other set of parents may reside.

[12] The marital surplus does not depend on bride and groom types because by assumption they are identical. This could be another channel to introduce heterogeneity in the model.

[13] An alternate specification of $cf + (1 - c)X$ would deliver the same results

[14] Location specific benefits could also be made a function of the total gifts $a$. As long as the incentive effect of gifts on time allocation is stronger on $X$ than on $L$ the intuition for the results goes through.

Any income earned by the couple from sources other than the joint family production function is captured by the marital surplus $X$ discussed earlier. Parents that live with the couple may also benefit from this source of the couple's income, but under this framework these benefits would be classified as network benefits and could possibly benefit both sets of parents. In addition, assuming that $L$ is a function of the time the couple allocates to the joint production function implies the time the couple spends working on the joint production function comes at a the cost of working on other projects independent of the joint family.

This makes the total benefit from the match to the parents

$$\text{Total benefits} = \begin{bmatrix} f + cX + \mu L & \text{if couple lives with parents} \\ f + cX & \text{otherwise} \end{bmatrix}$$

The magnitude of these benefits depend on the parameters $c, \mu$. Marriage payments here would be viewed as an investment to maximize the payoff from these source of benefits. The outside option for these payments is that they could be invested in the market. Denote by $R \geq 1$ the per-unit return from investing in the outside market. Another interpretation is that instead of networks and the couple, parents could potentially obtain these same benefits like credit/insurance from the outside market. The choice between obtaining these services via the network or via the outside market is not modeled.

Parameters $c, \mu, R$ are the same for all the families in the economy. This parameter could be different for different families within the economy but for ease of exposition is assumed to be the same for all families. The location of the couple after marriage is taken as exogenously given. In addition location of the couple is taken to be the same for all families in a society. In reality there is heterogeneity which depends on factors like the presence of sons to inherit property etc. For this paper these differences are assumed away[15]. Since most of the societies in reality are patrilocal the analysis will only focus on patrilocal societies[16].

Each parent has the option of remaining unmatched. In this setting remaining unmatched means that the child remains unmarried In this case the parents have the benefit from their existing network $f(\gamma^s, 0)$, $s = \{B, G\}$. In addition the unmarried child contributes to household income. Suppose that this contribution is independent of the type of the parent and so all children contribute the same to household income[17]. Denoted this contribution

[15] Since location specific benefits will be important, one could argue that location of the couple could potentially be an important part of marriage negotiations and thus endogenous. Anthropologists have tried to identify the factors correlated with the location decisions of the couple (patrilocal versus matrilocal). However factors correlated with location decisions have been difficult to identify. See (Korotayev 2001) for a review of the empirical and theoretical literature.

[16] A more general analysis would include matrilocal societies and they associated patterns of payments can then be obtained. The intuition will however still remain the same.

[17] This can be relaxed to allow for the outside option to depend positively on the type. With appropriate

by $O$. Total outside option is given by $f(\gamma^s, 0) + O$

**Assumption 1** *Assume that* $X'_s > 0, X''_{ss} < 0$ *for* $s = \{\gamma^B, \gamma^G, t, a\}, L'_{1-t} > 0$, *Also assume that* $X''_{t\gamma^B} = X''_{t\gamma^G} = L''_{1-t\gamma^G} = 0$ *for all* $t \in [0,1]$

**Assumption 2** *Assume,* $X''_{at} > 0$

The first part of assumption 1 is a standard diminishing marginal returns assumption for time, assets and parental returns on the couple's marital surplus. The next part assumes that the parental characteristics do not affect the marginal product of the couple's time. This is not an essential assumption but it simplifies the equations while keeping the intuition the same.

Assumption (2) is the most crucial. It assumes that the time the couple spends working on their own marital surplus becomes more productive if they have more assets. The idea is that this is an economy where physical assets are important (rather than human capital). Having more capital enables the household to exploit scale economies thus making their time more valuable. (Ebrey 1993)[18] discusses how the fine silk and jewelry as part of a bride's dowry could be sold for cash to finance capital for the couple's household business. Another way to view the assets would be as a safety fund that enables the household to undertake a riskier but more profitable income opportunity or ensure its survival. (Goody 1973) discusses how dowry (asset transfers to the couple) emphasizes the establishment of the conjugal fund that could be used to generate income by the conjugal unit. He also discusses the role that the type of agriculture plays (like the argument in (Boserup 1970)). Dowry tends to be found in societies where the quantity of assets (usually land) was important to determine household wealth. The idea being that with plow agriculture, having a larger amount of land to work with makes your household richer. This would be an example of assumption (2). ZFor shifting agriculture or slash and burn, the constraint in the amount of labor available to the household and not the land. This would be an example where assumption (2) is very weak or does not hold. Later in the paper the role of the assumption in generating marriage payments will be discussed. As to the interaction between assets and separate household income steams (Goody 1973)[19] summarizes the evidence when he says that in a situation where the couple bring in assets to establish a conjugal fund it has the effect of separating the conjugal unit from the larger family unit. The assets also help put the unit on a footing that is more intimate and more solid.

conditions on the rate of growth of the outside options compared to the complementarities, it will not change the analysis. The analysis could be further extended to allow the outside options to depend on the gender of the child. This will also not change the results of the analysis

[18] page 100-101

[19] page 38

Consider the evidence on arranged marriages in modern India in (Mathur 2007). She finds that parents strongly prefer their son to have an arranged marriage if they live with their son (or joint family) or if their son works in a family business. To the extent that arranged marriages will proxy for parental control over marriage market outcomes, her evidence indicates that when location benefits are important, parents will try to affect outcomes. In addition these sons tend to choose women with lower human capital and are less likely to be engaged in the workforce. Thus the emphasis is on lowering the value of $X$ so that the couple can focus on $L$.

## 2.2 Payoffs

Denote the payoff to bride's parents $(i)$ when their daughter matches with the $j's$ son by

$$\begin{aligned} P^B\left(\gamma_i^B,\gamma_j^G,t,a\right) &= f\left(\gamma_i^B,\gamma_j^G\right)+cX\left(\gamma_i^B,\gamma_j^G,t,a\right) \\ &\quad -RT_{ij}-Ra^B \end{aligned} \tag{1}$$

where $T_{ij}$ is the net transfer made by bride's parents $i$ to groom's parents $j$. The only sources of benefit are network benefits.

Similarly the total payoff to groom $j's$ parents when their son matches with $i's$ daughter is given by

$$\begin{aligned} P^G\left(\gamma_i^B,\gamma_j^G,t,a\right) &= f\left(\gamma_i^B,\gamma_j^G\right)+cX\left(\gamma_i^B,\gamma_j^G,t,a\right) \\ &\quad +\mu L\left(\gamma_j^G,1-t\right)+RT_{ij}-Ra^G \end{aligned} \tag{2}$$

Where the groom parents get the extra payoff from location benefits $(\mu L)$. The quasilinear benefit function is useful to ensure the matching is efficient.

Denote the payoff of the couple by $P^C$. The couple's only decision is how to allocate their time. Their income depends on their marital surplus $X$ and the location specific benefits of the parents $\mu L$. The payoff to the household established when $i's$ daughter matches with $j's$ son by

$$P^C\left(\gamma_i^B,\gamma_j^G t,a\right)=X\left(\gamma_i^B,\gamma_j^G,t,a\right)+\mu L\left(\gamma_j^G,1-t\right)$$

It assumes that the couple inherits $\mu L$ or benefits from the location benefits. They choose $t$ to maximize their total income.

Assume that there are strict complementarities in type for the parents. That is if there are two bride types $\gamma_1^B>\gamma_0^B$ and two groom types $\gamma_1^G>\gamma_0^G$, the following inequalities hold for all $t, a$.

$$P^B\left(\gamma_1^B,\gamma_1^G\right)+P^B\left(\gamma_0^B,\gamma_0^G\right)>P^B\left(\gamma_1^B,\gamma_0^G\right)+P^B\left(\gamma_0^B,\gamma_1^G\right)$$
$$P^G\left(\gamma_1^G,\gamma_1^B\right)+P^G\left(\gamma_0^G,\gamma_0^B\right)>P^G\left(\gamma_1^G,\gamma_0^B\right)+P^G\left(\gamma_0^G,\gamma_1^B\right)$$

Finally, assume that complementarities are strong enough so that when the two lowest types match and $a^*, t^*$ are determined by the stages that follow, the following inequality holds

$$\begin{aligned} & 2\left[f\left(\gamma_L^B,\gamma_L^G\right)+cX\left(\gamma_L^B,\gamma_L^B,a^*,t^*\right)\right]+\mu L\left(\gamma_L^G,1-t\right)-a^*\left(\gamma_L^B\right)-a^*\left(\gamma_L^G\right) \\ \geq & \left[f\left(\gamma_L^B,0\right)+f\left(\gamma_L^G,0\right)+2O\right] \end{aligned}$$

This assumption ensures that in the matching process below, all types will always prefer to be matched rather than remain unmatched

# 3 Marriage Market Equilibrium

Before discussing the equilibrium, some definitions are needed. The first of which is feasibility. It says that the matching function assigns only one groom to each bride and that the payoffs from matching are at least as good as the outside option of the agents.

