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Till taxes do us part: Tax penalties or bonuses and the marriage decision

This is the submitted version (pre peer-review, preprint) of the following publication:

Published Version:

Barigozzi, F., Cremer, H., Roeder, K. (2019). Till taxes do us part: Tax penalties or bonuses and the marriage decision. EUROPEAN ECONOMIC REVIEW, 118, 37-50 [10.1016/j.eurocorev.2019.05.001].

Availability:

This version is available at: <https://hdl.handle.net/11585/688072> since: 2020-03-01

Published:

DOI: <http://doi.org/10.1016/j.eurocorev.2019.05.001>

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(Article begins on next page)

This is the pre-peer reviewed version of the following article:

Barigozzi, Francesca, Helmuth Cremer, and Kerstin Roeder. "Till taxes do us part: Tax penalties or bonuses and the marriage decision." *European Economic Review* 118 (2019): 37-50.

The final published version is available online at:

<https://doi.org/10.1016/j.euroecorev.2019.05.001>

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Till taxes do us part: tax penalties or bonuses and the marriage decision¹

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October 2017, revised April 2019

¹We thank the reviewers and the editors for their constructive and insightful comments.

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Abstract

The tax regimes applied to couples in many countries including the US, France, and Germany imply either a marriage penalty or a marriage bonus. We study how they affect the decision to get married by considering two potential spouses who play a marriage proposal game. At the end of the game they may get married, live together without formal marriage, or split up. Proposing (or getting married) implies a cost that can indicate strong love. The striking property we obtain is that a marriage *bonus* may actually *reduce* the probability that a couple gets married. If the bonus is sufficiently large, signaling is no longer informative, and a pooling equilibrium in which no couples get married remains. Similarly, a marriage *penalty* may *increase* marriages. The penalty may lead to a separating equilibrium with efficiency enhancing information transmission, which was otherwise not possible.

JEL classification: J12, D82, H31

Keywords: marriage penalty, marriage bonus, proposal game, signaling

My most brilliant achievement was my ability to be able to persuade my wife to marry me.

Winston Churchill

1 Introduction

The tax regimes applied to couples typically imply either a marriage penalty or a marriage bonus. A marriage penalty involves higher taxes for married couples than for two otherwise identical single individuals; a bonus implies lower taxes for married couples. A marriage penalty applies, for instance, in the US; see Alm *et al.* (1999). In France or Germany, on the other hand, there is a marriage bonus due to income splitting.¹ While there appears to be a trend towards more individualized tax systems, very few systems are effectively completely neutral with respect to the marital status; see OECD (2005; 2017). Even when the tax unit is nominally referred to as “individual based”, there is in most instances some correction reflecting the marital status. Consequently, most tax systems potentially affect a couple’s decision to get married in the first place.²

In this paper we study the impact of a marriage bonus or penalty on the decision to get married. We consider a model where two potential spouses play a marriage proposal game at the end of which they may get married, live together without formal marriage, or split up. This is a signaling game where proposing, or more precisely getting married, involves the risk of a costly divorce, but can indicate a high quality match. Consequently, the possibility to send a costly signal may permit “efficient” (that is mutually beneficial) matches to be concluded which otherwise would not be achieved because of asymmetries of information. The striking property we obtain is that a marriage bonus may actually reduce the probability that a couple gets married.

¹In France and Germany each spouse’s taxable income is defined as half of total family income. The couple’s total tax liability is then twice the tax calculated for each spouse. Because of the concavity of the tax function this reduces the couples’ tax liability unless both spouses have identical incomes or, at least, are in the same tax bracket.

²For the interpretation and discussion we concentrate on income taxation, but other taxes, like inheritance taxes are typically also affected by the marital status. The same is true for some welfare benefits which can be considered as negative taxes.

If the bonus is sufficiently large, the signal becomes uninformative: pooling equilibria emerge in which either inefficient matches also occur or no matches at all are concluded. Similarly, a marriage penalty may induce efficient marriages. Specifically, the penalty may lead to a separating equilibrium with efficiency enhancing information transmission, which absent of a costly signal would not occur.

