A Model Explaining Simultaneous Payments of a Dowry and Bride-Price (Preliminary Draft)

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Abstract

Standard economic models of marriage contracts, starting with Becker (1981), explain the existence of the dowry and bride-price as pecuniary transfers necessary to clear marriage markets. These models predict that when marriage payments are made, either a payment is made from the bride to the groom (dowry) or a payment is made from the groom to the bride (bride-price), but not both. This contradicts one of the stylized facts of marriage contracts. When a dowry is paid, it is usually reciprocated with a bride-price. I develop a model that explains why the dowry and bride-price are paid simultaneously. In the model, both payments are crucial, not just the net amount exchanged. In addition, the model is consistent with the general frequencies, patterns and characteristics of the dowry and bride-price observed across cultures throughout history.

JEL classification: B52; C72; D13; J12

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1 Introduction

Standard economic models of marriage contracts, starting with Becker (1981), explain the existence of dowries and bride-prices as pecuniary transfers necessary to clear the marriage market. These models predict that when marriage payments are made, either a payment is made from the bride to the groom (dowry) or a payment is made from the groom to the bride (bride-price), but not both. This contradicts one of the stylized facts of marriage contracts: when a dowry is paid, it is usually reciprocated with a bride-price. To date, no model has been able to explain why dowries and bride-prices are paid simultaneously. In this paper, I develop a model that is able to do so. The predictions of the model explain important stylized facts about marriage contracts across cultures throughout history. The stylized facts of marriage contracts are as follows.

1. The bride-price is common.
2. The dowry is less common.
3. When a dowry is paid, it is usually reciprocated by a bride-price.
4. Generally, dowry payments are much larger than bride-price payments.
5. Bride-price societies tend to be characterized by high female contribution to agricultural work and high female economic autonomy.
6. Dotal societies feature low female contribution to agriculture and high levels of dependence of women and children on the husband's economic support.

The model that I develop is very different from previous models of the marriage market. I take an evolutionary perspective and assume that payoffs are given by the biological fitnesses of the players; biological fitness is defined as the number of surviving offspring. By doing this, the model immediately focuses on the fitness maximizing mating strategies of men and women. As is well established in the sexual strategies theory literature from evolutionary psychology and biology, when maximizing fitness, the optimal strategies for a man and woman tend to be very different (Buss and Schmitt, 1993). For both sexes, a monogamous long-term mating strategy is one option. For men, an attractive alternative strategy is a short-term mating strategy. A man may be better off if he mates with a woman, then abandons her in search of another woman, and continues this process repeatedly. For women, the short-term mating strategy is not a viable option because they become pregnant and must carry the child for at least 9 months.

In the model, the dowry and bride-price evolve as mechanisms to ensure that men pursue a long-term mating strategy. The game has two possible unique Nash equilibria. Which equilibrium exists depends on the parameter values of the model. In one equilibrium, a bride-price is paid and in the other a dowry and bride-price are simultaneously paid.

The first equilibrium is as follows. If the woman's payoff outside of marriage is high enough, then given that men will cheat, the woman will choose not to enter into marriage. In this case, the men may find it optimal to offer a gift at the beginning of a potential marriage. This payment is a bride-price. The bride-price is a credible signal to the woman that the man will be faithful. It is credible because it lowers the man's payoff to cheating relative to committing. If the man wants to cheat in every relationship he will have to pay the bride-price in every new relationship. If he commits, he only pays the bride-price once.

The second equilibrium is as follows. If the woman's payoff outside of the marriage is sufficiently low, then even knowing that the man will cheat, the woman is best off agreeing to match with the man; her payoff to being in a cheating marriage is higher than her payoff to being alone. In this environment, a woman could threaten not to marry unless the man offers a bride-price at the beginning of the match. If this threat is believed by the man, then he would choose to offer the gift and be faithful. However, the woman's threat is not credible. She will agree to marriage even if no gift is offered by the man. The threat becomes credible if there exists a custom that dictates that before marriage the woman and her family must give a productive asset to the man and his family. Because this asset is productive it yields a payoff each period; examples include money, livestock and land. The giving of the asset increases the control over resources that the man has and lowers the control that the woman has if the marriage occurs. The payment decreases the woman's payoff in a cheating marriage. This payment is a dowry. If the dowry lowers the woman's payoff within the marriage enough, then her payoff within the marriage will be lower than her payoff outside of the marriage. The woman's threat not to agree to marriage unless the man offers a bride-price is now credible. The man is then best off offering a bride-price and committing in every period. In this equilibrium a bride-price and dowry are both paid.

In the next section, I summarize the stylized facts about marriage contracts. In Sections 3 and 4, I describe the model and its equilibria. In Section 4, I consider the dynamic properties of the game. Section 5 concludes.

2 Stylized Facts about Marriage Contracts

In this section, I provide a detailed look at the six stylized facts of marriage contracts described in the introduction. In Table 1, data on the form of marriage payments in all cultures of the world from the White-Veit Ethnographic Atlas are reported.[1] The definitions of the payments reported are:[2]

Table 1: Marriage Payments in the Societies of the World.

Form of Marriage Payment	Number of Societies
Absence	**44**
Bride Price or bride-wealth	54
Bride Service	27
Token Bride Price	8
Woman Exchange	9
Bride Price Only Total	**98**
Gift Exchange	15
Indirect Dowry plus Bride Price, and Dowry	18
Both Total	**33**
Dowry	**11**
Total	**186**

Absence: the absence of any significant consideration, or bridal gifts only.

Bride-price or bride-wealth: transfer of a substantial consideration in the form of livestock, goods, or money from the groom or his relatives to the kinsmen of the bride.

Bride-service: a substantial material consideration in which the principal element consists of labor or other services rendered by the groom to the bride's kinsmen.

Token Bride-price: a small or symbolic payment only.

Woman Exchange: transfer of a sister or other female relative of the groom in exchange for the bride.

[1]Reported is variable 1273 (Marriage Payments).

[2]See Murdock (1967, 47).

Gift Exchange: reciprocal exchange of gifts of substantial value between the relatives of the bride and groom, or a continuing exchange of goods and services in approximately equal amounts between the groom or his kinsmen and the bride's relatives.

Dowry: transfer of a substantial amount of property from the bride's relatives to the bride, the groom, or the kinsmen of the latter.

This table provides evidence supporting stylized facts 1 to 3. The first is that the bride-price is common. In 53% (98 of 186) of the societies in the world a bride-price or other form of similar payment is the only payment made. Murdock's (1967) *Ethnographic Atlas* reports the same data defining a society at a finer level and finds that in 839 of 1,267 (66%) societies bridewealth exists. Of the societies that report any exchange during marriage, 131 of 142 (92%) of the marriage contracts contain a bride-price.

The second fact is that the dowry is less common. In only 11 cultures is a dowry the only payment made, and in only 44 cultures is a dowry part of the marriage contract. In only 44 of 142 (31%) of the cultures that report exchange during marriage do the contracts contain a dowry. Murdock (1967) reports that in only 35 of 1,267 (3%) of societies does the dowry occur. The dowry is essentially restricted to circum-Mediterranean and East Asian societies, and even in these areas the practice is far from universal.

The third fact is that when some form of a dowry exists, 75% of the time (33 of 44 cases) the dowry occurs with a bride-price or other form of gift from the woman or her family to the man or his family. In only 11 of 186 total cases (13%) do dowries occur on their own.

The fourth stylized fact is that dowries tend to be much larger than bride-prices. Data reported in Botticini and Siow (2003) confirm that at least in Florence (1242–1436), Athens (4–6th centuries BCE) and for Jews in the Mediterranean (10–12th centuries CE), dowries tended to take the form of productive assets, the most common being cash.[3] Their data also indicate that the size of dowries were significant, equivalent to 3 to 6 years of wages of a skilled worker in Florence and its countryside between 1242 and 1436.

The fifth and sixth stylized facts are that bride-price societies tend to be characterized by high female contribution to agricultural work and high female autonomy, while dotal societies are characterized by high levels of dependence of women and children on the husband. Esther Boserup (1970, 48–50) observes that bride-price societies are characterized by high

[3] See in particular Tables 1 and 2 of Botticini and Siow (2003).

female contribution to agricultural work (typically using temporary, burned plots of land), and high female economic autonomy. On the other hand, dowry societies feature low female contribution to agriculture (typically plow-cultivation systems), and high levels of dependence on the husband for economic support.

3 The Model

There exists a continuum of women of mass 1, and a continuum of men of mass 1. Time is discrete. At the end of each period the fraction $1 - \delta$ of men and the fraction $1 - \delta$ of women die; individuals in a match always die together. The model is an infinite horizon game. Within a match, both players have perfect information of the history of the match. However, players do not know the history of their partners in other matches. The value of i's stream of his or her payoffs is given by the discounted average payoff

$$\Pi^i = (1 - \delta) \sum_{t=0}^{\infty} \delta^t \pi^{i,t}$$

New pairs are randomly matched together. Each pair plays the stage-game shown in Figure 1, where the woman's payoff is listed first and the man's is listed second. *NC* denotes the man's action 'not commit'. It is assumed that $A > B > C$.