**Definition 3** *Matching $M$ that assigns brides to grooms is said to be* feasible *if for any subset of groom's parents $E \subseteq N$,*

$$Measure^B\ \left(M^{-1}(E)\right)=Measure^G(E).$$

*and the equilibrium transfers and time allocations $\{T^*, a^*, t^*\}$ for all $i, j$ satisfy*

$$\begin{aligned} P^B\left(\gamma_i^B,\gamma_j^G\right) &\geq f\left(\gamma_i^B,0\right)+O \\ P^G\left(\gamma_i^B,\gamma_j^G\right) &\geq f\left(\gamma_j^G,0\right)+O \end{aligned}$$

The next condition is stability. It ensures that no two agents can get at least the same benefit (with at least one strictly better off) by matching with each other instead of matching with the person the matching function assigns them.

**Definition 4** *The matching function $M$ is stable if there does not exist any bride parent $h$,* *groom parent c and transfer $\hat{T}$ such that with this transfer*

$$\begin{aligned} P^B\left(\gamma_h^B,\gamma_c^G,\hat{T}\right) &\geq P^B\left(\gamma_h^B,M\left(\gamma_h^B\right)\right) \\ P^G\left(\gamma_h^B,\gamma_c^G,\hat{T}\right) &\geq P^G\left(M\left(\gamma_c^G\right),\gamma_c^G\right) \end{aligned}$$

*and at least one of the inequalities is strict.*

**Definition 5** *Equilibrium is a matching function $M$ and transfer payments $T$, time choices $t\left(\gamma^B,\gamma^G,a\right)$, and asset transfers $a^B\left(\gamma^B,\gamma^G\right), a^B\left(\gamma^B,\gamma^G\right)$ such that $t, a^B, a^G$ form a subgame perfect Nash equilibrium and $M$ with $T$ is feasible and stable.*

With the basic framework established, the game is solved backwards starting from Stage 3.

## 3.1 Asset transfers and time allocation (Stages 2 and 3)

**Time allocation:**

Consider the time allocation choice of the couple. Their partners are chosen and they have received a total assets of $a = a^G + a^B$ from both parents. They choose $t$ to maximize their income

$$t^* = \arg\max\{X\left(\gamma_i^B,\gamma_j^G,t,a\right) + \mu L\left(\gamma_j^G,1-t\right)\}$$

When $\mu = 0 \Rightarrow t = 1$. For $\mu = 1$, the first order condition will be given by

$$X_t'\left(\gamma_i^B,\gamma_j^G,t,a\right) - L_{1-t}'\left(\gamma_j^G\right) = 0$$

the couple chooses their time allocation such that the marginal benefit of time from both sources is the same.

**Asset transfer choice:**

Taking this into account, the parents then have to decide on the asset transfers they have to make to the couple. At this stage they have already matched and take their partner as given when deciding how much of an asset transfer to give. Both sides make their asset transfer decision simultaneously and their asset transfer is a best response to the other parent's asset transfer as the couple's optimal $t$ depends on the total asset transfer received $\left(a = a^B + a^G\right)$. Notice the role that the location of the couple plays in a parent's asset transfer decision. A higher asset transfer increases the value of only the marital surplus. To the extent that this changes the incentives of the couple to change their optimal $t^*$ the asset transfer decision of the parents depends on the location of the couple.

Consider the asset transfer decision for the groom's parents that have the couple living with them. The total asset transfer $a_G^*$ that maximizes their benefit (subject to their match) satisfies the following first order condition

$$a_G^* \left[ c \left[ X_a' + X_t' t_a' \right] - \mu L_{1-t}' t_a' - R \right] = 0$$

For any asset transfer $a^B$ made by the bride's parent's the best response of the groom's parents is $a^G = \max\{0, a_G^* - a^B\}$. Given the asset transfer of the other side, their best response is to provide the remainder to reach their optimal total asset transfer size $a_G^*$.

For the bride's parents that do not have the couple living with them however their total asset transfer $a_B^*$ that maximizes their benefit (subject to their match) satisfies the following first order condition

$$a_B^* \left[ c \left[ X_a' + X_t' t_a' \right] - R \right] = 0$$

For any asset transfer $a^G$ made by the bride's parent's the best response of the groom's parents is $a^B = \max\{0, a_B^* - a^G\}$. Given the asset transfer of the other side, their best response is to provide the remainder to reach their optimal total asset transfer size $a_B^*$.

Notice that if $\mu = 1$ this introduces a difference in what the parents would like the total asset transfer to the couple to be. In particular if $\mu = 1$, $a_G^* < a_B^*$. That is, the parents who obtain the location specific benefits will prefer a smaller asset transfer as a higher asset transfer increases the allocation of the couple towards their own marital surplus and away from the location specific benefits. Asset transfers are constrained to being non-negative. This pushes us towards a corner solution where $a^{*G} = \max\{0, a_G^* - a^{*B}\} = 0$ and $a^{*B} = \max\{0, a_B^* - a^{*G}\} = a_B^*$ where $a_B^*$ is the solution to $a_B^* \left[ c \left[ X_a' + X_t' t_a' \right] - R \right] = 0$ . In this case, the only parents that make an asset transfer will be the bride's parents.

Notice also the role of $c$. The asset transfer will only be positive iff $c > 0$ If $c = 0$, the couple's marital surplus does not affect the parent's benefit at all and since making a asset transfer is costly, the parents choose a zero asset transfer. The higher the importance of the location independent benefits of the couple (the higher the $c$) the higher the marginal product of the asset transfer to the parents benefit and the higher the asset transfer, all else equal.

The effects of the outside option $R$ is also interesting. A higher market option reduces the relative benefit of investing in networks and results in a lower asset transfers. It does not affect the presence or absence of marriage transfers. The policy implication of this would be to lower the magnitude of marriage asset transfers, one needs to improve the external markets for things that agents would otherwise obtain through networks.

If location specific benefits are unimportant ($\mu = 0$) then there is no difference by side

| $c=0,\mu=\{0,1\}$ | $c>0,\mu=1$ | $c>0,\mu=0$ |
|---|---|---|
| No asset transfers given | Only bride's parents give couple assets | Both sides give couple equal asset amounts |

Table 1: Gifts for patrilocal societies

(bride or groom) for the parents $a_B^* = a_G^* = a^*$. The couple supplies the whole unit of time to their marital surplus $X$. Both parents have the same preferences for the size of the asset transfer and the asset transfer could be shared between them. Abstracting away from the factors that could affect this sharing of asset transfer, we assume that the both sides make equal asset transfers to the couple $a^{*G} = \max\{0, a_G^* - a^{*B}\} = \frac{a^*}{2}$ and $a^{*B} = \max\{0, a_B^* - a^{*G}\} = \frac{a^*}{2}$,where $a^*$ satisfies $a^*\left[cX_a' - R\right] = 0$ for a given match $\left(\gamma^B, \gamma^G\right)$. This is summarized in the proposition below. The predictions can be summarized in Table 1

**Proposition 6** *The pattern of asset transfers at stage two looks like the following*

- *If* $c = 0$, $a^{*G} = a^{*B} = 0$
- *If* $c > 0$
  - *and* $\mu > 0$ *then* $a^{*G} = 0, a^{*B} = a^*$ *where for a given match* $\left(\gamma^B, \gamma^G\right)$, $a^*$ *satisfies* $a^*\left[c\left[X_a' + X_t' t_a'\right] - R\right] = 0$
  - *and* $\mu = 0$ *then* $a^{*G} = a^{*B} = \frac{a^*}{2}$ *where* $a^*$ *satisfies* $a^*\left[cX_a' - R\right] = 0$ *for a given match* $\left(\gamma^B, \gamma^G\right)$
  - $\frac{da^*}{dc} > 0, \frac{da^*}{dR} < 0$

**Proof.** see discussion above and using $\frac{\partial t}{\partial a} > 0$ for $\mu = 1$ (because $X_{ta}'' > 0$), $X_a'', X_t'' < 0, L_{1-t}' > 0$ ■

This brings us to a discussion of stage 1 where parents compete for the best match of their children.