Our focus on the signaling value of a marriage proposal is in line with evidence from studies of the family. For instance, Seltzer (2000, page 1252) argues that, in the U.S., “informal unions dissolve more quickly than do formal marriages because of differences in the quality of the match between partners who marry and those who do not.” Using Swedish data, Perelli-Harris and Andersson (2017) find that the union stability advantage of married couples may, to a large extent, be driven by the selectivity of couples who choose to marry. Hiekel and Keizer (2010), examining Dutch adults’ perceptions about cohabitation and marriage, report that marriage is not only considered a signal of serious allegiance towards one’s partner, but is also a public statement in front of family and friends. More recently, Lundberg *et al.* (2016) argue that marriage works as a commitment device because it is more costly to exit than cohabitation. Our model shows that this cost can signal the quality of a match and that the cost differential explains why marriage is a more effective signaling device than cohabitation.

From a positive perspective, our paper provides an analysis of how real world tax systems may affect the decision to get married and it offers a possible explanation to the relevant empirical results. Empirical papers suggest that a bonus or a penalty have little impact on the marriage decision. This is rather surprising since they can be rather sizeable; see Leturcq (2012) for an overview of this literature.³ This result can reflect two rather different realities at the micro level. On the one hand, it may arise because *individual* marriage decisions are not significantly affected by taxes. This is puzzling, though, precisely because the penalties or bonuses can be quite large (and in any given country they all go in the same direction). However, we can also have an insignificant

³Leturcq (2012) concentrates on civil unions rather than on marriage. However, in the introduction she extensively discusses the literature which has looked at the impact of the tax system on marriage, mainly in the US, but also in France.

aggregate impact when individuals effects are significant but go in different directions. Our model offers a possible foundation for the latter explanation. We indeed show that depending on the couple's parameters a given penalty or bonus can both foster or deter marriages. The aggregate impact thus sums up positive and negative effects which may well more or less cancel out. This of course depends on the distribution of the parameters in the population, but either way it is clear that the conflicting individual effect will tend to mitigate the aggregate impact; see Section 5 for further discussion.

In addition, our analysis is meant to provide guidance to future research on the optimal taxation of couples. The existing theoretical literature on couple taxation mostly ignores how taxation affects the decision to get married.⁴ As pointed out by Kaplow (2008, page 342) "... a scheme that is ideal on distributive grounds is likely to influence marriage decisions." In other words, it is unlikely that a purely individualistic tax (which would be neutral with regard to the marriage decision) is optimal.⁵ But it is not clear whether this optimal joint taxation fosters or discourages marriages. To the best of our knowledge, there is no general result in tax theory concerning the desirability of a marriage bonus or penalty, even when couples are exogenously given. Considering endogenous marriages adds an extra layer of complexity. Assuming, like Kaplow suggests, that the marriage decision would be otherwise privately optimal, the effect a tax system has on this decision should be accounted for when designing the optimal policy.

Our paper is not in contradiction to his otherwise insightful view, but it shows that the potential distortions are more complex than those he envisions; see the Conclusion for further discussion.

Signaling in the marriage market has been analyzed as a way to overcome asymmetric information and allow profitable matching. However, earlier studies emphasize the role of status goods and conspicuous consumption as signals of income, which represents

⁴See, for instance, Boskin and Sheshinski, (1983); Apps and Rees (1999); Cremer *et al.* (2012), or, more recently, Cremer *et al.* (2016). Chade and Ventura (2002) do study tax design with endogenous marriages and search frictions, but they focus on tax reform rather than on optimal taxation.

⁵For a given family structure, the optimal tax schedule is determined by a number of possibly conflicting effects. These include issues of redistribution between and within couples, labor supply elasticities, efficiency of household production, etc.; see Apps and Rees (2009, Ch 6); or Kaplow (2008, Ch 12) for detailed overviews.

a crucial but unobservable characteristic evaluated by potential partners (see De Fraja 2009, Bronsert *et al.* 2016, and references within). Our signaling model has a different focus. First, potential partners signal their feelings rather than some pecuniary characteristics. Second, our model is related to the “motivation crowding theory” according to which monetary rewards may undermine intrinsic motivation and reduce individuals’ prosocial activities (Titmuss 1970). Different mechanisms have been proposed to explain the unintended consequences of monetary incentives. Like Bénabou and Tirole (2006), we examine how pecuniary incentives might interact with individuals’ intrinsic motivation by diluting the signaling value of (virtuous) behavior.⁶ A nice feature of our very simple signaling model is that, without information transmission, no matching is possible; thus welfare gains and losses from monetary incentives are extremely natural and simple to measure.

