ALLEVIATING THE INFORMATION PROBLEM IN MATE SELECTION: CHOICE OF THE LENGTH OF COURTSHIP AND THE DEGREE OF COMMITMENT

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Abstract: There is an inherent information problem in mate selection. Marital success requires a high level of compatibility between the mates but credible information about the attributes of a potential marriage partner is not easily obtainable. The institutions of courtship and its later stage, engagement, are essentially information gathering processes. We argue that a couple's display of their commitment to the relationship and their choice of the length of the courtship reveal information about their marriage compatibility. The efficacy of courtship and engagement depends on the parameters of the social and cultural context.

Keywords: Information Economics, Incomplete Information, Signaling, Game Theory, Engagement, Family Economics

INTRODUCTION

Marriage is unparalleled as an institution in its importance on one's life. Most people spend the majority of their lifetime in marriage. Personal satisfaction and happiness are closely linked to the quality and the stability of the marital relationship. Success under the conjugal bond, however, is not easily achieved unless there is a high level of compatibility between the spouses. Therefore, selecting the right person becomes the most crucial task for anyone intent on tying the knot.

The selection of a compatible marriage partner is challenging and, by no means, guaranteed because credible information about the other party cannot be obtained easily. A potential mate may be evaluated more or less correctly in terms of his economic resources, but his personality characteristics and attitudes, his values and expectations from marriage and his family's approach to the relationship have to be discerned by careful observation, frequent interaction and communication. The process gets even more complicated as the mates willingly or unwillingly may present a distorted picture of themselves, or they may not be certain of the desired characteristics they should look for in the other, or the parents and the society may place restrictions on the couple's interaction.

The solution in all human societies to this informational problem has been the institution of courtship. It is "a process by which unmarried partners select each other as mates and decide to enter matrimony, as well as the stage (or period) of a relationship that occurs before a couple marries" (Niehuis, Huston and Rosenband, 2006). A courting couple is given a socially legitimate right to gather information about each other and to test their compatibility as potential spouses. It is as if they are allowed to play a restricted simulation of the marriage game. The intent to marry and the disclosure of this intent to the community are the unchanging properties of courtship although its practice shows variations across societies and over time in the same society.

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Engagement is the final and most visible stage of the courtship process. In more traditional societies, it may be the only stage, perhaps preceded by a brief period when it is made public that the couple will be engaged shortly. In modern societies, engagement is frequently preceded by a dating period, which provides the initial screening stage before the couple begins considering marriage seriously. Even though it is being more common for couples to have a close relationship and, thus, know each other better before they are engaged, engagement has still an important information gathering function: they have to test their relationship in a context where the marriage obligations, the demands of the families and the community come into the picture.

In this paper, we argue that the courtship process, particularly the engagement period, functions a social screening tool, which succeeds in preventing some of potentially unsuccessful marriages. The couple's display of their commitment to the relationship and their choice of the length of the courtship reveal information about their compatibility as marriage partners. The efficacy of this tool depends on the parameters of its social and cultural context.

1. RELATED LITERATURE

Engagement is the period starting with a couple's decision to marry and ending with the conclusion of the marriage contract. It is a time when the couple tests their compatibility in values, needs and interests, prepare themselves for their family roles and put in place the material conditions of the marital life. It is an important social institution; almost all human societies throughout the history had elaborate customs and ceremonies shaping the engagement process. Today societies rely more on written rules of conduct; many countries reserve a place for the engagement contract in their legal codes. According to the Turkish Civil Law, engagement creates obligations for both parties because it implies a promise to marry. The party breaking the engagement without a valid cause may be required to pay compensation to the other party. Gifts that are not consumed by use such as jewelry have to be given back if marriage does not take place (Abik, 2005).

Engaged couples gather information about the extent of their compatibility by observing each other's behavior in various situations, and they form beliefs about their similarities and differences. The length of engagement may have an important effect on the likelihood of marriage in this respect. In a long engagement, these beliefs tend to be more accurate as they are supported by larger number of observations.

Another information revealing factor is the quality of the couple's interaction during the engagement. Positive behavior exchanges between the parties and enthusiastic displays of commitment to the relationship enforce the couple's confidence in their decision to marry. Quality time spent together, joint leisure activities, gifts that are not required by the custom are such displays of strong interest in the other. Surra (1985) finds that the length of the courtship depends on the level of companionship between the couple. Highly companionate couples sharing domestic activities and leisure time marry sooner. In couples with low amounts of sharing, women have more doubts about marriage. The courtship of these couples lasts longer as they need more evidence of their compatibility.

We consider these shared activities and gift giving as investment because they require considerable amounts of time, energy and money, and they help create attachment between the mates and remove doubts about moving onto marriage.