## 3.2 Matching (Stage 1)

Stage 1 is the matching stage where bride and groom parents compete for the match that maximizes their benefit anticipating what happens in the second stage. At the matching stage each side first makes announcements of the transfer they are willing to make and based on these announcements, matching takes place. This is essentially a competition for the best brides and grooms and the net transfer that results will be the price that clears the market.

With strict complementarities, perfect assortative matching is efficient. Consider in particular a matching function $M$ such that a bride of type $\gamma_i^B$ is matched with a groom of type $\gamma_j^G$ who is chosen randomly from amongst the grooms at the same percentile as the bride in the distribution of types i.e. $\eta\left(\gamma_j^G\right) = \eta\left(\gamma_i^B\right)$

$$M\left(\gamma_i^B\right) = \eta^{-1}\left(\eta\left(\gamma_i^B\right)\right)$$

By behaving like a higher type a bride can improve her match by

$$M'\left(\gamma_i\right) = \frac{\eta'\left(\gamma_i\right)}{\eta'\left(M\left(\gamma_i\right)\right)}$$

The assumptions on the distribution functions $\eta$[20] ensure that the matching function is differentiable. The assumption of identical supports and distributions implies that $M'\left(\gamma_i\right) = 1$ and $M\left(\gamma\right) = \gamma$. Denote the associated net transfers from bride to groom with such a matching function by $T\left(\gamma_i\right)$. Suppose for now that this net transfer function is continuous and differentiable. Later on we will show that this is the case. Also note that the assumptions on the payoffs ensure that even the lowest types will prefer to match then remain unmatched.

For this matching function to be stable there should not exist any pair and a transfer that makes then no worse of (and one of them strictly better off) by matching with each other. Proposition 7 below shows what the transfer scheme should look like in order to ensure that the assortative scheme outlined above is stable.

**Proposition 7** *Suppose the matching function is assortative and is given by* $M\left(\gamma^B\right) = \eta^{G-1}\left(\eta^B\left(\gamma^B\right)\right)$. *The matching is stable if transfers satisfy the following differential equation*

$$T'\left(\gamma^B\right) = \frac{c}{R}\left[X'_{\gamma^G} - X'_{\gamma^B}\right]$$

**Proof.** See appendix ■

Consider the bride's parents decision about the size of transfer they offer in the marriage market. Given their match they can always try to increase their utility by matching with a higher type than what they are assigned. The maximum they are willing to pay will be the extra benefit gained from matching with the higher type, the marginal benefit of a higher match. To get the higher type groom's parents to match with them the size of the transfer needs to be at least as high as the benefit the groom's family gives up by marrying down. So the bride who is matched to this higher type of groom needs to give the higher type of groom no incentive to deviate and marry lower down. Strong complementarities ensure

[20] continuous with non-disappearing density over a convex support

that the higher type bride's family is able to do so. The groom's family makes a similar calculation. Putting these two together gives us a the slope of the transfer function. Strict complementarities and a quasi linear benefit function gives us that the matching described above is efficient.

**Boundary condition:** The transfers for each type are determined by the extent of competition for each type. With assortative matching, the lowest types are always matched to each other and there is no competition from below and another constraint is needed to determine their net transfer.

The bride's parent's outside option is given by $f\left(\gamma_L^B, 0\right)+O$ and the groom's by $f\left(\gamma_L^G, 0\right)+O$. The assumptions on the payoffs ensure that the lowest types always find it profitable to match. The maximum transfer the lowest type bride's parent is willing to make is given by their individual rationality constraint

$$\begin{aligned} T\left(\gamma_L^B\right) \leq\; & \frac{1}{R}\left[f\left(\gamma_L^B, \gamma_L^G\right)+cX\left(\gamma_L^B, \gamma_L^G, t, a\right)\right] \\ & -a_L^G-\frac{1}{R}\left[f\left(\gamma_L^B, 0\right)+O\right] \end{aligned}$$

and the minimum transfer the lowest type on the groom's side is willing to accept to enter into a match with the lowest type is given by

$$\begin{aligned} T\left(\gamma_L^B\right) \geq\; & \frac{1}{R}\left[f\left(\gamma_L^G, 0\right)+O\right]-\frac{1}{R}\left[f\left(\gamma_L^B, \gamma_L^G\right)+cX\left(\gamma_L^B, \gamma_L^G, t, a\right)\right] \\ & -\frac{\mu}{R}L\left(\gamma_L^G, 1-t\right)+a_L^G \end{aligned}$$

The net transfer for the lowest type needs to lie within these bounds. Assume for simplicity, that the transfer is exactly halfway between these bounds. This would make the boundary condition $\alpha=T\left(\gamma_L^B\right)$ for a given $c, , R, \mu$ given by

$$\alpha=\frac{1}{2R}\left[R\left(a_L^G-a_L^B\right)-\mu L\left(\gamma_L^G, 1-t_L\right)\right]$$

Depending on the parameters, we could be in a case where $\alpha<0$ where the groom's side needs to give the lowest type on the bride's side an incentive to enter into a marriage with the lowest type groom's family. For $\alpha>0$, the lowest type groom's family would need to be paid $\alpha$ to get them to agree to a match with the lowest type of bride's family.

The predictions of the model regarding the shape of the transfer function for a patrilocal society are summarized in table 2. The transfer function is the solution to the differential equation and boundary condition $\alpha$ for $c>0$.

| $c=0,\mu=1$ | $c>0,\mu=1$ |
|---|---|
| $T(\gamma) = -\frac{\mu L(\gamma_L^G)}{2R} < 0$<br>for all $\gamma$ | $\alpha = -\frac{Ra(\gamma_L^B)+\mu L(\gamma_L^G)}{2R} < 0$<br>$T'_\gamma = \frac{c}{R}\left[X'_{\gamma^G} - X'_{\gamma^B}\right]$ |
| $c=0,\mu=0$ | $c>0,\mu=0$ |
| $T(\gamma)=0$<br>for all $\gamma$ | $\alpha=0$<br>$T'_\gamma = \frac{c}{R}\left[X'_{\gamma^G} - X'_{\gamma^B}\right]$ |

Table 2: Net transfers for patrilocal societies

# 4 Bride price and Dowry

The previous section analyzes the three stages separately. Putting them together gives the patterns of marriage payments by direction and recipient in the economy. Table 3 gives the patterns of transfers and asset transfers for the different parameter combinations. The shape of the transfer function when not constant is drawn as linear for expositional purposes only. The actual shape will depend on the functional forms.

To match the patterns of direction and recipient discussed in the introduction and depicted in figure 1 we would require the following parameter combinations

| Payment | Parameter Restrictions | Predictions |
|---|---|---|
| Bride price | $c=0,\mu=1$<br>i.e. couple network<br>link unimportant but<br>location benefits important | $*$No asset transfers to couple<br>$*$constant (by type) transfers<br>from groom's parents<br>to bride's parents |
| Dowry | $c>0,\mu=1$<br>i.e. couple network link<br>and location benefits<br>important | $*$Bride's parents make<br>asset transfers to couple<br>$*$Net transfers between parents<br>depend on $\left(\frac{c}{R}\left[X'_{\gamma^G} - X'_{\gamma^B}\right]\right)$ |

**Bride price:** When the couple's network benefits are unimportant ($c=0$), then neither side has an incentive to give a asset transfer. Since the couple's marital surplus does not matter to the parents there is no variation in transfers by type. The transfer for the lowest type, the boundary condition determines what the transfer for all types will be. Consider the transfer exchanged by the lowest type. For $\mu=1$, location benefits are important and so the groom's parents get a higher payoff than the bride's parents. The surplus sharing rule ensures that the groom's family makes a transfer to the bride's family and bride price results. This is the same transfer exchanged by all types. The model is able to replicate the