2 The Model

2.1 The marriage proposal game

Sam ($S = \textit{Sender}$) and Robin ($R = \textit{Receiver}$) are two partners who interact strategically.⁷ They may or may not be already cohabiting. Let $\theta_S \in \{\theta_L, \theta_H\}$ with $\theta_H > \theta_L > 0$ denote the probability that the match between the two partners is long lasting. This probability represents Sam’s unobservable feelings for Robin. Some information on the quality of the match may already have been disclosed, but some uncertainty remains.⁸

⁶We depart from Bénabou and Tirole (2006) in two important ways. First, the mechanism analyzed by Bénabou and Tirole (2006) focuses on the interaction between an individual’s “image concern” and their “altruism” which jointly motivate prosocial activities. Uncertainty on both characteristics is essential to generating net crowding out. Our mechanism does not require such a degree of complexity and we can focus on a single parameter of private information. Second, in Bénabou and Tirole (2006), individuals’ utilities are an increasing function of their reputation of being altruist, which in turn is generated by their prosocial activities. The authors are not interested in the strategic interaction between the sender of the signal (the individual) and the receiver (all the other individuals). We instead focus on the interaction between the sender and the receiver and crowding in/out is *directly* measured by the amount of efficient matches that become possible/impossible.

⁷As illustrated by the choice of the player’s name our game is meant to represent the proposal game of any pair of potential partners irrespective of their gender. This gender neutrality is implicit in all our arguments even though we often refer to Sam, the sender, as “he” and Robin, the receiver, as “she”. This concession turned out to be necessary to avoid the tedious “he or she”. Using the plural or the singular “they” (which are now recommended by most styleguides to circumvent the he/she) would have made many statements ambiguous.

⁸As show in Section 5 this is in line with the empirical evidence.

With probability λ Sam's love is strong ($\theta_S = \theta_H$) and the probability that the match will last is high. With probability $1 - \lambda$ Sam's love is weak ($\theta_S = \theta_L$) and the probability of a long lasting match is low. This parameter affects the partners' expected utility if they remain together.

Sam chooses an action $a_S \in \{0, c, m\}$. Specifically, if $a_S = m$, Sam proposes marriage; if $a_S = c$, he proposes cohabitation without formal marriage, which confirms the status quo if they are already living together. Finally, when $a_S = 0$, Sam breaks the relationship. In this case the game ends and both partners receive their reservation utilities \underline{U}_S and \underline{U}_R , where $\underline{U}_S, \underline{U}_R > 0$ represent possible future matches. Denoting M_R the extent to which Robin enjoys living with Sam, we make the following assumptions throughout the paper.

Assumption 1: $E[\theta_S] M_R = [\lambda\theta_H + (1 - \lambda)\theta_L]M_R < \underline{U}_R,$

Assumption 2: $\theta_L M_R < \underline{U}_R < \theta_H M_R,$

Assumptions 1 and 2 ensure that Robin's incomplete information about Sam's feelings is relevant for the outcome. In other words, Assumption 1 implies that absent any information acquisition, Robin's expected value of $\theta_S M_R$ is smaller than her reservation utility. Consequently, Robin prefers to look for a new partner when the initial uncertainty about the quality of the matching persists. Assumption 2, on the other hand, implies that Robin wants to accept Sam's proposal if she knows for sure that Sam's feelings are strong ($\theta_S = \theta_H$), while she would refuse the proposal if she knew that the quality of the match is low ($\theta_S = \theta_L$).⁹

Sam's action implies a cost $\varphi_S(a_S)$. We assume that $\varphi_S(0) = \varphi_S(c) = 0$, while a marriage proposal, if accepted, implies the expected cost $\varphi_S(m) = (1 - \theta_S)D$, where $(1 - \theta_S)$ is the probability of divorce and D its cost. The expected cost of the marriage proposal is lower when the quality of the matching is high: $\varphi_H(m) < \varphi_L(m)$. Note that when a marriage proposal is accepted, a binding contract is concluded: after marriage,

⁹As a referee observed, our results remain valid when divorce implies some alimony for Robin, provided that Assumptions 1 and 2 continue to hold. Specifically, Robin's utility in case of marriage would be $U_R = \theta_S M_R + (1 - \theta_S)A$, where A denotes alimony. Assumptions 1 and 2 become $E[\theta_S] M_R + (1 - E[\theta_S])A < \underline{U}_R$ and $\theta_L M_R + (1 - \theta_L)A < \underline{U}_R < \theta_H M_R + (1 - \theta_H)A$, respectively.

the union can only be dissolved by paying the cost of divorce. With cohabitation instead the relationship can be broken without any cost.¹⁰ For simplicity we assume that the proposal in itself is not costly. However, our formal model would not change if proposing would involve a cost, say a diamond ring. What matters then would be the total cost of an accepted proposal. In equilibrium Sam would never buy a diamond ring if the proposal would be refused.