There are few studies on engagement or courtship in the economics literature. The most relevant one is that of Farmer and Horowitz (2004). They model the engagement period as a game, in which the suitor decides to offer a long or brief engagement. The woman, knowing that her suitor can be either a suitable or unsuitable marriage partner, accepts or rejects the engagement offer. If a brief offer is made and it is accepted, the couple marries without delay. On the other hand, if the woman receives a long offer and accepts it, she can observe the suitor better and make a more informed decision about his suitability. Either party has to take into account the probability of a good match, the waiting costs and costs associated with breaking the engagement, the marriage utility and the single utility in their decision. Farmer and Horowitz find a mixed equilibrium and various pooling equilibria, which correspond to a brief or long engagement depending on the parameters of the model.

Camerer (1988) and Bolle (2001) explain the inefficient exchange of gifts between courting couples by motives of building trust and discouraging opportunist behavior. Gifts are inefficient when the receiver would be better off if she could spend a sum equal to the price of the gift according to her tastes. An expensive gift that has little or no resale value is a real sacrifice on the part of the giver, and it shows his long-term commitment to the receiver.

Finally, Bergstorm and Bagnoli (1993) explain the observed age difference between spouses by a model where men's timing of marriage depends on their economic potential. A man's economic capabilities are revealed only gradually after he has spent time in the workforce. Men with higher income potential delay marriage until their advantage surfaces while men who are financially less fortunate marry younger.

Our model is inspired by the contribution of Farmer and Horowitz. We extend their model by incorporating the insights of Camerer and Bolle. The information gathered during the engagement depends on the length of the period and on the quality of the interaction between the mates. We find differently from (Farmer and Horowitz, 2004) that there exists a separating equilibrium where only the suitable type invests significant resources into the relationship and the engagement process is more effective in preventing unsuccessful marriages. We proceed as follows: The model is presented in section 2. The equilibria of the model are analyzed in section 3. Section 4 discusses the results and concludes.

2. MODEL

Our model of engagement, like the models mentioned in the previous section, is a signaling game. Signaling games have been widely applied in economics.[3] In a typical signaling game with two players, one of the players, say Player 1, has information that is crucial for the other player's decision but unknown to her. The informed player might find revealing the information advantageous or not depending on his type. The type of Player 1 willing to communicate the information to Player 2 can do so by sending a 'signal' with his chosen action if the other Player 1 types find the action too costly to mimic. Then Player 2 can respond to the signal so that the outcome will be beneficial to both. However, signaling will be impossible and a particular action by Player 1 will be uninformative for Player 2 if the unwilling Player 1 types can act the same way as the willing type.

We choose to model the courtship process as an engagement game because engagement is common to almost all societies, whereas dating (even if the couple's intent is to marry) is not as widespread in traditional cultures. However, the model can easily be evaluated more generally as the later stages of courtship when the mates are seriously considering marriage.

In our model, a suitor, K, wants to make a marriage proposal to a woman, F. They might have been dating for a while, they might have known each other as members of the same community, or they might have been introduced to each other by their social network a short time ago. If F accepts his proposal, they get engaged. The engagement may be concluded by marriage or the couple may break-up depending on how the game is played out.

F believes that her happiness in marriage depends on choosing the suitor who values her highly and, thus, will be a good companion. She will marry K only if she believes he is the right person, or the suitable type (S) following Farmer and Horowitz, in which case her marriage will be rewarding with a high marriage utility V_h. On the other hand, their union will be troubled if he is the unsuitable type (T), in which case F will be disillusioned with a low utility V_l. F would prefer to remain single rather than to marry an unsuitable suitor; her bachelor utility U^F is higher than V_l. F doesn't know whether K is suitable or not; she only has a guess. We assume her guess takes the form of a simple probability distribution, assigning π to K's being suitable and $(1-\pi)$ to his being unsuitable.[4] She may have formed the probability π by using several sources such as his past behavior towards her if they were dating or her limited observations if they were given the chance to interact before

[3] See Riley (2001) for a literature review. Gibbons (1992) provides an easy-to-follow introductory exposition of the signaling games.