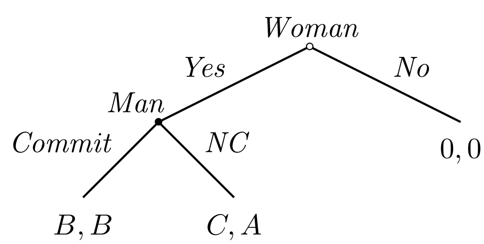

Figure 1: The Basic Game

The history of a match is as follows.

1. A man and a woman are randomly matched. Neither knows the other's history outside of the match.

2. The woman decides whether to enter into marriage, choosing either *Yes* or *No*.

- If the woman chooses *No*, then the match breaks up, both receive a payoff of zero that period, and both are rematched with another randomly chosen individual of the opposite sex at the beginning of the next period.
- If the woman chooses *Yes*, then the match continues.

3. The man chooses between committing to the relationship and being faithful (*Commit*), and not committing and being unfaithful (*NC*).
4. The period ends. Both players receive their payoffs. At this point, the man can choose whether to remain in the match or to be rematched at the beginning of the next period.

   If the match is not broken up, then the process begins again starting at 2. If the match is broken up, then the man and woman enter new randomly chosen matches at the beginning of the next period.

The equilibrium of the stage-game depends on whether $C > 0$ or $C < 0$. As will be shown, whether the customs of a dowry or bride-price are developed also depends on this distinction. I consider both cases individually.

3.1 $C < 0$: The Bride-Price

As shown in Figure 2, if $C < 0$, the subgame perfect equilibrium of the one-shot game is (*No*, *NC*). In this case the payoffs received are $(0, 0)$. This outcome is inefficient.

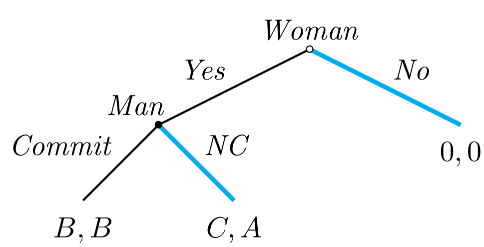

Figure 2: SPE of the Commitment Game when $C < 0$

In this environment, repeated play cannot induce a cooperative outcome. Threats, such as trigger strategies, cannot induce cooperation because at the end of a period, after a man deviates, he can break up the match and avoid punishment from the woman. The following proposition shows that there does not exist a Nash equilibrium that yields the payoff profile (B, B) in every period.

Proposition 1. *The game has no Nash equilibrium in which, in every period, a woman chooses Yes and a man chooses Commit.*

Proof. Consider any strategy of a woman that is part of a strategy profile that induces the outcome $(Yes, Commit)$ in every period. This strategy must specify that in the first period she play *Yes.* If the woman's strategy does not specify this, then the strategy profile will not generate the outcome $(Yes, Commit)$ in the first period.

Given this characteristic of the woman's strategy, a man can always deviate by choosing a strategy that dictates that he play *NC* in the first period of the match and then break-up the match at the end of the first period. This strategy yields him a payoff of A in every period. □

The ability of the man to leave the match at the end of the period prohibits the woman from inducing cooperation by using a trigger strategy that threatens the man. A man can always escape punishment by breaking up the match at the end of the period, before the woman is able to inflict any punishment upon him.

The following proposition illustrates that there exists a fully non-cooperative equilibrium where each period the outcome is *No*; that is, the woman rejects the match.

Proposition 2. *For all values of δ, there exists a (subgame perfect) Nash equilibrium in which every man plays the following strategy: Every period choose NC, and break up the match at the end of the period. All women play the following strategy: Choose No every period.*

Proof. Given that every man will choose *NC*, every woman is best choosing *No* at the beginning of the period. If a woman chooses *Yes* she will receive $C < 0$, rather than the payoff of 0 she receives from choosing *No.* The man cannot deviate and be made better off. In the subgame following the history *Yes*, *NC* yields a higher payoff. □

In this environment, because the man is able to leave a marriage at the end of any period, the outcome of the game in every period is *No.* The man and woman receive the suboptimal payoff profile $(0, 0)$.

I now assume that at the beginning of every match, the man has the option of offering a bride-price $\phi \in [0, \infty)$ to the woman. This offer is conditional on the woman agreeing to marriage. That is, both players know that the bride-price is paid only if the woman chooses *Yes*. I assume that cheating or non-payment by the man is not possible.

The game is shown in Figure 3. As can be seen, if the woman chooses *Yes*, then the man pays the amount offered, ϕ, to the woman. This payment is shown in the figure as a payoff at that point in the game: $(\phi, -\phi)$. In the figure, at each point in the the game where payoffs are altered, the change in payoffs are reported in brackets. Having paid the bride-price, the man then chooses whether to commit or not: C or NC. The woman observes this and in the beginning of the next period, she chooses whether or not to remain in the marriage. If the woman chooses *Yes*, then the man chooses whether or not to commit that period. This is repeated as long as the woman chooses to remain in the marriage. The repetition of the decision is illustrated in the diagram by the dashed arrows.

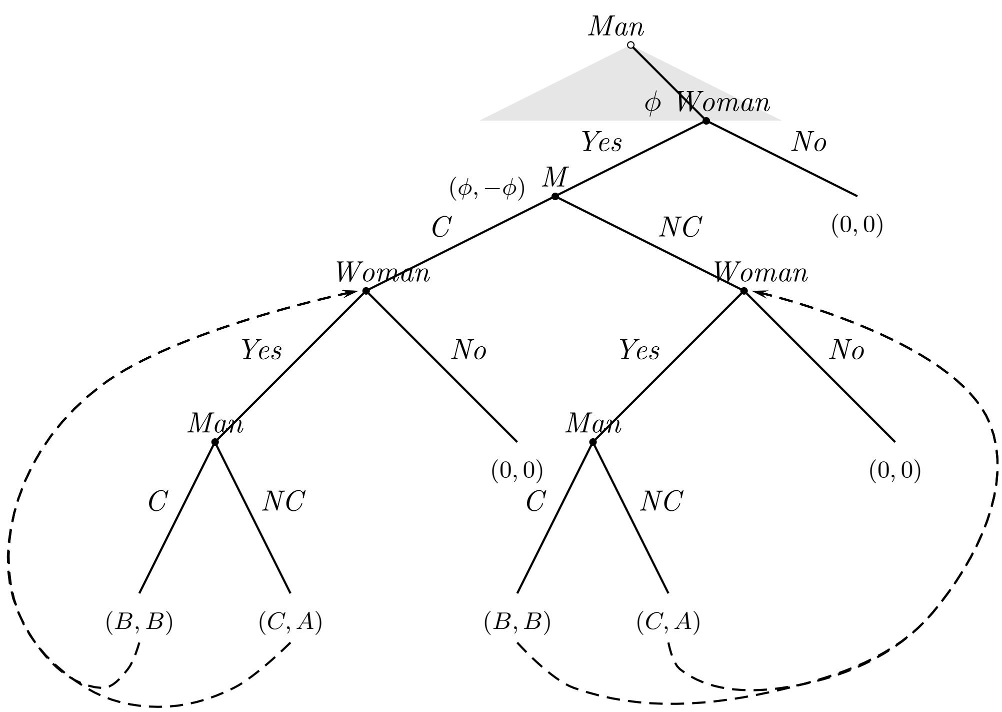

Figure 3: The marriage game with a bride-price.

The following proposition shows that there exists an equilibrium in this game where the man pays a bride-price and commits in every period and every period the woman agrees to remain in the marriage.

Proposition 3. *For each $\phi^* \in [\frac{A-B}{\delta}, \frac{B}{\delta}]$, there exists a Nash equilibrium in which the man pays ϕ^* in the first period, and chooses Commit in every period. In this equilibrium, the woman chooses to remain in the relationship (Yes) in every period if the man offered at least ϕ^* in the first period and committed in all previous periods, otherwise she chooses not to remain in the relationship.*

Proof. Consider the following strategy profile:

Man: Pay a bride-price equal to ϕ^* in the initial period, and choose *Commit* in every subsequent period of the match.

Woman: Agree to match in the initial period (*Yes*) if a bride-price of at least ϕ^* is offered. Choose *Yes* in every period of the match if the man chose *Commit* in the previous period. Do not agree to match if a bride-price less than of ϕ^* is offered.

In equilibrium, the woman receives a payoff of $B + \phi^*$ in the first period and B in every subsequent period. The man receives $B - \phi^*$ in the first period and B in subsequent periods.