After observing Sam's action, Robin chooses $a_R \in \{y, n\}$. Robin can either accept Sam's proposal ($a_R = y$) or break the relationship ($a_R = n$).

The two partners' utilities are given by

$$\begin{aligned} U_R &= (1 - I) \underline{U}_R + I \theta_S M_R, \\ U_S &= (1 - I) \underline{U}_S + I [\theta_S M_S - \varphi_S(a_S)], \end{aligned} \tag{1}$$

where I is an indicator function which takes the value $I = 1$ if $a_S \in \{c, m\}$ along with $a_R = y$ (Sam and Robin stay together) and the value $I = 0$ otherwise (either Sam or Robin breaks the relationship). When Robin and Sam remain together, Sam's expected utility from the matching quality is $\theta_S M_S$, where M_S measures the extent to which Sam enjoys living with Robin. Our main results are obtained for the case where absent of divorce costs Sam prefers to remain with Robin, no matter of his type.

Assumption 3: $\theta_H M_S > \theta_L M_S \geq \underline{U}_S$

Recall that from Assumptions 1 and 2 Robin always prefers to look for a new partner when the matching quality is low, or when she is uncertain about the matching quality, that is $\underline{U}_R > E[\theta_S] M_R > \theta_L M_R$.

This is the most interesting case because it implies that Sam's and Robin's preferences are not perfectly aligned (see the end of Section 2.2 for the case in which they are instead fully aligned). This creates some incentives to lie. Specifically, when the matching quality is low Sam has an incentive to try to persuade Robin that the matching is

¹⁰The perception of the barriers to breaking up when married is widespread (see Seltzer, 2000). "Cohabitation has emerged as a way for two people to live together without marriage and to avoid the potentially higher costs of divorce if the union does not last" (Perelli-Harris et al. 2017, page 303). See also Lundberg *et al.* (2016).