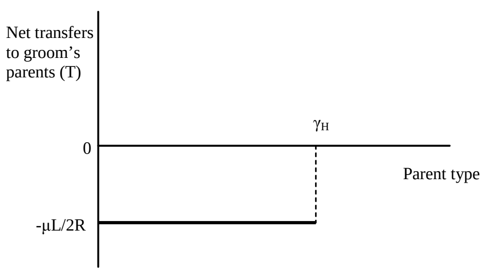
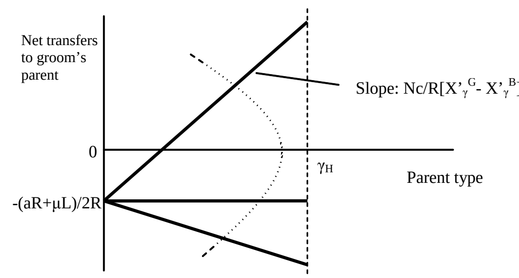
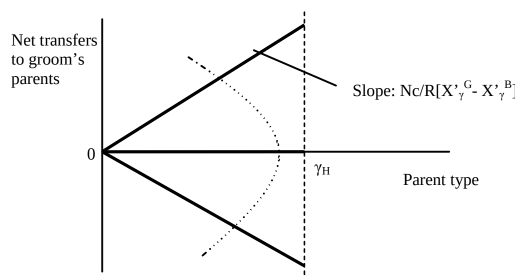
<table>
<tr><th>$c = 0, \mu = 1$</th><th>$c > 0, \mu = 1$</th></tr>
<tr><td>BRIDE PRICE<br>No asset transfers given<br>
</td><td>DOWRY<br>To couple: Only bride's parents<br>
</td></tr>
<tr><th>$c = 0, \mu = 0$</th><th>$c > 0, \mu = 0$</th></tr>
<tr><td>No asset transfers given<br>No parental transfers</td><td>To couple: Both parents give equal<br>
</td></tr>
</table>

Table 3: Marriage payments for patrilocal societies

fact that bride prices tend to be constant (Goody 1973)

**Dowry:** The classification above, broadly classifies dowry to be marriage payments where the only asset transfers to the couple are from the bride's parents. Dowry in figure 1 could also have transfers exchanged between parents. For the parameters $c > 0, \mu = 1$, the absolute transfers are determined by the solution to the differential equation $T' = \frac{c}{R}\left[X'_{\gamma^G} - X'_{\gamma^B}\right]$ and boundary condition $\alpha = -\frac{Ra\left(\gamma_L^B\right)+\mu L\left(\gamma_L^G\right)}{2R} < 0$. To match indirect dowry the absolute net transfers ($T$) to the groom's parents would have to be negative. To match the European experience the transfers would have to be $\simeq 0$. For both of these to hold the slope would have to be "small enough", i.e. $\left[X'_{\gamma^G} - X'_{\gamma^B}\right] \leq \beta$ for $\beta$ "small enough". To match the Indian experience (Anderson 2005) where transfers flow from the bride's parents to the groom's parents, would require a large slope and thus $\left[X'_{\gamma^G} - X'_{\gamma^B}\right] > \delta$ for $\delta$ "large enough". Any more structure would require additional assumptions.

This would make the difference between the Indian dowry experience and the European experience boil down to the differential impact of the parental characteristics on the couple's marital surplus. If the groom's parents had a bigger impact on the earnings capacity of the couple net transfers to the groom are more likely to be positive. In India this would be a result of caste, which is inherited through the groom's side which has an important effect on the couple's earnings. (Anderson 2005) uses a similar argument, but she uses it to explain why there is dowry inflation in India and not in Europe.

There are two types of evidence provided for the results: evidence from specific studies for the predictions of the model which are discussed below. The second type is an empirical analysis which is discussed in section 5.

## 4.1 Theory and Evidence

In this section the model's predictions are compared to the evidence on bride price and dowry.

**Prediction 1 (Bride price and dowry).** Bride price and dowry societies both have location benefits (couple's labor contribution being important). The difference is in the composition of network benefits. Bride price societies will rely on larger kin networks while dowry societies concentrate on the lineal family units, specifically the couple. ■

The first part of the prediction deals with the importance of location benefits. For this extensive evidence is provided in (Botticini and Siow 2003) (especially their online appendix) for the case of dowry societies. For the case of bride price societies, evidence is provided in (Goody 1973) and (Boserup 1970).

The fact that the benefits from a child's marriage comes from the network links is well understood. A factor that differentiates bride price and dowry societies in the model is the nature of these network benefits. As model predicts, bride price societies tend to rely on larger kin networks while dowry societies concentrate on the lineal family units (Anderson 2007a). A more detailed analysis can be seen in (Dekker and Hoogeveen 2002) who consider bride price payments in rural Zimbabwe. They find that these payments create a vast network of affines and serve as an important source of insurance against risk. (Rosenzweig and Stark 1989) look at rural South India (which is a dowry society[21]) find evidence that families use marriages as risk sharing, consumption smoothing strategies. Families chose the location of their son-in-law that would best mitigate the risk they face. The emphasis here being on the link to the couple.

(Watson 1981) compares the marriage payments for different classes of the same Teng lineage in the village of Ha Tsuen in Hong Kong's New Territories. There are two classes of the same lineage: peasants (tenants) and landlords. The marriage ceremonies are exactly the same for both classes but they differ in the payments made. There is village exogamy and so the bride always come from outside the village. Both the tenant class and the landlord class maintain links to affines, but the nature of these links differ. For the tenant families the main link to their affines was maintained by the women of the larger family unit of both sides. A couple (through the bride) formed a link through which both sides could draw on the female network on the other side for goods and services, especially in time of need. The landlord class was different. This access to the larger kin network through the bride was a very small part of the benefits from the marriage. The landlords used marriages to choose specific families to align themselves. The relationship was less dependent on the larger affine kin network and more on the smaller family unit. The marriage payments for the landlord class are meant to provide the first clear recognition of the new, but yet embryonic economic unit. What she finds is that payments in the tenant class are bride price in nature while payments in the landlord class were dowry like in nature. This is evidence of dowry when the couple benefits are important.

In the middle ages, Roman society had dowry where the primary purpose of it was to support the conjugal unit. The Barbarian society at the same time had a bride price system. The difference between these societies was also that in the Roman middle ages kinship ties had gone weak and the emphasis was on linear descendents. For the Barbarians on the other hand the larger kinship networks were very important (Gies and Gies 1987)[22].

Consider differences in marriage payments across Africa and Europe. In Africa, payments

[21] Although they do not explicitly consider dowry contracts and payments, their data set is the ICRISAT data. This data has been used in other papers (for example (Rao 1993)) that document and analyze dowry payments.

[22] page 32-33, 21

are primarily bride price in nature while in Europe they were mainly dowry. (Goody 1973) ties these differences to the level of stratification in these societies. African ones being more homogenous in terms of wealth while Europe is more stratified. He uses the argument that in unequal societies parents care about the wealth and status of their daughter's household and so they give daughters an inheritance too in the form of a dowry. Dowry is just way of transferring an inheritance. Another way of interpreting this is to think about the effect of stratification on network ties. (Munshi and Rosenzweig 2007) for example argue that the caste network is an important source for credit. The advent of modernization causes this network to break down as the highest incomes select out of the system. The argument here would be that those that select out of the network insurance are more likely to rely on other sources (say children) and thus are more likely to have dowry. So as opposed to (Goody 1973) here if stratification causes an increased emphasis on the couple rather than the extended family one should see dowry in stratified societies and bride price in more homogenous ones.

**Prediction 2 (i) (Transitions for** $c$**).** When location benefits are important ($\mu = 1$) an increased emphasis on the couple from the extended kin network ($c = 0$ to $c > 0$) would result in a move from bride price to dowry. ■

For India, dowries have been rapidly increasing and selection into the system is rising. An examination of the reasons behind this transition is in (Caldwell, Reddy, and Caldwell 1983). They discuss selection into the dowry system by sections of society engaging in bride price payments. Their main hypothesis is about the role of hypergamy and the marriage squeeze. However they also discuss how the links between families have reduced importance while the benefits from the couple have risen. They contrast the experience of North India versus South India. In the north, the emphasis on networks was low and dowries emerged. The south because of its emphasis on networks[23] did not have dowry but over time as networks reduced in important, dowry starts to arise[24]. The two major changes they note are first a transition to a dowry system and second a reduction in the proportion of all marriages between close relatives. Studies on dowry take as exogenously given that marriages with close families result in lower dowries without explaining why this is so (Kuhn, Mobarak, and Peters 2007). In this setting one could interpret marrying close relatives as an endogenous way of choosing the highest payoff from the match. If the network is the largest source then choosing to marry within the network would be an optimal response to maximizing the payoff from this source. However when the couple becomes more important then the need is to choose the best match to maximize the payoff from that channel. The reason the people in their study sample give for marrying outside the close relative circle is that heterogeneity within the

[23](Dumont 1983)

[24](Malhotra, Vanneman, and Kishor 1995), (Miller 1981)

group has increased. If as discussed in (Munshi and Rosenzweig 2007) heterogeneity results in weakening kin networks this could be naturally interpreted as a reduction in the benefits arising from networks. (Kuhn, Mobarak, and Peters 2007) find similar effects for a natural experiment in Bangladesh. As the risk levels of a family decrease they are less likely to marry a biological relative. If a reduction in risk reduces the benefits from an network then the focus is on the benefits arising from the children.