[4] Following Harsanyi's (1967-68) suggestion, we analyze this incomplete-information game as a game where all information is common knowledge (complete information) but some information is revealed only to one of the players (imperfect information). Thus, we suppose that Nature chooses the type of the man just before the game starts according to the given probabilities. The man himself knows his type but the woman only knows the probability of him being either type at the start of the game. The equilibria of the converted game will be the same as the equilibria of the former game.

engagement, opinions of her trusted ones who know about him and, even though it is not a good predictor, his looks and charm. For example, π is likely to be high if she has been in a satisfactory relationship with K for a long time, or all people around her believe that she should marry this handsome, well-mannered and affluent young man. We take π as given at the start of the game, but F revises π when new information about K is revealed during the game, as we will see. To avoid the case where F rejects to be engaged to K and the game ends without any insight, we assume that π is sufficiently high at the outset so that she wants to try the engagement. Therefore, her expected marriage utility is higher than her bachelor utility when the game starts:

$$\pi V_h + (1-\pi)V_l > U^F$$

The value of marrying F for K is W_h if he is the type S, in which case they will make a compatible couple; otherwise his marriage utility will be W_l, which is lower than W_h but still higher than U^K, his bachelor utility. K knows the value of marriage for him with certainty. The curious assumption that K prefers marriage to the singlehood even when he knows they will not make a great couple is necessary; otherwise, the information problem disappears and the game has a trivial solution where K proposes only if he is suitable, and F marries K with certainty once he proposed. This asymmetry in the model, F wants to avoid an incompatible spouse while K always prefers to marry, could be justified to some extent if we consider that men seem to gain more from marriage; household responsibilities fall disproportionately on women even when they work; the reversal of the marriage decision, divorce, is less costly for men.[5]

The assumptions above create a context of insufficient information; there is no guarantee that a compatible couple would reach the altar. F knows that her suitor could be either S or T; she needs to be convinced by him that he is really S unless π is very high. K can try to assure F of his commitment by investing high amounts of time and energy into the relationship. He can share most of his leisure time with her in activities of her choice, he can try to impress her family and friends, he can be understanding and keep his enthusiasm when they run into problems. He can also spend considerable amounts of money for flowers, dinners at prestigious restaurants, or expensive social events in addition to the jewelry, gold coins, other precious items he is required to give according to the customs of his society. Here we need to differentiate this type of spending from buying jewellery or similar items which don't get consumed by use and can be resold at a value close to the purchase price. The money spent on leisure activities and consumable gifts represent a real sacrifice because it is sunk; there is no way to get it back. That's why this way of spending is a better signal to show a suitor's trust

[5] The model would have been more realistic if K, like F, didn't know his type for certainty; he would have some doubts in marrying F. This increases the complexity of the model considerably and the gain in terms of obtaining new results would not be worth the ensuing loss of analysis clarity. On the other hand, the assumption that the final decision for marriage rests with the woman sounds reasonable. Women are more cautious than men about entering into romantic relationships; they are more sensitive to the problems within the relationship and they are more likely to end a seemingly unsuccessful relationship (Rubin, Peplas and Hill, 1981).

in himself as a good marriage partner and his commitment to his fiancée. In the model, K invests high (H) if he spends significant time, energy and money to convince F in the first engagement period.

K, on the other hand, can invest low (L) by choosing to give gifts most of which he can claim back in case of break-up, or he allocates less time and effort to be with F. We assume that H is a more costly investment strategy for both S and T, but it is less so for S. The cost of low investment is I_l for both types of K. The cost of high investment is I_h if K is the suitable type; $\widetilde{I}_h$ otherwise ($I_l < I_h < \widetilde{I}_h$). K will expend resources more willingly to invest high if he is really attracted to F and values her highly (W_h).

F, after observing K's investment choice, updates her guess of K being the right man. Then, she makes a decision and chooses between three alternative actions. She may reject him and break the engagement (R). She may decide to marry him without any delay (M). In these two cases, the game ends. Or she may want to know him better if she still has doubts, and so she chooses to wait some more (W). In this case, the engagement lasts longer and F has more opportunity to observe K by obtaining a behavior observation x, where a higher x indicates more desirable behavior. The cumulative distribution function of the behavior observation on suitable and unsuitable types S and T, are respectively $F_s(x)$ and $F_t(x)$, with associated density functions $f_s(x)$ and $f_t(x)$. These density functions overlap to some extent so that there is still some uncertainty as to the suitor's type in a long engagement. Therefore, a suitable man can be out of luck and be rejected after he has produced a bad performance. On the other hand, chance and contextual factors may work in favor of an unsuitable man as he produces a high x and consequently marries F. Then, F decides to marry (M) or not (R) in the last period.

There are waiting costs associated with the engagement process. Each person stays away from the marriage market during this period that burdens a cost on parties, C_1. In addition to that the longer the engagement, the higher is the opportunity cost of missing a good match, therefore $C_2 > C_1$. We assume that the time costs are identical for F and K. There is also a stigma cost, C_s^F for F and C_s^K for K, in the case of the break-up of a long engagement. Stigma cost arises from the possibility of creating a bad reputation that would have a negative effect on the person's future courtship chances. Women are judged more harshly than men in case of an unsuccessful relationship at least in traditional societies; hence, we assume that ($C_s^F > C_s^K$).