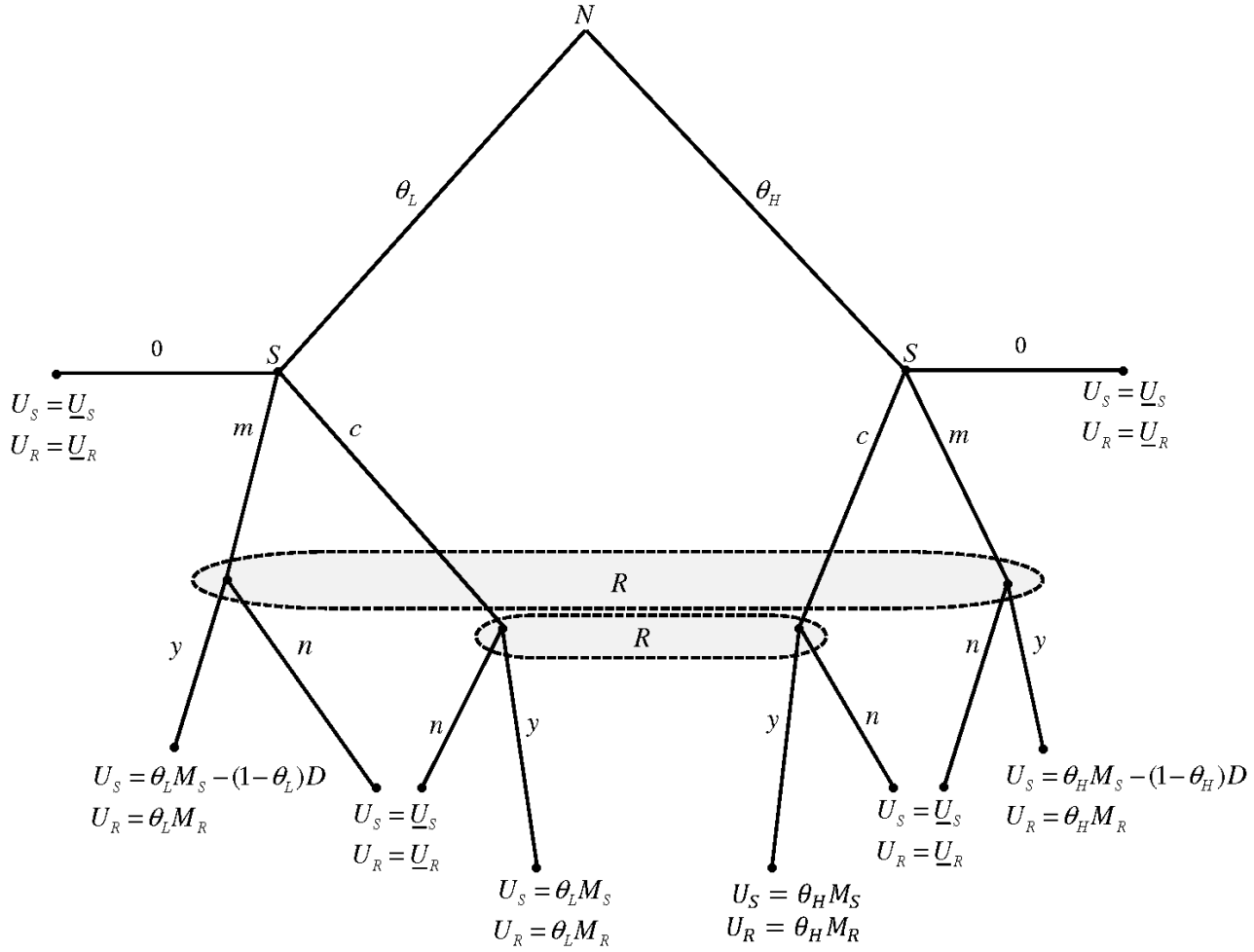


Figure 1: Game tree.

high in order to stay together. As a consequence, a simple communication like “Our love will be forever” would represent mere cheap talk and would not be credible. Conversely, when the matching quality is high Sam may want to invest in a costly proposal to make the transmission of information about the matching quality credible.

The timing of actions is the following. First, Nature draws the type of the matching quality, $\theta_S \in \{\theta_L, \theta_H\}$, which is observable to Sam but not to Robin. Robin only knows the distribution of types. Then, Sam chooses $a_S \in \{0, c, m\}$. After observing Sam’s action, Robin chooses $a_R \in \{y, n\}$. Figure 1 represents the extensive form of the game.

Given that Sam knows θ_S , Sam's action potentially transmits some information to Robin about the matching quality. When observing Sam's action, Robin updates her beliefs using Bayes' rule. Let $\tilde{\lambda}(a_S)$ denote Robin's *posterior* belief that the matching quality is high. Robin's utility when staying with Sam can then be rewritten as

$$U_R = E[\theta_S|a_S]M_R = [\tilde{\lambda}(a_S)\theta_H + (1 - \tilde{\lambda}(a_S))\theta_L]M_R.$$

Robin will choose to remain with Sam ($a_R = y$) if and only if her *posterior* belief $\tilde{\lambda}(a_S)$ is sufficiently large. Conversely, given $\underline{U}_R > E[\theta_S]M_R > \theta_L M_R$, Robin will break the relationship when learning that the matching is low, or when there is no information transmission.

When discussing the outcome of the game we shall often refer to the concept of "efficient" match. A match is efficient if $\theta_S M_S \geq \underline{U}_S$ and $\theta_S M_R \geq \underline{U}_R$ so that the relationship generates some surplus for both partners. Given Assumptions 1–3 this translates into:

Definition 1 *A match is efficient if $E[\theta_S|a_S]M_R \geq \underline{U}_R$ and $\theta_L M_S \geq \underline{U}_S$; both partners receive a utility larger than their reservation level.*

In a world of full information all efficient matches, and only these, would continue. Under the asymmetric information structure considered here, efficient matches may not be durable unless Sam can somehow signal his type in a credible way.

We will focus on Perfect Bayesian Equilibria in pure strategies; see footnote 11.

2.2 Marriage or cohabitation?

Let us determine under which conditions a separating equilibrium exists, where couples whose match is efficient, because $\theta_H M_R > \underline{U}_R$ and $\theta_H M_S > \underline{U}_S$, remain together. In such an equilibrium, Sam signals to be strongly in love ($\theta_S = \theta_H$) by choosing the marriage proposal ($a_S = m$) and Robin, by observing the marriage proposal, infers that $\theta_S = \theta_H$ and accepts the proposal ($a_R = y$). Conversely, when the matching quality is low ($\theta_S = \theta_L$), Sam optimally asks for cohabitation ($a_S = c$), Robin infers that the

matching quality is low and breaks the relationship ($a_R = n$). *Posterior* beliefs are then $\tilde{\lambda}(m) = 1$ and $\tilde{\lambda}(c) = 0$.