Further evidence for India is discussed in (Shenk 2005). For Bangalore, India, she examines the differential effects of kin network and parental characteristics on the characteristics of their child and the child's spouse. She finds evidence that family autonomy increases as parents move into a wage based economy. The professional parents also rely on outside credit more than their kin network to finance wedding expenditures. This is one indicator of the relative reliance on kin networks. In a follow up paper (Shenk 2007) she find that professional parents are also more likely to pay dowry while bride price is restricted to the poorer uneducated families earlier (less wage based economy) in time.

For Europe consider the discussion of the evolution of the family in (Goody 1983).What he finds is in general a shift from the extended kinship networks to a conjugal family unit. The evolution was such that the broader kinship group lost power and the monogamous family group constituted the basic social group. Together with this is a general trend towards daughters receiving asset transfers at the time of marriage. He interprets this as increased stratification causing asset transfers. In this framework increased importance of couple versus kin networks is important. As kinship networks fail, the parents depend more heavily on their children for location independent things like old age support etc. In this case the bride's parents have an incentive to give the couple asset transfers even though they do not live with them. In the high middle ages in Europe a change from large kinship groups to the linear family unit was accompanied by a transition from bride price to dowry in the society (Gies and Gies 1987)[25]

For China in the Sung period (Ebrey 1991)[26] discusses the transformation from bride price to dowry and the accompanying societal changes. She argues that the focus shifted from larger affine links to the couple. The bride's parents started to care about the link to a valuable groom regardless of his family because the household they would set up was important to the family. The bride's family by paying a dowry could count on more help from the new household. The groom's parents were also concerned about the dowry that the bride's family brought because it indicated the wealth and success of the new household to which these assets went.

[25] page 128-9
[26] pages 116-120

**Prediction 2 (ii) (Transitions for $\mu$).** When the couple is an important source of network benefits ($c > 0$) a move from location benefits being important to location benefits being unimportant ($\mu = 1$ to $\mu = 0$) would result in a move from dowry to equal asset transfers by both sides. ■

Consider the evidence presented in (Nazzari 1990) on the evolution of dowries as a gift in Sao Paulo 1600-1770. This is a society where network benefits are important[27]. The couple is also important[28]. There is a change over time in the importance of location specific benefits. What she finds is that initially when location specific benefits are very important because the couple worked for the groom's family estate, parents of sons were loathe to let their sons get married. In order to get married, a son had to have enough of his own land to be able to set up a household. Parents in this case would give their daughters large dowries consisting of land and slaves and other factors important to set up a new household to enable the groom to marry. They gave their sons nothing when they got married. However over time as location specific benefits start to lose ground because of the decline in agriculture, sons and daughters both received asset transfers to enable them to start up a household and the emphasis became on matching contributions of the bride and groom. In this framework of the model, this exercise would hold $c$ constant and gradually decrease $\mu$. The prediction that this would result in a movement from asset transfers by only the wife's family to a situation with asset transfers by both families is borne out in her study.

**Prediction 3 (Composition of dowries).** Dowries will consist of assets that enable the couple to set up separate income steams ■

(Tambiah 1973)[29] discuses how the bride price payments are not given to the couple as capital to set up their own household. Whereas dowry is to be specifically used by the conjugal estate to be used as capital by the husband and wife and to be passed on in time to their children. Widows in bride price society get their bride price returned by the bride's family to the groom's family. However in dowry societies because dowry forms part of the conjugal estate she retain control of it. The extent to which either of this happens depends on specific circumstances in a society. In the Roman middle ages (Gies and Gies 1987)[30] describes how the purpose of the dowry was to support the conjugal unit.

(Nazzari 1990) documents that parents would give their daughters large dowries consisting of land and slaves and other factors important to set up a new household to enable the

[27] "As in other regions of the world where state power was weak or non-existent, seventeenth-century Paulista society was organized through the extended family or clan" (page 640)

[28] "The fact that the daughter's marriage thus expanded the family's alliances, while incorporating another male into its military, political or economic projects, was sufficient reason for her dowry to take precedence among the family's expenditures" (page 654)

[29] page 61-62

[30] page 21

groom to marry. (Ebrey 1993)[31] discusses how the fine silk and jewelry as part of a bride's dowry could be sold for cash to finance capital for the couple's household business. Further evidence in provided in (Botticini and Siow 2003) where they document from a variety of sources and societies that dowry consisted mainly of cash and movables and sometimes for the rich, land.

**Prediction 4 (Matrilocal societies).** The analysis above can be extended to matrilocal societies. The predictions in this case would be that in matrilocal societies where location benefits are important and the couple is an important source of network benefits the groom would bring assets with him to be used by the couple. If the couple is unimportant, the bride's parents pay the groom's parents a transfer ■

(Quale 1988)[32] describes how in Japan (1608-1868) when a bride moved to a groom's family marriage payments looked like indirect dowry: the groom's family paid a transfer to the bride's family and the bride took gifts with her to her new household . However when the couple's labor was important for the bride's family and the groom moved to the bride's house, the bride's family paid a money gift to the groom's family. In addition the groom brought he brought a contribution of assets to his new household. For Sung China (Ebrey 1991) that for the case when the groom moved to the bride's family, marriage documents indicate that he took a 'dowry' with him [33] however when the bride moved she took a dowry with her. Further evidence is provided in the online appendix of (Botticini and Siow 2003).

**Prediction 5.** Children of both sexes who leave the household for reasons other than marriage (for example to become priests or nuns) would receive an asset transfer at the time of leaving as long as the parents expect some network benefits from them $(c > 0, )$ $\mu = \{0, 1\}$ ■

(Botticini and Siow 2003) give examples where children leaving the household for reasons other than marriage got assets at the time they left. In this setting as long as the parents had some benefit from these children in terms of old age support etc.$(c > 0)$, they always have an incentive to supply them with asset transfers to enable them to enlarge their $X$ and provide these services. Asset transfers have the effect of making the child's time more productive which results in a higher household value and hence a more valuable link in the chain. However since the priest or nun child doesn't have to make a distortionary effort choice, parents do not differentiate by gender and give children of both sexes (priests and nuns) a asset transfer when they leave. This is a similar prediction to the one in (Botticini and Siow 2003) but for different reasons.

[31] page 100-101
[32] page 247
[33] page 106

# 5 Empirical Evidence

In order to test the predictions of the model more rigorously, one would need either to observe a country over time which has changes in the direction and recipient of marriage payments or a cross section of societies with a variation in the direction and recipient of marriage payments. This part uses a cross country data set to examine to predictions of the model.

## 5.1 Data and methods

The Ethnographic Atlas is a database on 1,268 societies coded by George P. Murdock and published in successive installments in the journal *Ethnology*, 1962-1980. It gives ethnographic codes and geographical coordinates for all these societies[34]. The complete version of this data was published in *World Cultures Journal*, Vol 15, No 2. This data set is the biggest cross country data set that has roughly comparable anthropological data on societies. It is widely used in anthropology for a wide range of topics to conduct cross country analysis. Papers like (Harrell and Dickey 1985), (Goody 1973), (Shenk 2007) and references therein have used it to specifically check for society wide characteristics that are correlated with the presence of dowry in a society. Economists (for example (Botticini and Siow 2003), (Nunn 2005), (Anderson 2007a) and references therein) looking for factors correlated with dowry have used tabulations from versions of this Atlas .

This data set only has information on the direction of marriage payments and not on the recipient. It also does not have any information on the average size of marriage transfers. There are data sets available on the magnitude of bride price/dowry payments for families/ regions in particular societies, but these are difficult to get into a form that can be comparable across countries. Since the concern is with predicting the presence of dowry a cross country data set like this with information on the social characteristics is particularly useful even without a sense of average payments or whether they are increasing or decreasing in type.

A probit analysis is performed to predict the probability of dowry and bride price in a

[34] A summary volume of the Atlas was published as a book by the University of Pittsburgh Press in 1967. It contained the data on 862 of the better-described societies in each of 412 cultural clusters of the world. Many people confuse the subset with the complete sample. Murdock continued to add more societies to the Ethnographic Atlas after 1967. More importantly, he continued to make corrections to previously published codes. There are numerous cases where values printed in the 1967 volume were changed in a later Ethnology installment. The data used incorporates all these changes over the years and is a complete, corrected version of the Ethnographic Atlas.

society

$$\begin{aligned}
dowry_i &= \Phi\left(\begin{array}{c} \alpha_0 + \alpha_1 complex_i + \alpha_2 polygyny_i + \alpha_3 women\ value_i + \\ +\alpha_5 couple_i * sons\ inherit_i \end{array}\right) \\
brideprice_i &= \Phi\left(\begin{array}{c} \beta_0 + \beta_1 complex_i + \beta_2 polygyny_i + \beta_3 women\ value_i + \\ +\beta_5 \left(1 - couple_i\right) * sons\ inherit_i \end{array}\right)
\end{aligned}$$

where $\Phi$ denotes the cumulative normal distribution function associated with a probit specification. Since dowry has a strong regional component, the errors are clustered by geographical region. Since most of the predictions of the literature for dowry refer to patrilocal societies and most of the societies in the data are patrilocal, all non-patrilocal societies are dropped.