To show that this strategy profile is a Nash equilibrium, I first consider possible deviations by the man. Consider the man's deviation from his strategy after the bride-price ϕ^* has been paid. When the man deviates he receives A that period, but the match is subsequently terminated. In the subsequent period he is rematched with a new woman and must pay a bride-price ϕ^* again, and receives the payoff B that period. In the subsequent period he receives his continuation value for being in a relationship after the bride-price has already been paid; I denote this V_c. Therefore, the payoff to deviation is given by

$$\Pi_{deviate} = (1-\delta)[A + \delta(B - \phi^*) + \delta^2 V_c]$$

If, instead, the man adheres to the strategy, then in this period he receives B, in the next period he receives B, and in the subsequent period he receives his continuation value. The payoff to adhering to the strategy is given by

$$\Pi_{adhere} = (1-\delta)[B + \delta B + \delta^2 V_c]$$

The payoff to adhering to the strategy is higher than deviating if and only if $\Pi_{adhere} \geq \Pi_{deviate}$, which is satisfied if

$$\phi^* \geq \frac{A-B}{\delta}$$

Other possible deviations by the man do not yield a higher payoff. If the man offers a bride-price higher than ϕ^* he is worse off. If the man offers a bride-price less than ϕ^* he receives 0 in every period and is worse off, as long as $B - (1-\delta)\phi^* \geq 0$ or equivalently $\phi^* \leq \frac{B}{1-\delta}$. I assume that δ is close enough to 1 to satisfy this inequality.

Next, I consider possible deviations by the woman. The woman may find it optimal, after ϕ is offered, to choose *Yes*, receive the bride-price and the one period payoff, and then break-up the match at the beginning of the following period. Under this strategy the woman's expected payoff is

$$\Pi_{deviate} = (1-\delta)[(B+\phi^*) + \delta 0 + \delta^2(B+\phi^*) + \delta^3 V_c]$$

If the woman does not deviate from her strategy, then her payoff is

$$\Pi_{adhere} = (1-\delta)[(B+\phi^*) + \delta B + \delta^2 B + \delta^3 V_c]$$

and $\Pi_{adhere} \geq \Pi_{deviate}$ if and only if

$$\phi^* \leq \frac{B}{\delta}$$

Putting together both conditions on ϕ^*, we find that the strategy profile is a Nash equilibrium if and only if ϕ^* satisfies the following

$$\frac{A-B}{\delta} \leq \phi^* \leq \frac{B}{\delta} \tag{1}$$

□

The intuition for the result is that if a man cheats in the first period of every match, then he has to pay ϕ^* every period. If instead he cooperates every period, then he only has to pay ϕ^* once. Therefore, the bride-price increases the relative payoff of committing relative to not committing.

To my knowledge, this explanation for the role that the bride-price plays has not yet been put forth. By paying a bride-price the man's payoff to cheating relative to committing decreases. Therefore, any promise the man makes to commit in the future becomes credible when it is accompanied by a bride-price. This same mechanism was put forth as an explanation for gift giving in Carmichael and MacLeod (1997). At first glance, the role the bride-price plays in the model seems similar to the role that the posting of bonds plays in labour markets. Bonds allow workers to credibly commit to not shirking if hired. A bond is posted and if the worker is caught shirking then the bond is forfeited to the employer. Although the bride-price also serves the same purpose – as a credible commitment not to behave badly – the mechanism is not the same. The bride-price is paid no matter how the man behaves. The amount is paid ex ante and is completely independent of how the man behaves.

An additional characteristic of the equilibrium is that the values of ϕ^* that can support a cooperative equilibrium are bounded from above and below. The bride-price must be large enough to induce the man to commit rather than cheat, but it cannot be so large that the woman chooses *No*. The upper bound is significant because although dowry inflation is commonly observed, bride-price inflation is not. As will be shown, there is no upper bound on the dowry when it is given in equilibrium.

The proof illustrates that whether or not the woman can break-up the match at the end of the period, as well as at the beginning, is crucial. If she can break it up at the end of the period, as a man can, then she is always better off marrying, taking the bride-price and then leaving at the end of the period. Is it reasonable to assume that she cannot break-up the match at the end of the period? The assumption is that there is some mechanism that prevents her from cheating in this manner. She cannot take the money and run – instead she must stick it out for at least 1 period before leaving. An alternative is to assume the woman must return the bride-price to the man if she breaks up the match.

Note that if $A > 2B$ then a cooperative equilibrium is not possible. That is, no value of ϕ^* satisfies (1). Intuitively, if the return to not committing (A) is high enough relative to committing (B), then an equilibrium where the man commits will not exist.[4]

The higher is δ, the lower the minimum and maximum bounds on ϕ. The intuition for this is as follows. The more patient a man or woman is, the less he or she values the gain from deviating today relative to the future gains from not deviating today. The lower bound on the bride-price gives the minimum ϕ that can keep the man from deviating. The more he cares about the future, the lower the ϕ necessary to keep him from deviating. The result for the woman is slightly counter intuitive. As δ increases, the payoff of deviating relative to adhering to her strategy increases. Also, as ϕ increases, the payoff to deviating relative to adhering increases. Therefore, the upper bound of ϕ decreases when δ increases.

[4]When $A > 2B$, then a bride-price does not solve the commitment problem. However, other mechanisms may be used to achieve an outcome where fitness is greater than zero. An obvious candidate is polygamy. In this case polygamy may be practiced with a bride-price. This is consistent with the stylized fact that the bride-price and polygamy are practiced together, but the dowry and polygamy tend not to be practiced together.

3.2 $C > 0$: The Dowry and Bride-Price

As illustrated in Figure 4, if $C > 0$ then the unique subgame perfect equilibrium of the one-shot stage-game is (*Yes*,*NC*) and the payoffs are (C, A). The woman agrees to remain in the match and the man chooses to not commit (*NC*).

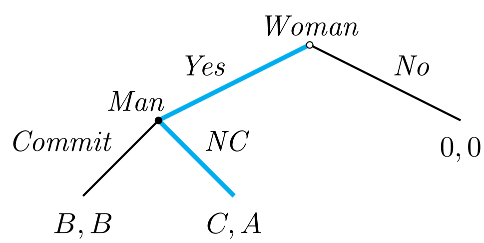

Figure 4: SPE of the Commitment Game when $C > 0$

Consider the repeated environment described in Section 3.1. As before, it can be shown that there does not exist an equilibrium where the man commits in every period.

Proposition 4. *There does not exist a Nash equilibrium where, in every period, the woman chooses Yes and the man chooses Commit.*

Proof. The argument of this proof is identical to the proof of Proposition 1. □

There exist a number of Nash equilibria, where men choose not to commit every period, and the payoffs each period are (C, A). The proposition below provides one example of a non-cooperative Nash equilibrium.

Proposition 5. *For all values of δ, there exists a Nash equilibrium where every man chooses NC every period and the woman chooses Yes every period.*

Proof. The man's strategy is: Choose *NC* every period, and at the end of every period break-up the match. The woman's strategy is: In every period choose *Yes*.

Neither a man or woman can change their strategy and increase their payoffs, given the strategy of the other player. First consider a man. Given the strategy of all women, if he chooses *Commit* in any period he receives B instead of A that period and is worse off, and his future payoffs are not improved by choosing *Commit* rather than *NC*. If the man chooses to stay in the match at the end of the period, rather than break-up the match, his future payoffs are unaffected (given the strategy of the woman) and he is no better off.

Next, consider possible deviations by the woman. If a woman chooses *No* in some period then she receives the payoff of 0 rather than $C > 0$ in that period, and her future per period payoffs are unaffected. Therefore, the woman cannot improve her payoff by choosing an alternative strategy that specifies that she choose *No* in some period. □

I now modify the game and, as before, allow the man the choice of paying a bride-price of ϕ. In this case, with $C > 0$, the introduction of the bride-price has little effect. It can be shown that the non-cooperative equilibrium described above still exists, with an additional component of the strategy being that the man chooses $\phi = 0$.

Next, consider how the game changes when I also introduce a dowry. At the beginning of the match, the bride (and her family) can now offer a fixed resource (a dowry – denoted Φ) to the groom (and his family).[5] This resource, unlike the bride-price, is productive and yields a return of r per period. This key assumption regarding the characteristic of dowries is supported by the historical evidence from a number of different cultures. Dowries were/are often paid in cash or land, and tend to be for large amounts. In some cases cash dowries were also paid in installments over a number of years. In this case, quite literally the dowry yields r for a number of periods (see Botticini and Siow, 2003, 10). Therefore, the dowry Φ reduces the bride's income each period by r and increases the groom's income each period by r. Recall from Section A that the transfer in income from the woman to the man does not decrease the payoffs of the woman unless the man cheats. This result is reflected in the payoffs of the game.[6]

I assume also that the dowry is immobile, taking the form of a house, a plot of land, a washing machine, etc. If the marriage breaks up because of

[5] The assumption that the man has some control over the dowry is key. The dowry is modelled as a transfer of wealth from the bride's dynasty to the groom's dynasty. My assumption can be contrasted to the model of Botticini and Siow (2003), where it is assumed that the dowry is controlled by the woman. In this case the dowry is seen as a transfer from the parents to the daughter rather than a transfer from the bride and her family to the groom and his family. Note that Anderson (1993) defines dowries as "income transfers from the family of a bride to the groom or his parents".