A strategy for the man consists of a choice by him of one of the three actions (propose and invest high (H), propose and invest low (L), do not propose (NE)) specified for each of his possible types. For example, the strategy (H,L) tells the man to propose to the woman and make an irrecoverable (high) investment during the engagement if he is the suitable type and to propose and make a safe (low) investment if he is the unsuitable type. There are nine possible strategies for the man: (H,H), (H,L), (H,NE), (L,L), (L,H), (L,NE), (NE,NE),

(NE,H), (NE,L). We can rule out (NE,NE), (NE,H) and (NE,L) because S will be better off by playing H, in which case he will have a high probability of getting married.

Each of the woman's strategies will specify a possible response by her after she observes the man's action. According to her strategy (M,W), for example, she will accept his marriage proposal after a brief engagement period when the man invested high; otherwise, upon seeing that the man only made a low investment, she will choose to wait a little longer before making the marriage decision. There is no need to specify her responses in the case the man chooses not to propose because the game will end before she has the chance to decide. She has also nine possible strategies: (M,M), (M,W), (M,R), (W,W), (W,M), (W,R), (R,R), (R,M), (R,W). It is not reasonable for F to reject K if he invested high in period 1, given that she wanted to be engaged at the start of the game. Therefore, we can eliminate (R,R), (R,M) and (R,W). Similarly, it doesn't make sense to marry a suitor who invested low, but to wait if he invested high; thus, we can leave out (W,M) as well.

Each possible realization of the game will be represented by a pair of strategies, one chosen by the man and the other by the woman. For instance, if the players choose the strategies (H,L) and (M,W), the outcome of this game will be denoted by (H,L;M,W), where the suitor will invest high if he is S and low if he is T, and the woman will marry the suitor if he invested high and wait if he invested low.

To summarize, the game is played as follows:

Period 1: Nature chooses K's type; K learns his type. F forms a guess of K's type, attaching the probability π to his being S.

Period 2: K proposes and invests high or low; otherwise, he doesn't propose and the game ends.

Period 3: After observing K's investment, F decides to marry K, or rejects him, in which cases the game ends, or she chooses to wait another period to know K better.

Period 4: K displays a behavior x; F updates her guess about K's type accordingly.

Period 5: F decides either to marry K or to reject him.

The game tree can be seen in Figure 1.