The goal of the analysis is to identify the societal characteristics that lead to dowry or bride price. The dependent variable $dowry_i$ is measured with an indicator that takes the value 1 if the society has dowry and 0 if there is anything else. The variable $brideprice_i$ the value 1 if the society has bride price or bride service or token bride price. The other possible categories are absence of any consideration, sister or female exchange and reciprocal gift exchange. Indirect dowry could possibly fall in these categories but it is impossible to identify precisely.

The independent variables are the factors that would influence the presence of dowry in a society. The $complex_i$ variable is an indicator variable that takes the value 0 if societies are homogenous or are divided into to at most two socioeconomic classes. A more complex differentiation into classes correlated in large measure with extensive differentiation of occupational statuses is given a value of 1. This variable is meant to capture the inequality (stratification) in a society and is equivalent to an increase in the range of types in society, that is the length of $[\gamma_L, \gamma_H]$ in the model. The analysis in the model holds the level of stratification fixed and does not have any predictions as to whether stratification increases or decreases the likelihood of dowry. As (Goody 1973) for example argues, a higher level of stratification will be positively correlated with dowry as stratification makes parents more likely to give their daughters a dowry to ensure that their household has a status at least as high as that of her natal household.

The presence of polygyny in a society is captured by the variable $polygyny_i$. It is an indicator variable that takes the value 1 when marriages in a society are polygynous and 0 if they are monogamous. This is used to capture the supply and demand for bride argument as a determinant of the price of a bride. The literature should predict that it is a negative predictor of dowry. This channel is not present in the model and is controlled for.

The next variable $women\ value_i$ is meant to capture the compensation argument for dowry. If a bride is valuable to her family, the loss of a bride due to her marriage and movement to the groom's family means that her family needs to be compensated for her loss. It should be a negative predictor of dowry. It is classified based on the contribution of women to agriculture. Since these are pre industrial societies, primarily agriculture based, the contribution of women to agriculture is important as emphasized by (Boserup 1970). It is an indicator variable that takes the value 0 if men contribute more than women to agriculture and 1 if the contribution is equal, equal but differentiated and women contribute more. This effect is not present in the model and is controlled for[35].

The main results depend on two parameters in the model. The first is $c$, the importance of the couple versus the family network for total location independent benefits from the match. The second is $\mu$ the importance of location specific benefits to the family the couple lives with. These measures are unfortunately not directly available in the data. we use the following proxies to capture this idea.

First consider the proxy for $c$. Societies in the data set are classified based on words societies use to describe familial relationships. It was proposed by anthropologist Lewis Henry Morgan. There are six main types: Hawaiian, Sudanese, Eskimo, Iroquois, Crow: and Omaha. The Eskimo (versus the others) system places no distinction between patrilineal and matrilineal relatives, instead focusing on differences in kinship distance (the closer the relative is, the more distinguished). The system also emphasizes lineal relatives. All other relatives are grouped together into categories. It uses both classificatory and descriptive terms, differentiating between gender, generation, lineal relatives (relatives in the direct line of descent), and collateral relatives (blood relatives not in the direct line of descent). The system is largely used in bilineal societies where the dominant relatives are the immediate family (Goody 1970). Since it emphasizes linear descent we treat it as the case when the primary source of location independent benefits is the couple. If networks are more important then the words used to describe kinship relationships would put more emphasis on them. The variable $couple_i$ is an indicator variable which takes the value 1 when the kinship term used is Eskimo and 0 otherwise.

Next consider the proxy for $\mu$. This variable should capture the importance of the location specific benefits of the couple to the parents. The interpretation in the model is linked to the value of the couple's labor for the parents they live with. The time allocation decision implies that when location benefits are important, the couple trades off working for the parents and setting up their separate income stream. Here, a proxy for $\mu$ is $sons\ inherit_i$. The argument in (Botticini and Siow 2003) says that for patrilocal societies where incentive efforts for

[35] In a version of the model where this is present it does not have an important effect on the direction of transfers.

| Variable | Obs | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|---|
| Dowry | 873 | 0.02 | 0.16 | 0 | 1 |
| Bride price | 880 | 0.74 | 0.44 | 0 | 1 |
| Polygyny | 856 | 0.89 | 0.32 | 0 | 1 |
| Complex | 744 | 0.08 | 0.27 | 0 | 1 |
| Value of women | 643 | 0.75 | 0.43 | 0 | 1 |
| Sons inheriting | 598 | 0.53 | 0.50 | 0 | 1 |
| Couple contribution | 607 | 0.19 | 0.39 | 0 | 1 |

Table 4: Data description for patrilocal societies

sons who live with their parents are important, a society will endogenously choose to have sons inherit and give their daughters their inheritance through a dowry. So if incentives are important, this will be captured by sons inheriting. The $sons\ inherit_i$ variable is an indicator variable that takes the value of 1 when only sons inherit land and 0 if daughters or other relatives inherit land. In the model the couple working on the farm gets benefits from it. It is equivalent to assuming that in patrilocal societies son's inherit. These variables are summarized in Table 4

The model predicts that:

- Bride price is more likely when location benefits are important and the couple's contribution to network benefits is ($c = 0$ and $\mu = 1$). This would be captured by $(1 - couple_i) * sons\ inherit_i$

- Dowry (i.e asset transfers via the bride) is more likely when both location benefits and the couple's network contributions are important ($c > 0$ and $\mu = 1$) which would be captured by $couple_i * sons\ inherit_i$

The model would imply that the predicted sign of the coefficient on $couple_i * sons\ inherit_i$ for dowry and the predicted sign of the coefficient on $(1 - couple_i) * location_i$ for dowry is positive.

## 5.2 Results

Consider the results in Table 5. The supply/demand for brides through polygyny predicts that the sign on polygyny should be negative for dowry and positive for bride price. This is consistent with the results in the table. The compensation argument of (Boserup 1970) says that the value of women should always be a negative predictor of dowry. The value of women argument is not present in the data as the marginal value is mostly zero and insignificant

Marginal effects are reported for the probit analysis

| | Base | Location benefits | Couple network benefits | Interaction effects | |
|---|---|---|---|---|---|
| Dependent variable | dowry | dowry | dowry | bride price | dowry |
| complex | 0.15*** | 0.13*** | 0.11*** | 0.01 | 0.09*** |
| | -8.99 | -6.99 | -6.24 | -0.08 | -5.96 |
| polygyny | -0.10*** | -0.13*** | -0.12*** | 0.38** | -0.14*** |
| | -3.03 | -3.10 | -3.02 | -2.07 | -3.04 |
| value of women | 0.00 | 0.00 | 0.00 | 0.00 | -0.01 |
| | -0.29 | -0.26 | -0.65 | -0.05 | -0.74 |
| Inheritance by sons | | 0.00 | | | |
| | | -0.42 | | | |
| Couple contribution | | | 0.01 | | |
| | | | -0.90 | | |
| couple* sons inherit | | | | | 0.03* |
| | | | | | -1.72 |
| (1-couple)*sons inherit | | | | 0.10*** | |
| | | | | -2.67 | |
| Observations | 599 | 437 | 470 | 347 | 347 |

Robust z statistics in parentheses
*significant at 10%;** significant at 5%; *** significant at 1%
Errors clusters by geographical region

Table 5: Probit results identifying the factors affecting the probability of dowry and bride price

implying that the compensation argument is not very important for the whole sample. This channel is not in the model and so is controlled for[36].

The argument in (Goody 1973) says that as a society gets more stratified, women get inheritances in the form of dowry to enable them to maintain the status of their family. This argument would imply that the effect of stratification is positive as stratification causes dowry. The results in Table 5 show that complex is a strong positive predictor of dowry. In the model this argument would say that as the length of $[\gamma_L, \gamma_H]$ increases, asset transfers increase which is not a prediction of the model. The model holds constant the level of stratification as the range of $\gamma$ does not change. (Botticini and Siow 2003) argue that the sign on *sons inherit* is positive for patrilocal societies. The direct effect of sons inheriting is zero and insignificant in the regression. The current literature says that although reliance on kin networks is a distinguishing feature of dowry and bride price societies[37] there is no theoretical reason for it alone to affect the probability of dowry, which is borne out in the data as the direct effect is zero and insignificant in the regression.