[6] This assumption is not important. One could alternatively assume that the man's payoff is increased and the woman's payoff is decreased for all outcomes of the game; i.e. if the woman chooses *Yes* and the man chooses *NC*, then the payoffs are $(B - r, B + r)$, rather than (B, B). All of the subsequent results would still hold.

the groom (i.e. the groom leaves), then the dowry is kept by the bride. If the marriage breaks up because of the woman (i.e. the bride leaves), then the dowry is kept by the man.

3.2.1 A Simplified Illustration of the Basic Idea

To provide insight into the role played by the dowry, I first add the dowry without the bride-price. I also assume that the dowry decision is discrete. The woman must choose between a dowry $\Phi > 0$ and no dowry $\Phi = 0$. The game is shown in Figure 5. Also illustrated in the diagram is the subgame perfect equilibrium of the one-shot stage-game. Allowing the woman the

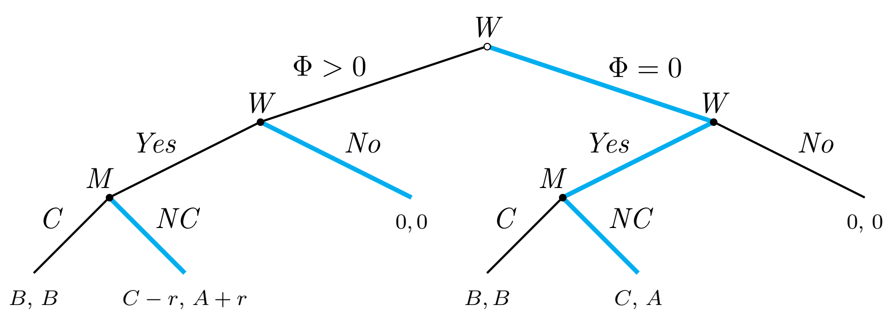

Figure 5: The SPE of the one-shot Commitment Game with a Dowry, where $r > C > 0$.

option of paying a dowry does not alter the outcome of the one-shot game. The woman chooses not to pay the dowry ($\Phi = 0$) and she still chooses *Yes* and the man chooses *NC*. As before, the woman receives C and the man receives A.

However, in a repeated game, the introduction of the dowry allows other more cooperative equilibria to be achieved. Consider the following repeated game. In the first period, the game in Figure 5 is played.

In the subsequent period the subgame (of length 2) following the history (Φ) is played repeatedly in all following periods if the woman played $\Phi > 0$ in the first period. If the woman chose $\Phi = 0$ in the first period, then in all subsequent periods the subgame following the history ($\Phi = 0$) is repeated.

Consider the case where in the first period the woman plays $\Phi > 0$ at the start of the game. Then the subgame following the history $\Phi > 0$ is repeated. If $C - r < 0$, then the one-shot SPE of this subgame is (No,NC)

and each player receives 0, as was the case in Section 3.1

As before, given the repeated environment, the man may find it optimal to offer a bride-price when the marriage is first agreed upon and then to commit in all future periods, with the outcome $(Yes, Commit)$ each period. In this case the per period payoffs are (B, B).

One can think of the situation as one where the dowry allows the woman to choose which game to play repeatedly with a man (because all men have the same strategy), with the only twist being that trigger strategies are not an option for the woman. (This is because the man can leave at the end of any match.) The woman can choose to play the 'left' or 'right' subgame of length 2.

If she chooses the right subgame, then in the repeated environment, where trigger strategies are not an option, the outcome is (*Yes*,NC) every period, and the payoff profile each period is (C, A).

If the woman chooses the left subgame, and if the man is allowed to offer a bride-price, then as shown in Section 3.1, a cooperative equilibrium is possible if men have the option of offering a bride-price at the beginning of a match. As shown, there exists an equilibrium where all men offer a bride-price at the beginning of each match and cooperate every period. In this equilibrium the outcome each period is (*Yes*,*Commit*), and the payoff profile each period is (B, B). The woman is better off here than in the outcome of the right subgame where she receives C every period for δ close enough to 1. One-shot transfers do not matter as $\delta \to 1$.

Another way to help understand the intuition here is to consider why a woman cannot simply threaten not to marry a man if he chooses not to pay ϕ^*. This threat is not credible and cannot be part of a subgame perfect equilibrium. A man knows that if the woman does not pay ϕ^*, then the woman is best off choosing *Yes* and receiving $C > 0$ in each period rather than receiving 0, which is the payoff if she choose *No*. The existence of the dowry Φ makes this threat credible.

3.2.2 The General Model

I now return to the general model. Specifically, I assume that the man and woman can choose among a continuum of values for the bride-price, $\phi \in [0, \infty)$, and the dowry $\Phi \in [0, \infty)$. Both choices can be thought of as offers to pay contingent on the marriage occurring. That is, if the couple does not get married, i.e. if the woman chooses *No*, then neither player is forced to pay.

The sequence of events is illustrated in Figure 6. After a couple is randomly matched, the woman offers a dowry, Φ. The man observes this and makes an offer of a bride-price, ϕ. The woman observes this and decides whether or not to get married: *Yes* or *No*.[7] If the woman chooses *Yes* and the marriage takes place, the dowry and bride-price are exchanged. These payoffs are shown in the figure by $(-\Phi+\phi, \Phi-\phi)$. In addition, the dowry, Φ, alters the relative payoffs in all future periods of this marriage. If the man cheats, then he now receives $A+r$, rather than A, where r is the return the dowry, Φ, yields each period. In period when the man cheats, the woman receives $C-r$ rather than C.

If the woman chooses *No*, then neither the dowry nor the bride-price is paid, both receive zero and the match is finished. The man and woman enter a new match next period. If the woman chooses *Yes*, the man chooses to commit or not. The woman observes this and the game moves to the beginning of the next period. This is illustrated in the figure by the dashed arrows. The woman then chooses whether or not to remain in the marriage. If she chooses *No* the match ends, if she chooses *Yes*, then the man chooses whether or not to cheat. This process is repeated as long as the woman chose *Yes* in all previous periods.

In this game there exists an equilibrium where a bride-price and dowry are paid, the man commits every period and the woman agrees to continue in the marriage every period. Each period, both players receive the payoff B. The following proposition and proof provide a full characterization of this equilibrium.

Proposition 6. *In the game with a dowry and a bride-price, there exists a subgame perfect equilibrium in which all men choose Commit in every period, and all women choose Yes in every period.*

Proof. Consider the following strategy profile.

Man:

- Upon first meeting a woman, offer to pay a bride-price equal to ϕ^* if a dowry greater than or equal to Φ^* is offered by the woman.

[7] In the game I do not explicitly model the ability of the man to choose between *Yes* and *No* to marriage. (Remember the man can choose between *Yes* and *No* at the end of the period.) The payoffs are such that the man will always want to choose *Yes* at some level of ϕ. That is, if the man offers $\phi = 0$ he is best off choosing *Yes*. This is independent of his subsequent action. He will receive at least $B + (\Phi - \phi)$ in the first period, which (as will be shown) is greater than 0. If he were to reject the match he would receive 0 this period. Because of this, I do not include the man's initial choice of *Yes* or *No* in the model. I take it as given that because of his optimal choice of ϕ, he is always best off choosing *Yes* and agreeing to marry initially.

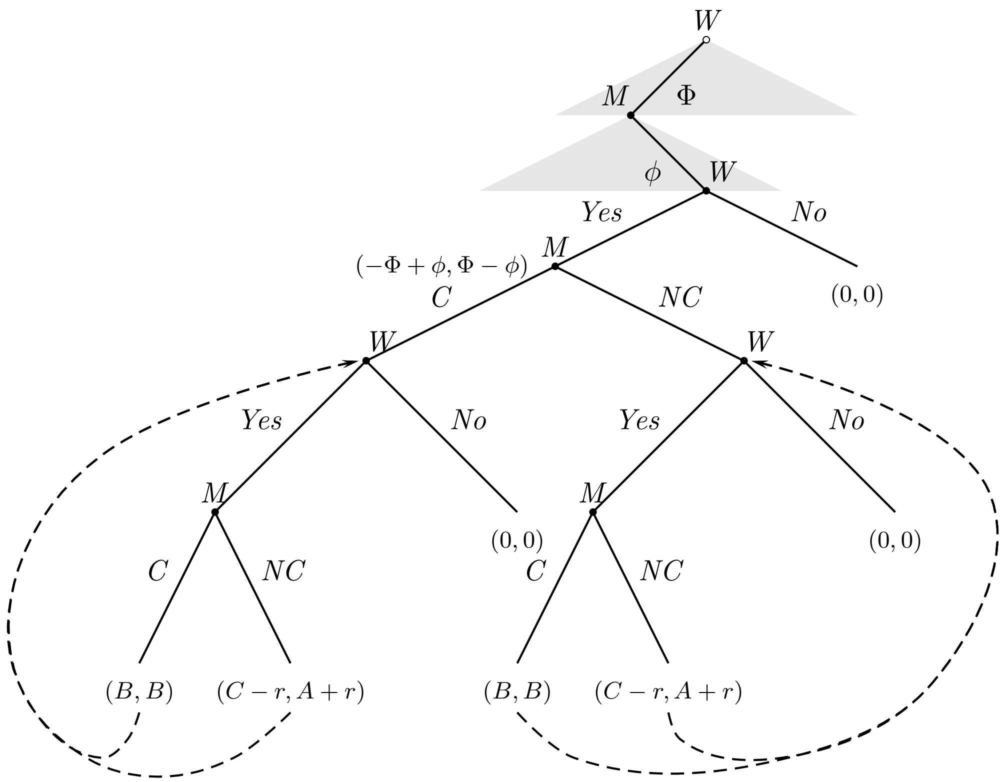

Figure 6: The marriage game with a bride-price and dowry.