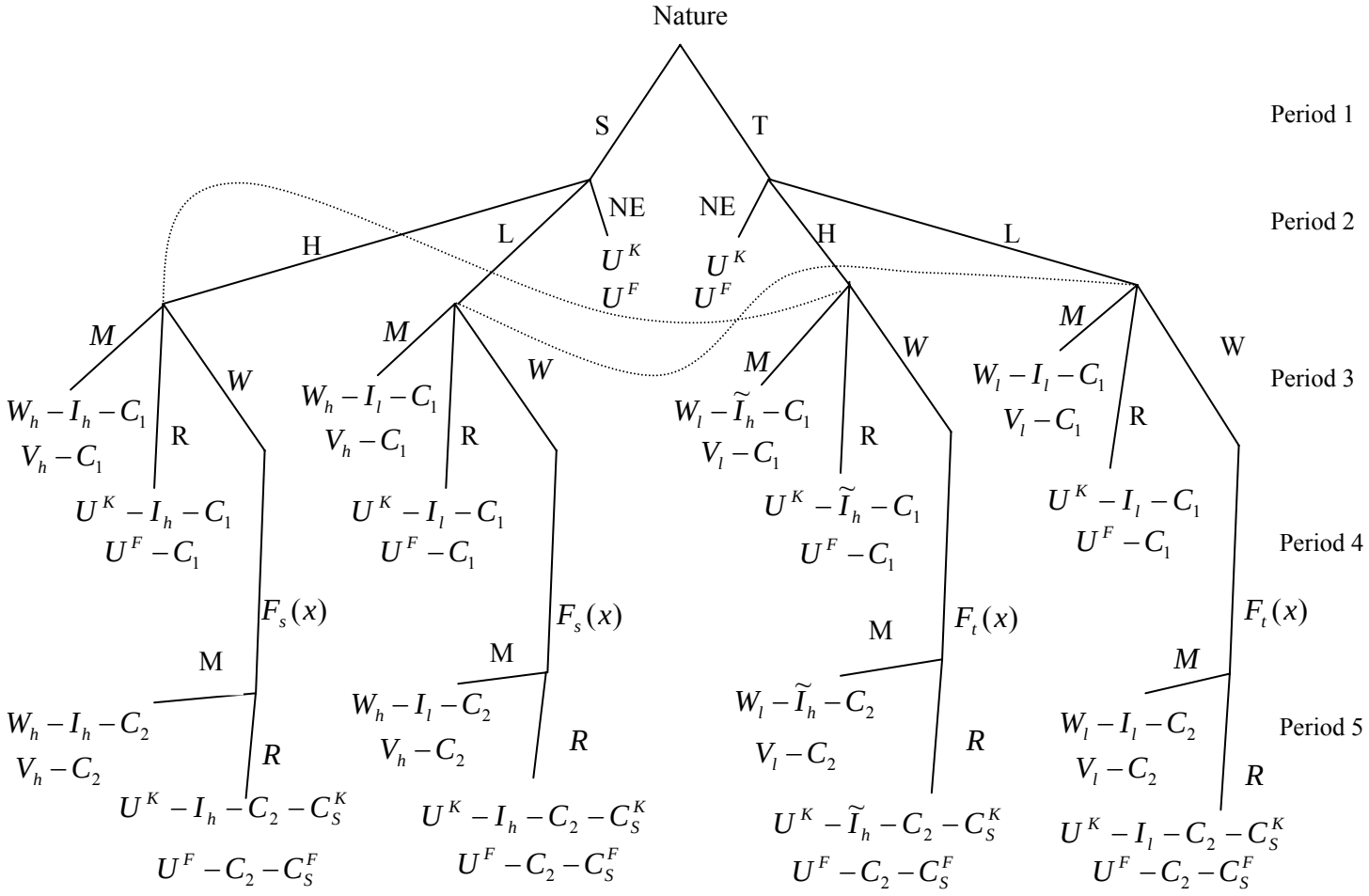
3. EQUILIBRIA ANALYSIS

We start the analysis by checking whether there are any pooling equilibria.

a. Check whether there is a pooling equilibrium where both types of K invest low.

F gets no new information on the suitor when both types play L. Therefore, she has to rely on her guess at the start of the game. By using backward induction, we calculate her expected utility for each of her actions. If she rejects K, her payoff will be

Figure 1. The game tree



$$E(R \mid L) = E(R) = U^F - C_1$$

If she chooses to marry him right away, she will get

$$E(M \mid L) = \Pr(S \mid L)(V_h - C_1) + \Pr(T \mid L)(V_l - C_1) = \pi(V_h - C_1) + (1-\pi)(V_l - C_1) \qquad (1)$$

, where $\Pr(S \mid L)$ is the probability that K is the suitable type given the low investment, which is equal to π when S and T men behave the same way. $\Pr(T \mid L)$, or $1 - \Pr(S \mid L)$, is the probability that K is the unsuitable type given L.

On the other hand, if she decides to wait, she can observe K more and update her guess by using the behavior observation x in period 4. Then, she decides to marry K in the last period if her expected utility of marriage is higher than her bachelor utility:

$$\Pr(S \mid L, x)(V_h - C_2) + \Pr(T \mid L, x)(V_l - C_2) > U^F - C_2 - C_S^F \quad (2)$$

$\Pr(S \mid L, x)$ is the probability that K is the suitable type if F observes low investment in period 2 and x in period 4. Similarly, $\Pr(T \mid L, x)$ is the probability that K is T given L and x. As x increases, $\Pr(S \mid L, x)$ rises while $\Pr(T \mid L, x)$ falls; thus F's expected utility of marriage increases. Let's take a particular value of x, say x^*, which turns (2) into an equality. Then, F will marry K in period 5 if she observes an x greater than x^* in period 4. The probability of observing an x greater than x^* is $(1 - F_s(x^*))$ if K is S and $(1 - F_t(x^*))$ if K is T, where the former probability is greater than the latter. Therefore, F knows that if she chooses to wait, she will marry K with the probability $\Pr(S \mid L)(1 - F_s(x^*)) + \Pr(T \mid L)(1 - F_t(x^*))$. The first term is the probability that K is S *and* x will exceed x^*; the second one is the probability that K is T *and* x will exceed x^*. There is a small probability that F can end up marrying an unsuitable man even when he behaves well during the long engagement period. On the other hand, she will reject K's marriage offer when x is below x^*, which occurs with the probability $\Pr(S \mid L)F_s(x^*) + \Pr(T \mid L)F_t(x^*)$. Similarly, there is a small probability, $\Pr(S \mid L)F_s(x^*)$, that F will reject the right person when he fails to produce an acceptable behavior observation.