However as argued in the model the benefits from the couple by itself should not predict only dowry in a society as it could also predict indirect dowry. To get only dowry one would need the couple to be important and in addition location benefits to be present. The results in table 5 show these results. If location specific benefits are important and the couple is unimportant, then bride price is more likely. The coefficient on $(1 - couple_i) * sons\ inherit_i$ is a positive and significant predictor of bride price as predicted. For dowry, the predicted sign of the coefficient on $couple_i * sons\ inherit_i$ for dowry is positive and significant which matches the predictions of the model.

# 6 Conclusions

This paper addresses the question of what predicts the patterns of marriage payments in a society? Specifically, the parents obtain network benefits from being connected by marriage to the other family, benefits from productive abilities of the married couple, and location specific benefits that accrue to the family that the couple live with (groom's family in patrilocal societies). If the location specific benefits are important, but the value of couple production is outweighed by the network benefits, we obtain bride price. If the location benefits and the productive abilities of the couple are important, we obtain various forms of dowry systems: If the bride's family characteristics are strong determinant of the couple's

[36] However in versions of the model where it is present, it is important only when the couple is unimportant and location specific benefits are high enough.

[37] (Anderson 2007a)

productive abilities, we obtain indirect dowry and the type of dowry seen in Europe. If they are not important, we obtain dowry seen in India. The predictions of the model are verified using anecdotal evidence and empirical analysis.

Since it shuts down channels that other papers have identified as important like polygyny etc., this explanation can be considered complementary to these approaches. This approach does not address magnitudes of payments. Other papers like (Anderson 2003), (Caldwell, Reddy, and Caldwell 1983) approach this question directly. It offers a single framework for both direction and recipient. Separating out payments to the couple and other parents gives the coexistence of asset transfers to the couple from the bride's side and transfers from the groom's parents to the bride's parents in a society.

We tie the various forms of the marriage payments to the impact of parental asset transfers to the couple on the value of the marriage to the parents. Dowry payments from the bride's parents to the couple are a way to make the couple invest more time in their marital surplus than in the estate of the groom's parents. It gives us a way of thinking about another role for asset transfers to the couple (distinct from (Botticini and Siow 2003)). Transfers between parents are tied to the differential impact of parental characteristics on the marital surplus of the couple.

Another important piece of the argument is location specific benefits. The composition of network benefits interacting with the role of asset transfers to the couple is the key mechanism behind the results as it generates the asymmetry between the parents. As the economy transitions towards an production structure that is more individual based rather than family based the asymmetry in payments by side should start to disappear

By tying observed network and occupation structures in the economy this paper offers a different channel to explain the observed link between modernization and the transition to dowry. Here if modernization results in a breakdown of extended kin network[38] and a focus more on children for things like consumptions smoothing etc. then it results in a transition from bride price to dowry. The policy implications here are different too. In the model improving outside market provision of services like insurance, credit, old age support that make the couple's productive assets important to the parents is one way to get rid of dowry like payments.

[38]see (Munshi and Rosenzweig 2007)

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# Appendix

**Proposition 8** *Suppose the matching function is assortative and is given by* $M\left(\gamma^B\right) = \eta^{G-1}\left(\eta^B\left(\gamma^B\right)\right)$*. The matching is stable if transfers satisfy the following differential equation*

$$T'\left(\gamma^B\right) = \frac{c}{R}\left[X'_{\gamma^G} - X'_{\gamma^B}\right]$$

**Proof.**

$$P^B\left(\gamma_i^B, \gamma_j^G\right) = f\left(\gamma_i^B, \gamma_j^G\right) + cX\left(\gamma_i^B, \gamma_j^G, t, a\right) - RT_{ij} - Ra^B$$

$$\begin{aligned} P^G\left(\gamma_i^B, \gamma_j^G\right) &= f\left(\gamma_i^B, \gamma_j^G\right) + cX\left(\gamma_i^B, \gamma_j^G, t, a\right) \\ &\quad + \mu L\left(\gamma_j^G, 1-t\right) + RT_{ij} - Ra^G \end{aligned}$$

The match is not stable if there exists a $\gamma_c^B$ and $\gamma_l^G$ and a transfer $\hat{T}$ such that

$$\begin{aligned} P^B\left(\gamma_c^B, \gamma_l^G, \hat{T}\right) &\geq P^B\left(\gamma_c^B, M\left(\gamma_c^B\right), T\right) \\ P^G\left(\gamma_c^B, \gamma_l^G, \hat{T}\right) &\geq P^G\left(M^{-1}\left(\gamma_l^G\right), \gamma_l^G, T\right) \end{aligned}$$

with one of the inequalities strict. From the benefit functions this implies that

$$P^B\left(\gamma_c^B, \gamma_l^G, \hat{T}\right) \geq P^B\left(\gamma_c^B, M\left(\gamma_c^B\right), T\right)$$

$$\begin{aligned} & f\left(\gamma_i^B, \gamma_j^G\right) + cX\left(\gamma_i^B, \gamma_j^G\right) - R\hat{T} - Ra^B\left(\gamma_i^B, \gamma_j^G\right) \\ \geq\ & f\left(\gamma_i^B, M\left(\gamma_c^B\right)\right) + cX\left(\gamma_i^B, M\left(\gamma_c^B\right)\right) \\ & - RT\left(\gamma_c^B\right) - Ra^B\left(\gamma_c^B, M\left(\gamma_c^B\right)\right) \end{aligned}$$

$$\begin{aligned} \Rightarrow\ & \hat{T} \leq \left[f\left(\gamma_i^B, \gamma_j^G\right) - f\left(\gamma_i^B, M\left(\gamma_i^B\right)\right)\right] \\ & + c\left[X\left(\gamma_i^B, \gamma_j^G\right) - X\left(\gamma_i^B, M\left(\gamma_i^B\right)\right)\right] \\ & + RT\left(\gamma_i^B\right) - Ra^B\left(\gamma_i^B, \gamma_j^G\right) + Ra^B\left(\gamma_i^B, M\left(\gamma_i^B\right)\right) \end{aligned}$$

$$P^G\left(\gamma_c^B, \gamma_l^G, \hat{T}\right) \geq P^G\left(M^{-1}\left(\gamma_l^G\right), \gamma_l^G, T\right)$$

$$
\begin{aligned}
& f\left(\gamma_i^B, \gamma_j^G\right) + cX\left(\gamma_i^B, \gamma_j^G, t, a\right) \\
& +\mu L\left(\gamma_i^B, \gamma_j^G\right) + R\hat{T} - Ra^G\left(\gamma_i^B, \gamma_j^G\right) \\
\geq\ & f\left(M^{-1}\left(\gamma_j^G\right), \gamma_j^G\right) + cX\left(M^{-1}\left(\gamma_j^G\right), \gamma_j^G, t, a\right) \\
& +\mu L\left(M^{-1}\left(\gamma_j^G\right), \gamma_j^G\right) + RT\left(M^{-1}\left(\gamma_j^G\right)\right) \\
& -Ra^G\left(M^{-1}\left(\gamma_j^G\right), \gamma_j^G\right)
\end{aligned}
$$

$$
\begin{aligned}
\Rightarrow\ & \hat{T} \geq f\left(M^{-1}\left(\gamma_j^G\right), \gamma_j^G\right) \\
& +cX\left(M^{-1}\left(\gamma_j^G\right), \gamma_j^G, t, a\right) \\
& +\mu L\left(M^{-1}\left(\gamma_j^G\right), \gamma_j^G\right) + RT\left(M^{-1}\left(\gamma_j^G\right)\right) \\
& -Ra^G\left(M^{-1}\left(\gamma_j^G\right), \gamma_j^G\right) \\
& -f\left(\gamma_i^B, \gamma_j^G\right) - cX\left(\gamma_i^B, \gamma_j^G, t, a\right) \\
& -\mu L\left(\gamma_i^B, \gamma_j^G\right) + Ra^G\left(\gamma_i^B, \gamma_j^G\right)
\end{aligned}
$$

with at least one of the inequalities strict. A sufficient condition to ensure that this does not occur is

$$
\begin{aligned}
& f\left(M^{-1}\left(\gamma_j^G\right), \gamma_j^G\right) + cX\left(M^{-1}\left(\gamma_j^G\right), \gamma_j^G, t, a\right) \\
& +\mu L\left(M^{-1}\left(\gamma_j^G\right), \gamma_j^G\right) + RT\left(M^{-1}\left(\gamma_j^G\right)\right) \\
& -Ra^G\left(M^{-1}\left(\gamma_j^G\right), \gamma_j^G\right) - f\left(\gamma_i^B, \gamma_j^G\right) \\
& -cX\left(\gamma_i^B, \gamma_j^G, t, a\right) - \mu L\left(\gamma_i^B, \gamma_j^G\right) + Ra^G\left(\gamma_i^B, \gamma_j^G\right) \\
\geq\ & \left[f\left(\gamma_i^B, \gamma_j^G\right) - f\left(\gamma_i^B, M\left(\gamma_i^B\right)\right)\right] + \\
& c\left[X\left(\gamma_i^B, \gamma_j^G\right) - X\left(\gamma_i^B, M\left(\gamma_i^B\right)\right)\right] \\
& +RT\left(\gamma_i^B\right) - Ra^B\left(\gamma_i^B, \gamma_j^G\right) + Ra^B\left(\gamma_i^B, M\left(\gamma_i^B\right)\right)
\end{aligned}
$$