- If a dowry of at least Φ^* is offered, then commit in every period.
- If a dowry less than Φ^* is offered, then do not pay a bride-price and choose NC in all future periods of the match.
- If you have chosen NC in any period in the past, then do not commit this period and break up the match at the end of the period.

Woman:

- Upon first meeting a man, offer to pay a dowry equal to Φ^*.
- After offering the dowry Φ^*, choose *Yes* if a bride-price of at least ϕ^* is offered, otherwise choose *No* in every period.
- In the periods after a bride-price and dowry of at least Φ^* and ϕ^* have been paid, choose *Yes* if and only if the man committed in all previous periods.

- If you offer a dowry less than Φ^*, then choose *No* in all subsequent periods of the match.

In equilibrium the woman's payoff is $B - (1-\delta)(\Phi^* - \phi^*)$ and the man's payoff is $B + (1-\delta)(\Phi^* - \phi^*)$.

To prove that this strategy profile is a subgame perfect equilibrium, I use the one deviation property. I check that no player can increase her payoff by changing her action at the start of any subgame in which she is the first mover, given the other player's strategies and the rest of her own strategy.

I first consider the man's strategy.

- *Upon first meeting a woman, offer to pay a bride-price equal to ϕ^* if a dowry greater than or equal to Φ^* is offered by the woman.* If the man chooses a bride-price less than ϕ^*, then the woman will choose *No* and he will receive 0 rather than B this period. He will not have to pay the bride-price, but he will not receive the dowry. If he adheres to the rest of his strategy, then the next period he will be matched with a new woman and the result will be a cooperative match from that point on. The payoffs to deviation and adherence to the strategy are,

  $$\Pi_{adhere} = B + (1-\delta)(\Phi^* - \phi^*)$$
  $$\Pi_{deviate} = 0 + \delta B + \delta(1-\delta)(\Phi^* - \phi^*)$$

  Therefore, $\Pi_{adhere} \geq \Pi_{deviate}$.

  If the man chooses a bride-price greater than ϕ^*, then he is worse off. All his payoffs are the same except he now pays a higher bride-price.

- *If a dowry and bride-price of at least Φ^* and ϕ^* are paid, then commit in every period.* In any period the man could deviate by cheating. Consider the case where the man deviates in this manner in the first period of the match. If the man pays the bride-price ϕ^*, but cheats and then leaves in the first period, then his payoff this period will be the dowry minus the bride-price, plus the payoff this period. When the man leaves, he leaves the dowry (I assume that he loses Φ^* in the beginning of the following period).[8] Because the man adheres to his strategy in all subsequent periods, in the next period he will pay the bride-price ϕ^*, receive the dowry Φ^* and the cooperative outcome will

[8]The timing of this is not crucial. I could also assume that he returns the dowry immediately, rather than having kept it for one period.

be achieved in each period. Thus, if the man deviates in this manner his payoff is

$$\begin{aligned}\Pi_{deviate} &= (\Phi^* - \phi^*)(1-\delta) + (A+r)(1-\delta) \\ &\quad -\delta\Phi^*(1-\delta) + \delta(\Phi^* - \phi^*)(1-\delta) + \delta B\end{aligned}$$

$$\Pi_{adhere} = (\Phi^* - \phi^*)(1-\delta) + B$$

$\Pi_{adhere} \geq \Pi_{deviate}$ if

$$\phi^* \geq \frac{A+r-B}{\delta} \tag{2}$$

- *If a dowry less than Φ^* is offered by the woman, then do not pay a bride-price and choose NC in all future periods of the match.* Given the woman's strategy, when she offers a dowry less than Φ^*, she chooses *No* in all future periods. If the man deviates from his strategy at one point by choosing *Commit* in any period, then he is no better off. Because the woman chooses *No*, he receives 0 whatever his action at that point in the game.

- *If you have chosen NC in any period in the past, then do not commit this period and break up the match at the end of the period.* In this case, the woman's strategy dictates that she will choose *No* next period. If you choose to commit this period you are worse off. If you do not break up the match at the end of this period, then from next period on you get $0 + \delta V_c$, where V_c is the continuation value of starting a new match. If you break-up the match you get V_c.[9]

Next, consider the woman's strategy.

- *Upon first meeting a man, offer to pay a dowry equal to Φ^*.* Given this action, the rest of the woman's strategy and the man's strategy, the payoff to the woman to adherence is

$$\Pi_{adhere} = B - (\Phi^* - \phi^*)(1-\delta)$$

If the woman deviates and offers a dowry less than Φ^*, her best action is to offer $\Phi = 0$. If she does this, then given the rest of her strategy

[9] This part of the strategy must only be specified because it ensures that the woman's optimal action at this point in the game is to choose *No* rather than *Yes*. Therefore, this part of the man's strategy can be interpreted as the woman's belief regarding what the man would do if she chose *Yes*.

and the man's strategy, the woman chooses *No*, receives 0 this period and enters a cooperative match next period.

$$\Pi_{deviate} = 0 + \delta\{B - (\Phi^* - \phi^*)(1 - \delta)\}$$

As long as δ is close enough to 1, such that $B - (\Phi^* - \phi^*)(1 - \delta) > 0$, then $\Pi_{adhere} \geq \Pi_{deviate}$.

If the woman deviates by offering a dowry higher than Φ^*, then she is worse off.

- *After offering the dowry Φ^*, choose Yes if a bride-price of at least ϕ^* is offered, otherwise choose No in every period.*

  The woman could choose an alternative action, where she chooses *No*, rather than *Yes* after she offers the dowry Φ^* and the man offers a bride-price of at least ϕ^*. If the woman does this she receives 0 this period, does not pay a dowry, does not receive a bride-price, and enters into a cooperative match starting next period. Her payoff to deviation is thus,

$$\Pi_{deviate} = 0 + \delta(\phi^* - \Phi^*)(1 - \delta) + \delta B$$

$$\Pi_{adhere} = (\phi^* - \Phi^*)(1 - \delta) + B$$

  It follows that $\Pi_{adhere} \geq \Pi_{deviate}$.

  If the bride-price is below ϕ^*, then the woman's strategy dictates that she choose *No* in every period. If the woman deviates by choosing the action *Yes* in that period, then given the man's strategy, he will cheat that period and break up the match. The woman receives $C - r$ that period. Given the rest of the woman's strategy and the equilibrium strategy of the man, the woman will enter into a cooperative relationship next period.

$$\Pi_{deviate} = (C - r)(1 - \delta) - \delta[B - (\Phi^* - \phi^*)(1 - \delta)]$$

$$\Pi_{adhere} = 0(1 - \delta) + \delta[B - (\Phi^* - \phi^*)(1 - \delta)]$$

  $\Pi_{adhere} \geq \Pi_{deviate}$ as long as $C - r \leq 0$.

- *In the periods after a bride-price and dowry of at least Φ^* and ϕ^* have been paid, choose Yes if and only if the man committed in all previous periods.* Consider the subhistory of this type that ends with the man having committed in the previous period. If the woman chooses *Yes* in this period, then given the rest of her strategy and the man's strategy, her payoff is

$$\Pi_{adhere} = B$$

If the woman chooses *No*, then given the rest of her strategy and the man's strategy her payoff is

$$\Pi_{deviate} = 0 + \delta(\phi^* - \Phi^*)(1 - \delta) + \delta B$$

The woman breaks up the match this period, but next period enters a cooperative match. $\Pi_{adhere} \geq \Pi_{deviate}$ if

$$\frac{B}{\delta} \geq \phi^* - \Phi^* \tag{3}$$

This condition must be satisfied to support the equilibrium.

Next, consider the subhistory of this type that ends with the man having not committed in the previous period. If the woman adheres to her strategy, then she breaks up the match and receives zero this period, but enters into a cooperative relationship next period. Her payoff is thus,

$$\Pi_{adhere} = 0 + \delta(\phi^* - \Phi^*)(1 - \delta) + \delta B$$

If instead she chooses the action *Yes* at this point in the game, then given the rest of her strategy and the man's strategy, this period the man will choose *NC* and break up the match at the end of the period. The woman will receive $C - r < 0$ this period and enter into a cooperative relationship next period.

$$\Pi_{deviate} = C - r + \delta(\phi^* - \Phi^*)(1 - \delta) + \delta B$$

The woman is worse off under this deviation.