Now we can calculate F's expected payoff from waiting if she observed L:

$$\begin{aligned} E(W \mid L) = {} & \Pr(S \mid L)(1 - F_s(x^*))(V_h - C_2) + \Pr(T \mid L)(1 - F_t(x^*))(V_l - C_2) + \\ & (\Pr(S \mid L)F_s(x^*) + \Pr(T \mid L)F_t(x^*))(U^F - C_2 - C_S^F) \end{aligned} \quad (3)$$

, which is equal to

$$\begin{aligned} E(W \mid L) = {} & \pi(1 - F_s(x^*))(V_h - C_2) + (1 - \pi)(1 - F_t(x^*))(V_l - C_2) + \\ & (\pi F_s(x^*) + (1 - \pi)F_t(x^*))(U^F - C_2 - C_S^F) \end{aligned} \quad (4)$$

F will choose the action with the best payoff. We know that F will not reject K in period 3 in this case because the expected value of marrying right away is greater than that of rejecting, $E(M \mid L) > E(R)$, from (1). Then, there are two possible cases:

i. If $E(M \mid L) > E(W \mid L)$

F marries K in period 3. There are no incentives for both types of men to play H because there is no need to incur the high investment cost to convince F. Thus, (L,L;M,M) is a pooling equilibrium. Such equilibrium is more likely when the probability of the suitor being a good match is high; a long engagement has high time costs; the stigma costs for women after an unsuccessful engagement is high; or her bachelor utility is low.

ii. If $E(M \mid L) < E(W \mid L)$

In this case, F chooses to wait. She has two such strategies, (M,W) and (W,W). Let's consider (W,W) first. S type men will have no incentive to play H; more costly investment will not result in a quick marriage, but they have to go through the long engagement process whether they play H or L. Similarly, T men will not play H either. They will play L and accept to wait only if their expected payoff from doing so is greater than their bachelor utility:

$$\left(1-F_t(x^*)\right)\left(W_l - I_l - C_2\right) + F_t(x^*)\left(U^K - I_l - C_2 - C_S^K\right) > U^K \tag{5}$$

Otherwise, they will not propose (NE). Given that (5) is satisfied, (L,L;W,W) is another pooling equilibrium. Low time and stigma costs, low bachelor utility for men, and a not-too-small probability of T men to produce an x greater than x^* make this equilibrium likely.

If F chooses (M,W), we have to check the conditions under which K will not deviate from L by playing H. S will not play H if marrying F in period 3 after investing high is the less attractive option compared to investing low and then waiting longer:

$$W_h - I_h - C_1 < \left(1-F_s(x^*)\right)\left(W_h - I_l - C_2\right) + F_s(x^*)\left(U^K - I_l - C_2 - C_S^K\right) \tag{6}$$

The similar condition for T is

$$W_l - \tilde{I}_h - C_1 < \left(1-F_t(x^*)\right)\left(W_l - I_l - C_2\right) + F_t(x^*)\left(U^K - I_l - C_2 - C_S^K\right) \tag{7}$$

If the utility of ensuring a quick marriage with high investment is greater than the bachelor utility for T men, $\left(W_l - \tilde{I}_h - C_1 > U^K\right)$, then (6) and (7) guarantee that (L,L;M,W) is an equilibrium. Otherwise, (5) must also be satisfied for T to play L. The conditions for this equilibrium are more restrictive: In addition to the requirement that the waiting costs be low, high investment cost must be quite high even for the suitable type.

b. Check whether there is a pooling equilibrium where both types of M invest high.

F has to use her prior guess in her decision at period 3; thus, her payoffs $E(M \mid H)$ and $E(W \mid H)$ will be the same as (1) and (4) respectively. We will investigate the conditions under which (M,R) or (M,W) could be equilibrium strategies for F. Notice that (M,M) and (W,W) cannot be part of an equilibrium since the suitor will deviate by playing L. We also leave out (W,R) because every cost including the cost of high investment must be unrealistically low for T men to play H and accept waiting throughout the long engagement.

F's decision will depend on whether the benefit from marrying soon is greater than her expected payoff if she prefers a long engagement.

i. If $E(M \mid H) > E(W \mid H)$

(H,H;M,R) will be an equilibrium as long as both types of men prefer incurring high investment cost for marriage to not proposing at all: $(W_h - I_h - C_1 > U^K)$ for S and $(W_l - \tilde{I}_h - C_1 > U^K)$ for T. We assume that the condition for S is satisfied easily; otherwise,

investment would have no signaling property. The condition for T is more critical as $W_l < W_h$ and $\widetilde{I}_h > I_h$.

(H,H;M,W) could be another equilibrium if the expected payoff from investing low and waiting is smaller than playing H for either type. This is the case where (6) and (7) are not satisfied simultaneously.

ii. If $E(M \mid H) < E(W \mid H)$

The only candidate for an equilibrium could have been (H,H;W,R), but we have already eliminated this case because it is only possible under very restrictive conditions.

Now, we will check if there are any separating equilibria.

c. Check whether there is a separating equilibrium where S type invests high and T type invests low.