Consider a deviation where type $\gamma^B$ tries to make a match with the groom assigned to type $\gamma^B + \epsilon$, $i.t.M\left(\gamma^B + \epsilon\right)$. A sufficient condition to ensure that this cannot happen is given by

$$
\begin{aligned}
& f\left(\gamma^B+\epsilon, M\left(\gamma^B+\epsilon\right)\right)+cX\left(\gamma^B+\epsilon, M\left(\gamma^B+\epsilon\right)\right) \\
& +\mu L\left(\gamma^B+\epsilon, M\left(\gamma^B+\epsilon\right)\right)+RT\left(\gamma^B+\epsilon\right) \\
& -Ra^G\left(\gamma^B+\epsilon, M\left(\gamma^B+\epsilon\right)\right)-f\left(\gamma^B, M\left(\gamma^B+\epsilon\right)\right) \\
& -cX\left(\gamma^B, M\left(\gamma^B+\epsilon\right), t, a\right) \\
& -\mu L\left(\gamma^B, M\left(\gamma^B+\epsilon\right)\right)+Ra^G\left(\gamma^B, M\left(\gamma^B+\epsilon\right)\right) \\
\geq\ & \left[f\left(\gamma^B, M\left(\gamma^B+\epsilon\right)\right)-f\left(\gamma^B, M\left(\gamma^B\right)\right)\right] \\
& +c\left[X\left(\gamma^B, M\left(\gamma^B+\epsilon\right)\right)-X\left(\gamma^B, M\left(\gamma^B\right)\right)\right] \\
& +RT\left(\gamma^B\right)-Ra^B\left(\gamma^B, M\left(\gamma^B+\epsilon\right)\right)+Ra^B\left(\gamma^B, M\left(\gamma^B\right)\right)
\end{aligned}
$$

$$
\begin{aligned}
\Rightarrow\ & T\left(\gamma^B+\epsilon\right)-T\left(\gamma^B\right) \\
\geq\ & \left[f\left(\gamma^B, M\left(\gamma^B+\epsilon\right)\right)-f\left(\gamma^B, M\left(\gamma^B\right)\right)\right] \\
& +c\left[X\left(\gamma^B, M\left(\gamma^B+\epsilon\right)\right)-X\left(\gamma^B, M\left(\gamma^B\right)\right)\right] \\
& -Ra^B\left(\gamma^B, M\left(\gamma^B+\epsilon\right)\right)+Ra^B\left(\gamma^B, M\left(\gamma^B\right)\right) \\
& -f\left(\gamma^B+\epsilon, M\left(\gamma^B+\epsilon\right)\right)-cX\left(\gamma^B+\epsilon, M\left(\gamma^B+\epsilon\right)\right) \\
& -\mu L\left(\gamma^B+\epsilon, M\left(\gamma^B+\epsilon\right)\right)+Ra^G\left(\gamma^B+\epsilon, M\left(\gamma^B+\epsilon\right)\right) \\
& +f\left(\gamma^B, M\left(\gamma^B+\epsilon\right)\right)+cX\left(\gamma^B, M\left(\gamma^B+\epsilon\right), t, a\right) \\
& +\mu L\left(\gamma^B, M\left(\gamma^B+\epsilon\right)\right)-Ra^G\left(\gamma^B, M\left(\gamma^B+\epsilon\right)\right)
\end{aligned}
$$

The same way, in order to ensure that the match of type $\gamma^B, M\left(\gamma^B\right)$ has no incentive to match with the bride of type $\gamma^B+\epsilon$ the following needs to hold

$$
\begin{aligned}
& f\left(\gamma^B, M\left(\gamma^B\right)\right)+cX\left(\gamma^B, M\left(\gamma^B\right)\right) \\
& +\mu L\left(\gamma^B, M\left(\gamma^B\right)\right)+RT\left(\gamma^B\right)-Ra^G\left(\gamma^B, M\left(\gamma^B\right)\right) \\
& -f\left(\gamma^B+\epsilon, M\left(\gamma^B\right)\right)-cX\left(\gamma^B+\epsilon, M\left(\gamma^B\right)\right) \\
& -\mu L\left(\gamma^B+\epsilon, M\left(\gamma^B\right)\right)+Ra^G\left(\gamma^B+\epsilon, M\left(\gamma^B\right)\right) \\
\geq\ & \left[f\left(\gamma^B+\epsilon, M\left(\gamma^B\right)\right)-f\left(\gamma^B+\epsilon, M\left(\gamma_i^B\right)\right)\right] \\
& +c\left[X\left(\gamma^B+\epsilon, M\left(\gamma^B\right)\right)-X\left(\gamma^B+\epsilon, M\left(\gamma_i^B\right)\right)\right] \\
& +RT\left(\gamma^B+\epsilon\right)-Ra^B\left(\gamma^B+\epsilon, M\left(\gamma^B\right)\right)+Ra^B\left(\gamma^B+\epsilon, M\left(\gamma^B+\epsilon\right)\right)
\end{aligned}
$$

$$
\begin{aligned}
\Rightarrow \quad & f\left(\gamma^B, M\left(\gamma^B\right)\right) + cX\left(\gamma^B, M\left(\gamma^B\right)\right) \\
& + \mu L\left(\gamma^B, M\left(\gamma^B\right)\right) - Ra^G\left(\gamma^B, M\left(\gamma^B\right)\right) \\
& - f\left(\gamma^B + \epsilon, M\left(\gamma^B\right)\right) - cX\left(\gamma^B + \epsilon, M\left(\gamma^B\right)\right) \\
& - \mu L\left(\gamma^B + \epsilon, M\left(\gamma^B\right)\right) + Ra^G\left(\gamma^B + \epsilon, M\left(\gamma^B\right)\right) \\
& - \left[f\left(\gamma^B + \epsilon, M\left(\gamma^B\right)\right) - f\left(\gamma^B + \epsilon, M\left(\gamma^B + \epsilon\right)\right)\right] \\
& - c\left[X\left(\gamma^B + \epsilon, M\left(\gamma^B\right)\right) - X\left(\gamma^B + \epsilon, M\left(\gamma_i^B\right)\right)\right] \\
& + Ra^B\left(\gamma^B + \epsilon, M\left(\gamma^B\right)\right) - Ra^B\left(\gamma^B + \epsilon, M\left(\gamma^B + \epsilon\right)\right) \\
\geq \quad & RT\left(\gamma^B + \epsilon\right) - RT\left(\gamma^B\right)
\end{aligned}
$$

Putting them together and substituting in the fact that the distributions of $\gamma$ are the same for bride and groom's parents and functions $f$ are the same for both sides. Use the fact that the distributions of $\gamma$ are the same for bride and groom's parents and functions and the functions $a, X$ are the same for both sides. With continuous types as $\epsilon \to 0$ this translates into

$$
T'\left(\gamma^B\right) = \frac{c}{R}\left[X'_{\gamma^G} - X'_{\gamma^B}\right] - a^{B\prime}_{\gamma^G} + a^{G\prime}_{\gamma^B} + \frac{\mu}{R} L'_{1-t} t'_{\gamma^B}
$$

With the assumption that $X'_{t\gamma} = 0 \Rightarrow t'_{\gamma^G} = a^{B\prime}_{\gamma^G} = 0$, this reduces the equation to

$$
T'\left(\gamma^B\right) = \frac{c}{R}\left[X'_{\gamma^G} - X'_{\gamma^B}\right]
$$

■