- *If you offer a dowry less than* Φ^**, then choose No in all subsequent periods of the match.* Given the man's strategy and the rest of the woman's strategy, the woman's offer of a dowry less than Φ^* will not result in a dowry and bride-price being paid. Therefore, in every period that the match continues the woman receives C. If the woman deviates from her strategy and chooses *Yes* this period, then she receives C, breaks up the match next period, and enters into a cooperative match two periods from now. Her payoff under this alternative action is

$$\Pi_{deviate} = [C + \delta 0 - \delta^2(\Phi^* - \phi^*)](1 - \delta) + \delta^2 B$$

If the woman adheres to her strategy, then given the man's strategy her payoff is

$$\Pi_{adhere} = [0 - \delta(\Phi^* - \phi^*)](1 - \delta) + \delta B$$

$\Pi_{adhere} \geq \Pi_{deviate}$ if

$$\frac{C}{\delta} \leq B - (1 - \delta)(\Phi^* - \phi^*)$$

This is satisfied for δ close enough to 1.

□

As illustrated in the proof, there are bounds on the values of Φ^* and ϕ^*. Using (2) and (3), the bound on the bride-price and dowry can be expressed as

$$\frac{A + r - B}{\delta} \leq \phi^* \leq \frac{B}{\delta} + \Phi^* \tag{4}$$

These restrictions on ϕ^* can be compared with the restriction on ϕ^* from the equilibrium where a bride-price only exists, which is given in (1). The necessary upper bound is now far less restrictive. Recall that the upper bound on ϕ^* was necessary, or else the woman may find it optimal to accept the bride-price each period and break-up the match the following period. Now, the woman must also pay the dowry each period, making this strategy less attractive, and, as a result, the upper bound on ϕ^* higher.

An additional restriction that must be satisfied is that the Φ^* must be large enough that $C - r < 0$. Intuitively, this condition ensures that the woman's strategy of choosing *No* if the man does not pay a bride-price is credible. If $C - r > 0$, then after the woman offers the dowry and the man offers a bride-price ϕ, and the woman's strategy dictates that she chooses *No* rather than *Yes*.

3.2.3 Equilibrium Payoffs of the Men and Women

In equilibrium every player's average discounted expected payoffs will be

$$\Pi^M = B + (1 - \delta)(\Phi^* - \phi^*) \tag{5}$$

$$\Pi^W = B - (1 - \delta)(\Phi^* - \phi^*) \tag{6}$$

Women are better off because of the traditions of the dowry and the bride-price if $B + (\phi^* - \Phi^*)(1 - \delta) > C$. This is satisfied for δ close enough to 1.

Men are better off because of the dowry and bride-price if $B + (\Phi^* - \phi^*)(1 - \delta) > A$. As δ approaches 1, then the inequality will not be satisfied. Therefore, the men do not benefit from the dowry and bride-price. However, given that the dowry is in place, the men are better-off because of the bride-price. If the men do not have the option of offering a bride-price to 'prove' that they are not going to cheat, their payoff is 0. With the bride-price their payoff is $B + (\Phi^* - \phi^*)(1 - \delta)$, which is greater than zero.

3.2.4 Other explanations for Dowries

One explanation for the existence of the dowry is that it is a payment by the bride's family in exchange for 'good' behavior on the part of the groom. For example, Esther Boserup (1970) argues that the dowry is a payment made by women that guarantees future support for them and their children. Within this model, the argument is that the bride pays the groom an amount Φ to commit. If the groom fails to commit and the marriage breaks up, the dowry must be returned to the family.

According to this explanation, the equilibrium outcome is that the bride pays a dowry Φ, the groom commits in all future periods, and the bride chooses *Yes* in each period. First, consider the payoff to a man who chooses the strategy from this strategy profile. The payoff to the man is,[10]

$$\Pi_{Commit} = (1 - \delta)\Phi + B$$

The man receives a once and for all payoff of Φ, and each period he receives the payoff of B.

Next, consider the payoff to a cheater. That is, a man who each period accepts the dowry and receives Φ, does not commit and receives $A + r$, and then after having his non-commitment observed, has the dowry taken away (at the beginning of the next period), losing $\delta\Phi$. The man receives these payoffs each period. Therefore, his stream of payoffs will be

$$\Phi + (A + r) - \delta\Phi + \delta\Phi + \delta(A + r) - \delta^2\Phi + \delta^2\Phi + \delta^2(A + r) - \ldots$$

and therefore

$$\Pi_{NC} = (1 - \delta)\Phi + A + r$$

Given this convention, $\Pi_{Commit} \geq \Pi_{NC}$ if

$$B \geq A + r$$

[10] I assume the dowry yields a return of r each period; this assumption has absolutely no effect on the analysis here and is just made to be consistent with the above.

This is not satisfied. Therefore, given these assumptions the dowry Φ does not induce the man to commit.

An alternative assumption is that the man has to return the dowry the same period. If this is the case, the man will commit if $A+r-B \geq (1-\delta)\Phi$. Even with this assumption, for δ large enough this will not hold. One could further assume that the dowry is not productive.

A second explanation of the dowry is that it is a pre-mortem bequest from the parents to the daughter. The problem with this explanation is that it does not explain why the payment is made at marriage. The bride's parents would be better off giving the dowry to the woman before the marriage rather than giving the money at the time of marriage to the communal 'household' and risking its theft or misuse by the man. Or, if the family wants to leave a pre-mortem bequest to the daughter for other 'strategic' reasons,[11] then, again, this bequest would be better done before or after the marriage.

4 The Evolution of the Dowry and Bride-Price

In this section, I consider the evolutionary properties of the equilibrium described in the previous sections. I consider the equilibrium with the dowry and bride-price, which occurs when $C > 0$.

I assume that the following strategy types exist in the population of women:

W_1:
- Do not offer to pay a dowry.
- Choose Yes in every period.

W_2:
- Offer to pay a dowry Φ.
- Choose *Yes* in every period.

W_3:
- Offer to pay a dowry Φ.
- Choose *Yes* in each period if a bride-price ϕ is paid by the man, and he has not cheated; otherwise choose *No*.

and that the following strategies exist for men:

M_1:
- Do not pay a bride-price ϕ.
- *Cheat* every period.

[11] As in Botticini and Siow (2003); see also the discussion in Harrell and Dickey (1985).

M_2:
- Pay a bride-price ϕ only if Φ is offered by the woman.
- *Cheat* every period.

M_3:
- Pay a bride-price ϕ only if Φ is offered by the woman.
- *Commit* in every period only if a dowry Φ is offered, otherwise *cheat* every period.

Table 2 summarizes the expected payoff to a type M_i man being matched with a type W_j woman for $i = 1, 2, 3$ and $j = 1, 2, 3$.

Table 2: Strategy pairs: Expected Payoffs and Stability.

Strategies	Woman's Payoff	Man's Payoff	Stable ?
(W_1, M_1)	C	A	Yes
(W_1, M_2)	C	A	No
(W_1, M_3)	C	A	No
(W_2, M_1)	C	A	No
(W_2, M_2)	$C - r - (1-\delta)(\Phi - \phi)$	$A + r + (1-\delta)(\Phi - \phi)$	No
(W_2, M_3)	$B - (1-\delta)(\Phi - \phi)$	$B + (1-\delta)(\Phi - \phi)$	No
(W_3, M_1)	0	0	No
(W_3, M_2)	$C - r + \phi - (1-\delta)\Phi$	$A + r - \phi + (1-\delta)\Phi$	No
(W_3, M_3)	$B - (1-\delta)(\Phi - \phi)$	$B + (1-\delta)(\Phi - \phi)$	Yes

For each strategy profile W_i, M_j, I consider whether an invasion of other strategies of men or women will lead to a decrease to zero in either the proportion of W_i or M_j types in the population. This requirement is weaker than an ESS. This is done because different strategies can do as well as the strategies of the ESS. This is because differences in the strategies are only differences in actions that do not occur when matched against the types that exist in the population. For example, consider the strategy profile W_1, M_1. This pair is an ESS in the weak sense that no strategies can invade this strategy pair and cause the size of either of the strategies of the pair to shrink to zero. However, invasions by other strategies can do as well as the strategies in the strategy pair. An invasion of ε type M_2 mutants will survive and grow at the same rate as type M_1. When an M_1 meets a W_1, then the following outcomes will occur: The woman does not offer Φ, the man does not offer ϕ, the man plays *cheat* every period, and the woman chooses *yes* every period. This is the same outcome that would be observed when types W_1 and M_2 meet. The difference is that the man would have offered ϕ if the woman had offered to pay Φ. But because this is off the equilibrium path, it is not observed and the difference in the two strategies does not affect the payoffs. Below I more precisely define what I mean by stability in this context. I call a strategy pair that satisfes this condition a 'Weakly Evolutionarily Stable Strategy Profile' or, simply, a stable strategy profile.