This cannot be an equilibrium. F will reject whenever she observes L, thinking that the suitor is of type T; thus, T can do better by playing either H or NE.

d. Check whether there is a separating equilibrium where S type invests low and T type invests high.

This cannot be an equilibrium too. F will reject whenever she observes H; thus, T can do better by playing L, in which case he incurs a lesser cost and succeeds to marry.

e. Check whether there is a separating equilibrium where S type invests low and T type does not propose.

F will marry K when she observes L. Then, T will get a higher payoff by playing L and consequently marrying F than playing NE. Since T would want to deviate, this fails to be an equilibrium.

f. Check whether there is a separating equilibrium where S type invests high and T type does not propose.

This is an equilibrium if the cost of high investment for T is large enough so that T will have no incentive to mimic S by playing H: ($W_l - \widetilde{I}_h - C_1 < U^K$). Only S type will propose and invest; F will accept marriage offer in period 3. Then, high investment will be a perfect signal and solve the information problem in the game.

g. Check whether there is mixed strategy equilibrium where S type plays H, T type plays H with probability α and NE with probability $(1-\alpha)$.

The separating equilibrium above is the best case for F; but if the condition for this equilibrium is not satisfied, the second best alternative for F could be a mixed equilibrium. Lastly, we consider this equilibrium candidate where S type plays H, T type plays H with probability α and NE with probability $(1-\alpha)$. F observes only H; then, she plays W with

probability β and M with probability $(1-\beta)$. This is an equilibrium if the unsuitable type suitor is indifferent between playing H or NE *and* the fiancée is indifferent between playing M or W.

When F observes an engagement proposal followed by high investment by K, she knows that K is the suitable type with the following probability:

$$\Pr(S \mid H) = \frac{\pi}{\pi + \alpha(1-\pi)}$$

If she chooses to wait, in which case she receives an x observation, she will update her guess of the fiancé being S to

$$\Pr(S \mid x, \alpha) = \frac{f_s(x)\pi}{f_s(x)\pi + f_t(x)\alpha(1-\pi)}$$

Then, she will marry K in the last period only if the expected utility of marriage is greater than her single utility:

$$\left(\frac{f_s(x)\pi}{f_s(x)\pi + f_t(x)\alpha(1-\pi)}\right)(V_h - C_2) + \left(1 - \frac{f_s(x)\pi}{f_s(x)\pi + f_t(x)\alpha(1-\pi)}\right)(V_l - C_2) > U^F - C_2 - C_S^F \tag{8}$$

There is a critical value of x, x^*, that makes (8) an equality. Her decision in period 5 depends on whether the observed x is larger (play M) or smaller (play R) than x^*. It can be seen from (8) that x^* rises as the proportion of the unsuitable types playing H, α, increases.

Then, F's payoff of playing W becomes

$$E(W \mid H) = \left(\frac{\pi}{\pi + \alpha(1-\pi)}\right)\left[\left(1 - F_s\left(x^*(\alpha)\right)\right)(V_h - C_2) + F_s\left(x^*(\alpha)\right)\left(U^F - C_2 - C_S^F\right)\right] + \left(1 - \frac{\pi}{\pi + \alpha(1-\pi)}\right)\left[\left(1 - F_t\left(x^*(\alpha)\right)\right)(V_l - C_2) + F_t\left(x^*(\alpha)\right)\left(U^F - C_2 - C_S^F\right)\right] \tag{9}$$

The equilibrium condition requires that F must be indifferent between waiting and marrying soon:

$$\left(\frac{\pi}{\pi + \alpha(1-\pi)}\right)\left[\left(1 - F_s\left(x^*(\alpha)\right)\right)(V_h - C_2) + F_s\left(x^*(\alpha)\right)\left(U^F - C_2 - C_S^F\right)\right] + \left(1 - \frac{\pi}{\pi + \alpha(1-\pi)}\right)\left[\left(1 - F_t\left(x^*(\alpha)\right)\right)(V_l - C_2) + F_t\left(x^*(\alpha)\right)\left(U^F - C_2 - C_S^F\right)\right] = \left(\frac{\pi}{\pi + \alpha(1-\pi)}\right)(V_h - C_1) + \left(1 - \frac{\pi}{\pi + \alpha(1-\pi)}\right)(V_l - C_1) \tag{10}$$

The second condition requires that T type suitors must be indifferent between H and NE. The expected utility of playing H depends on the probability β with which F plays W:

$$\beta\left[\left(1-F_t\left(x^*(\alpha)\right)\right)\left(W_l-\widetilde{I}_h-C_2\right)+F_t\left(x^*(\alpha)\right)\left(U^K-\widetilde{I}_h-C_2-C_S^K\right)\right]+(1-\beta)\left(W_l-\widetilde{I}_h-C_1\right) \quad (11)$$