Definition 1. ***Weakly Evolutionarily Stable Strategy Profile:*** *A strategy profile, W_i, M_i, of the marriage game is a Weakly Evolutionarily Stable Strategy Profile if for all $i \neq j$,*

$$\pi_{\mathrm{W}}(W_i, M_i) \geq \pi_{\mathrm{W}}(W_j, M_i) \text{ and } \pi_{\mathrm{M}}(W_i, M_i) \geq \pi_{\mathrm{M}}(W_i, M_j)$$

where π denotes the expected payoff.

The fourth column of Table 2 reports whether the strategy profile is a Weakly Evolutionarily Stable Strategy Profile. Checking each is quite mechanical. It turns out that only two strategy profiles are stable.[12]

The first consists of strategies W_1, M_1. This equilibrium is one where couples do not exchange a dowry or bride-price. The man cheats every period and the woman chooses to remain in the relationship every period. The intuitive reasoning for the stability of the equilibrium is as follows. The men can do no better than to cheat every period; if they commit they are worse off. The woman can do no better. If she leaves the man she gets 0 rather than C. If she chooses only to marry if a bride-price is reciprocated after she offers a dowry, then she will never get married because no men offer a bride-price and she receives zero every period.

The second stable strategy profile is W_3, M_3. Here, the marriages are characterized by a payment of a dowry and a bride-price. The man chooses

[12]The only slightly tricky strategy pair to check is W_3, M_2. Given the population of W_3 strategies for the women, M_2 yields a payoff of $A + r - \phi$. From (4) we know that $\phi \geq \frac{A+r-B}{\delta}$. Therefore, $A + r - \phi \leq A + r - \frac{A+r-B}{\delta} = \frac{B}{\delta} + (1-\delta)\Phi - \frac{(1-\delta)(a+r)}{\delta}$. As $\delta \to 1$, the inequality becomes: $A + r - \phi \leq B$. As long as the inequality on ϕ from (4) is strict, then for $A + r - \phi < B$, and for δ close enough to 1, M_3 yields a higher payoff for the man. Therefore, the strategy pair W_3, M_2 is not stable.

to commit every period and the woman chooses to remain in the match every period.

In the next section, I consider in more detail the two stable strategy profiles. I show what initial population distributions result in a convergence to each of the stable equilibria.

4.1 Stable Strategies and their Basins of Attraction

I now simplify the assumed set of strategies. I restrict the strategies to those that are part of strategy profiles that are evolutionarily stable: W_1, M_1 and W_3, M_3.

Table 3: Strategy pairs (2 strategies only): Expected Payoffs and Stability.

Strategies	Woman's Payoff	Man's Payoff	Stable ?
(W_1, M_1)	C	A	Yes
(W_1, M_3)	C	A	No
(W_3, M_1)	0	0	No
(W_3, M_3)	$B-(1-\delta)(\Phi-\phi)$	$B+(1-\delta)(\Phi-\phi)$	Yes

Given the small number of assumed possible strategy types in the population, the stability of the two strategy profiles can be explored further. Specifically, I show the qualitative features of the basin of attraction of the two stable strategy profiles. The basins of attraction are illustrated in Figure 7. Shown is a square with sides each 1 unit long. The vertical distance from the bottom of the box measures the proportion of type W_1 women in the population. The vertical distance from the top of the box measures the proportion of type W_3 women in the female population. Analogously, the horizontal distance from the left and right sides of the box measure the proportion of type M_1 and M_3 strategies in the male population.[13]

4.1.1 M_3, W_3

Consider a simultaneous invasion of a fraction of ε_{M} and ε_{W} males and females playing strategies M_1 and W_1 respectively. Using the payoffs reported

[13] This layout is analogous to that of the Edgeworth box.

in Table 3, the expected payoffs to each male type can be calculated; they are

$$\begin{aligned}\pi_{M_1} &= \varepsilon_{W_1} A + (1-\varepsilon_{W_1})0 \\ &= \varepsilon_{W_1} A\end{aligned}$$

$$\pi_{M_3} = \varepsilon_{W_1} A + (1-\varepsilon_{W_1})[B + (1-\delta)(\Phi - \phi)]$$

Type M_3 does better than type M_1 for all values of $\varepsilon_{W_1} > 0$.

The expected payoffs to each female type are

$$\begin{aligned}\pi_{W_1} &= \varepsilon_{M_1} C + (1-\varepsilon_{M_1})C \\ &= C\end{aligned}$$

$$\begin{aligned}\pi_{W_3} &= \varepsilon_{M_1} 0 + (1-\varepsilon_{M_1})[B - (1-\delta)(\Phi - \phi)] \\ &= (1-\varepsilon_{M_1})[B - (1-\delta)(\Phi - \phi)]\end{aligned}$$

Type W_3 does better than W_1 if

$$\varepsilon_{M_1} < 1 - \frac{C}{B - (1-\delta)(\phi - \Phi)}$$

As $\delta \to 1$, then this condition become $\varepsilon_{M_1} \leq 1 - \frac{C}{B}$.

4.1.2 M_1, W_1

Next consider the conditions for W_1, M_1 to be an ESS. Consider a simultaneous invasion of type W_3, M_3 men and women.

$$\begin{aligned}\pi_{M_1} &= \varepsilon_{W_3} 0 + (1-\varepsilon_{W_3})A \\ &= (1-\varepsilon_{W_3})A\end{aligned}$$

$$\pi_{M_3} = \varepsilon_{W}(B + (1-\delta)(\Phi - \phi)) + (1-\varepsilon_{W_3})A$$

Type M_3 does better than type M_1 for all values of $\varepsilon_W > 0$. However, as $\varepsilon_W \to 0$, then π_{M_1} increases and approaches π_{M_3}. The existence of type W_3 women in the population is what causes $\pi_{M_3} > \pi_{M_1}$. However, as is shown in the figure, type W_3 women do not fare well in a population dominated by type W_1 men.

The expected payoffs to each female type are

$$\begin{aligned}\pi_{W_1} &= \varepsilon_{M_3} C + (1-\varepsilon_{M_3})C \\ &= C\end{aligned}$$

$$
\begin{aligned}
\pi_{\mathrm{W}_3} &= \varepsilon_{\mathrm{M}_3}[B-(1-\delta)(\Phi-\phi)]+(1-\varepsilon_{\mathrm{M}_3})0 \\
&= \varepsilon_{\mathrm{M}_3}[B-(1-\delta)(\Phi-\phi)]
\end{aligned}
$$

Type W_1 does better than W_3 if

$$\varepsilon_{\mathrm{M}_3} < \frac{C}{B-(1-\delta)(\phi-\Phi)}$$

As $\delta \to 1$, this condition becomes $\varepsilon_{\mathrm{M}_3} \leq \frac{C}{B}$. Because $1-\varepsilon_{\mathrm{M}_1} = \varepsilon_{\mathrm{M}_3}$, this condition is equivalent to $\varepsilon_{\mathrm{M}_1} \geq 1-\frac{C}{B}$. This is the converse of the condition necessary for W_1 to do better than W_3. Therefore, if the population of M_1 types is sufficiently large ($\varepsilon_{\mathrm{M}_1} \geq 1-\frac{C}{B}$), then type $W1$ does better than W_3. If not ($\varepsilon_{\mathrm{M}_1} \leq 1-\frac{C}{B}$), then type $W3$ does better than type W_1.

This border is shown in the figure. It is the vertical dashed line at $\varepsilon_{\mathrm{M}_1} = 1-\frac{C}{B}$. To the right of this line type W_1 does better than type W_3. This is shown by the direction of the arrows. To the right of the line the arrows are pointed upwards, indicating an increase in the proportion of W_1 women. To the left the arrows are pointed downwards, indicating an increase in the proportion of W_3 women.

As has been shown, type M_3 always does better than type M_1. This is shown in the figure by the fact that all arrows point to the left indicating that for all population distributions (except a population of M_3 types equal to zero), the payoff to M_3 men is higher than M_1 men and therefore the proportion of M_3 strategies in the population is increasing.

Given this information, the basin of attractions of two strategy profiles is apparent. The area of the triangle in the upper right hand corner is the basin of attraction for the strategy profile W_1, M_1. Any initial population distribution in this triangle converges to a distribution of strategies that result in an outcome of (C, A) every period. This set of stable strategy profiles is shown by the bold line on the top right of the box. In these equilibria, there may be a positive number of type M_3 men. Asymptotically, the distribution of men will be constant, and the M_3 men will be indistinguishable from the M_1 men. The population distribution represented by the rest of the area of the square results in a convergence to the W_3, M_3 equilibrium. This equilibrium is shown by the dot on the bottom left hand corner of the box. Here the asymptotic population distributions consist of only W_3 and M_3 strategies.