Then, the T type will be indifferent when

$$\beta\left[\left(1-F_t\left(x^*(\alpha)\right)\right)\left(W_l-\widetilde{I}_h-C_2\right)+F_t\left(x^*(\alpha)\right)\left(U^K-\widetilde{I}_h-C_2-C_S^K\right)\right]+(1-\beta)\left(W_l-\widetilde{I}_h-C_1\right)=U^K$$

where the left hand side represents the expected payoff from playing H for T type and the right hand side is the payoff from playing NE for T type. One should also note that if type T is indifferent between playing H or NE, then a type S would strictly prefer to play H since the probability of getting a good draw x is greater.

Given the equilibrium value of α determined by (10) and $x^*(\alpha)$ determined by (8), we can solve for β from (11). We can expect that F is more likely to play M when there are more suitable types in the overall population (π rises) or there is less bluffing by unsuitable types (α falls). More waiting occur when both waiting costs and stigma costs are low. Also, as F has the opportunity to gather more reliable information, she is more likely to wait with the knowledge that the value of information in observing x will be high. As x becomes a stronger predictor of type, fewer unsuitable types will play H, F is more likely to accept marriages, and fewer unsuitable matches will occur.

4. DISCUSSION

In our model, the best case scenario for a fiancée is when her suitor shows his genuine commitment by investing significant resources into the relationship *while* a less devoted fiancé would not want to spend as much time and money. Then, she would be certain that she is with the right person; she would prefer to marry after a relatively brief engagement period. This is the separating equilibrium case, where only the suitable suitor has incentive to invest high. The unsuitable candidate will not want to be engaged because he will be rejected if he invests low, and there is no sense in investing high since it is too costly for him. The necessary condition is that his bachelor utility is greater than his marriage utility when he has to incur the high investment cost. Then, the information problem for the woman is solved completely; a suitor's willingness to sacrifice large amounts of resources is the perfect signal revealing his suitability.

The information problem persists if the cost of irrecoverable investment for the unsuitable type is not high enough. Then, he could be willing to spend these resources with the hope of being mistaken for the right man. The social and cultural parameters become crucial in this case. The time cost of a long engagement, the negative reputation and the stigma cost that follows the break-up of an extended relationship and the extent of freedom given to the couple to test their potential partnership shape the outcome.

We are likely to observe brief engagements, in which suitors invest only to satisfy the customary requirements when the time and reputation costs are high, the engagement process is less informative because of a couple's restricted interaction, and bachelorhood has low esteem in the society. These conditions are seen in more traditional societies; the pooling equilibrium where both the suitable and the unsuitable type invest low and the marriage is concluded after a brief engagement period reflects such a case. There is another equilibrium where both types of suitors invest high during the short engagement period. However, this outcome is less likely because the necessary parameter values reflect a traditional culture which is likely to select the former: a fiancé may be required to provide large amounts of precious items, which is considered as safe (low) investment in our model, but he will be discouraged to show his affection for his future bride by showering her with romantic gifts and undivided personal attention.

In less traditional societies where the conditions in the above paragraph are reversed to some extent, longer engagements will be more prevalent. It may be worthwhile for the woman to spend more time in order to know her fiancé better when she can observe his behavior closely and there is less pressure on her to get married. In this case, both probable outcomes predicted by the model involve waiting by the fiancée.[6] In the pooling equilibrium, the fiancé invests low and the woman chooses to extend the engagement period to form a better guess about their compatibility. The suitable type finds high investment unattractive when there is a higher probability of revealing his type during the long engagement and the costs associated with it are low. The unsuitable type will also invest low and cross his fingers that he can pass the test by chance when this strategy's payoff is greater than that of giving up the hope of marriage. Each engagement will be a long one and some engagements will not result in marriage. If the suitable type is not so optimistic of the probability of revealing his true type, he will invest high into the relationship. In this mixed equilibrium, some of the unsuitable suitors will mimic the suitable type by investing high, others will refrain from proposing. Some women will marry the suitor shortly after they observe high investment; others will wait to observe more. Some engagements will be short and followed by marriage whereas others will be long, some of which will be broken.

The engagement institution as modeled in this article is more effective in screening out potentially unsuccessful marriages compared to that of Farmer and Horowitz. Beside the case when the signaling is most effective (the separating equilibrium), the outcomes with waiting and high investment involve less unsuitable marriages because the cost of display of commitment discourages many unfit suitors from making a marriage proposal.

[6] There is a third outcome (L,L;M,W) which also leads to a long engagement. The conditions necessary for his equilibrium are more strict.

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