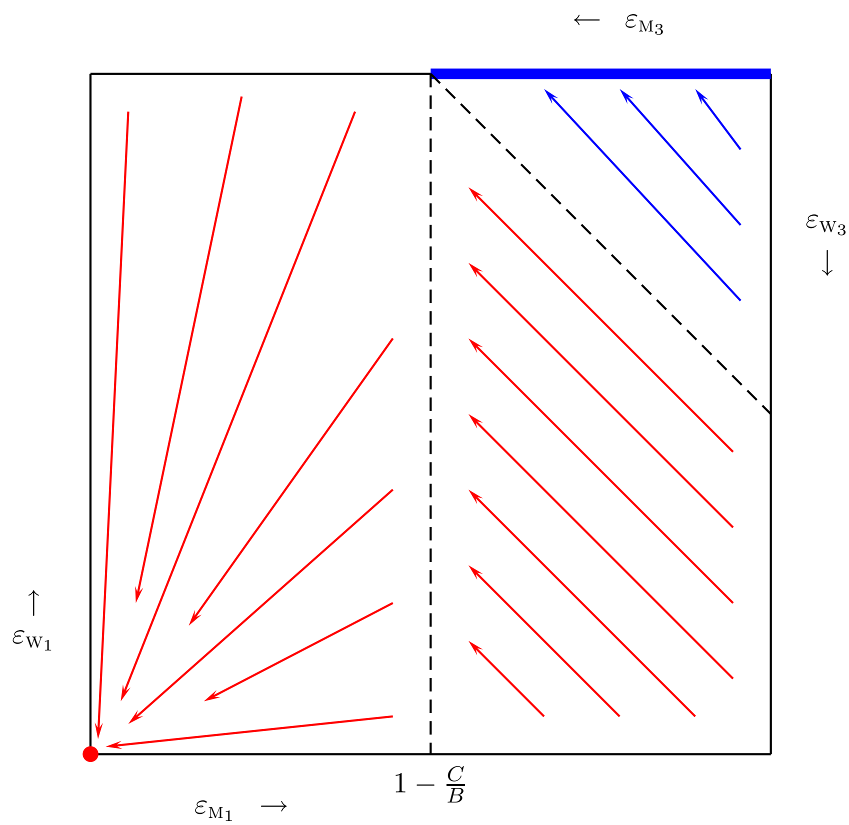

Figure 7: Basins of Attraction of the two Stable Strategy Profiles: W_1, M_1 and W_3, M_3.

5 Conclusions

I have developed a model that is able to explain why the dowry and bride-price exist simultaneously in marriage contracts. The model illustrates why contracts do not specify a net transfer but rather transfers from the bride to the groom and from the groom to the bride. Both transfers are important, not just the net amount exchanged.

The model is also able to explain the observed differences in the characteristics of dowries and bride prices. Dowries tend to be large payments of productive assets such as land or money. The bride-price tends to take the form of less valuable, less productive gifts. These characteristics of marriage contracts are predicted by the model.

A The Model's Microfoundations

A marriage occurs between one man and one woman. I measure all benefits in biological fitness. Because of this, the benefit from raising the child within the marriage is symmetric and non-rival. I further assume that consumption within the household is joint and non-rival. Although consumption does not directly enter into the utility function, it does have value because it enables one to live and have offspring in the future. The total income received each period is constant. However, what can vary is who has control over the goods. The man controls a proportion and the woman controls a proportion.

Each parent's payoff is equal to $U_i = V(I_{tot} - C) + X$, where I_{tot} is total income, C is the money spent to raise children and X is the number of children. That is, each parent's payoff is an increasing concave function of their consumption income $V' > 0$ and $V'' < 0$; and a linear function of the number of children that they have.[14] I normalize the price of raising a child to 1. I assume that $I_W > 1$ and that the woman spends all of her resources raising the child. She is always best off spending 1 to raise 1 child. Both players know this, and know that each other knows it. Therefore, I take this decision of the woman as given.

The man has the option of having offspring outside of the marriage. There is a biological limit to the number of children that a man can have in one period. I normalize one period to equal the amount of time that it takes a woman to have a child (approximately 9 months). I denote by η the maximum number of offspring that a man can produce during this

[14]Note that if the man cheats, then C will also include the money that the man spends on his other children.

period, where $\eta > 1$. For the man, I denote any strategy where he has children outside of the marriage as a "non-committal" strategy, or *NC*. I assume that if a man has offspring outside of the marriage, then he must pay for the full cost of raising this child. If a man chooses not to commit, his optimization problem is given by

$$U_M^* = \max_N \{V((I_M - N) + (I_W - 1)) + (N + 1)\}$$

subject to $N \leq \eta$ and $N \leq I_M$, where I_M and I_W represent the amount of I_{tot} that the man and woman have control over. I assume that I_{tot} is sufficiently large such that the optimal number of children for the man to have is greater than 1 (i.e. he has an incentive to cheat); $N^* > 1$. I also assume that I_M is sufficiently small such that it binds. That is, the inequality $N \leq I_M$ not $N \leq \eta$ is the binding constraint.

The man's Lagrangian is

$$\max_{N,\lambda_1,\lambda_2} L = V((I_M - N) + (I_W - 1)) + (N + 1) + \lambda_1(\eta - N) + \lambda_2(I_M - N)$$

The first-order conditions are

$$V'((I_M - N) + (I_W - 1)) + 1 - \lambda_1 - \lambda_2 \leq 0, N \geq 0, N(V'((I_M - N) + (I_W - 1)) + 1 - \lambda_1 - \lambda_2) = 0$$

$$\eta - N \geq 0, \quad \lambda_1 \geq 0, \quad \lambda_1(\eta - N) = 0$$
$$I_M - N \geq 0, \quad \lambda_2 \geq 0, \quad \lambda_2(I_M - N) = 0$$

If we are at a solution with $\lambda_1 = 0$, $\lambda_2 > 0$ and $-V'(I_W - 1) \leq 1$, then $N^* = I_M$ and any increase in I_M increases N^*. I assume this characterizes the solution. Intuitively, the man does not devote any of the resources that he controls to his family because the woman will devote her resources to the family, and his resources yield a higher return outside of the family. Instead he uses all of his resources to provide for children outside of the family.

The payoffs of the man and woman when the man does not commit (NC) are (N^* is determined by the man's FOCs above):

$$\begin{aligned} U_M^*(NC) &= V((I_M - N^*) + (I_W - 1)) + (N^* + 1) \\ U_W^*(NC) &= V((I_M - N^*) + (I_W - 1)) + 1 \end{aligned}$$

If the man commits (i.e. $N = 0$), then the payoffs are

$$\begin{aligned} U_M^*(Commit) &= V(I_M + (I_W - 1)) + 1 \\ U_W^*(Commit) &= V(I_M + (I_W - 1)) + 1 \end{aligned}$$

In the next sections I consider how a dowry and how a bride-price affect each individual's payoff. This is done to justify the assumed structure of the model.

A.1 The Dowry

Note that when a man does not cheat, any increase or decrease in I_M (i.e. transfers) does not affect the payoff of either person. That is, a dowry leaves both players' payoffs unaffected if the man commits. To see this, consider a dowry that transfers r per period from the woman to the man.

$$\begin{aligned} U_M^*(Commit) &= V((I_M + r) + (I_W - r - 1)) + 1 \\ U_W^*(Commit) &= V((I_M + r) + (I_W - r - 1)) + 1 \end{aligned}$$

The $+r$ and $-r$ simply cancel each other out.

Next, I consider how a dowry affects each person's payoff when the man chooses not to commit. In this case, the increase in the man's income allows him to have more offspring.

$$\begin{aligned} U_M^*(NC) &= V((I_M + r - N_{+r}^*) + (I_W - r - 1)) + N_{+r}^* + 1 \\ U_W^*(NC) &= V((I_M + r - N_{+r}^*) + (I_W - r - 1)) + 1 \end{aligned}$$

Given the above assumption of a solution with $N^* = I_M$, then $N_{+r}^* = I_M + r$ (assuming $I_M + r \leq \eta$).

I now summarize the payoffs to a man and a woman, when the man does not commit, for the case where a dowry is paid and for the case where no dowry is paid. When a woman pays a dowry to the man (and his family), then the woman is worse-off every period if he cheats, but is not worse-off if he does not cheat.

No Dowry:

$$\begin{aligned} U_M^*(NC) &= V(I_W - 1) + I_M + 1 \\ U_W^*(NC) &= V(I_W - 1) + 1 \end{aligned}$$

With Dowry:

$$\begin{aligned} U_M^*(NC) &= V(I_W - r - 1) + I_M + r + 1 \\ U_W^*(NC) &= V(I_W - r - 1) + 1 \end{aligned}$$

From the equations it is clear that this is the case. When the man cheats the dowry makes the man better-off (at least as well off because the man could always use all resources for household consumption) and the woman is unambiguously worse-off.

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