This separating equilibrium exists if the two partners' incentive compatibility constraints are satisfied. In particular, when $\theta_S = \theta_H$, Sam must prefer to pay the cost of the marriage proposal and to be perceived as a good matching partner instead of proposing cohabitation, and to be perceived as a bad matching partner, in which case Robin would break the relationship. This requires

$$\theta_H M_S - (1 - \theta_H)D \geq \underline{U}_S. \quad (IC_H)$$

When instead $\theta_S = \theta_L$, Sam must prefer asking to live together, being perceived as a bad match and remaining without a partner instead of asking for marriage and being perceived as a good matching partner, that is

$$\underline{U}_S \geq \theta_L M_S - (1 - \theta_L)D. \quad (IC_L)$$

From (IC_H) and (IC_L) a separating equilibrium in which the players' best replies are given by $[(a_S(\theta_H) = m, a_R(m) = y); (a_S(\theta_L) = c, a_R(c) = n)]$ exists if the following condition holds

$$\theta_L M_S - (1 - \theta_L)D \leq \underline{U}_S \leq \theta_H M_S - (1 - \theta_H)D. \quad (2)$$

The interval $[\theta_L M_S - (1 - \theta_L)D; \theta_H M_S - (1 - \theta_H)D]$ is not empty and the separating equilibrium we are studying is feasible.

Our assumptions then imply that Robin's choices are optimal for her updated beliefs, $\tilde{\lambda}(m) = 1$ and $\tilde{\lambda}(c) = 0$, and given Sam's strategies. Specifically, when $a_S = c$, Robin's optimal choice is to break the relationship because, $U_R = [\tilde{\lambda}(c)\theta_H + (1 - \tilde{\lambda}(c))\theta_L]M_R = \theta_L M_R < \underline{U}_R$; see Assumption 2. When instead $a_S = m$, Robin accepts the proposal if $U_R = [\tilde{\lambda}(m)\theta_H + (1 - \tilde{\lambda}(m))\theta_L]M_R = \theta_H M_R > \underline{U}_R$, which follows again from Assumption 2. Out-of-equilibrium beliefs that sustain this separating equilibrium are, for instance, given by $\tilde{\lambda}(a_S) = 0 \forall a_S \neq m$.

What happens when (2) is not satisfied? Suppose first that $\underline{U}_S < \theta_L M_S - (1 - \theta_L)D$ so that (IC_L) is violated. In this case it would be optimal for Sam to propose

marriage irrespective of his type. But Sam's action then transmits no information and Robin would break the relationship because she cannot be sure about Sam's feelings ($E[\theta_S] M_R < \underline{U}_R$). Hence, Sam does not make a costly marriage proposal in the first place but suggests cohabitation $a_S = c \forall \theta_S$, which is refused by Robin.

Finally, suppose that (IC_H) is not satisfied because $\theta_H M_S - (1 - \theta_H) D < \underline{U}_S$. Then, Sam's optimal strategy is $a_S = c, \forall \theta_S$. Once again, Sam's action does not provide any information about his type and Robin prefers to break the relationship. To sum up, when the incentive constraint of either of Sam's types is violated there is a pooling equilibrium described by $[a_S(\theta_H) = a_S(\theta_L) = c; a_R(c) = n]$. The following proposition summarizes results obtained so far.

Proposition 1 (Signaling without bonus/penalty) *Under Assumptions 1–3:*

- (i) **Separating equilibrium with marriage.** *If (2) is satisfied, then the separating equilibrium $[(a_S(\theta_H) = m, a_R(m) = y); (a_S(\theta_L) = c, a_R(c) = n)]$ exists with posterior beliefs $\tilde{\lambda}(m) = 1$ and $\tilde{\lambda}(c) = 0$ (and possible out-of-equilibrium beliefs as $\tilde{\lambda}(a_S) = 0 \forall a_S \neq m$). In words: Sam proposes marriage when the matching quality is high and cohabitation when it is low. Robin infers Sam's type from his action and thus accepts the marriage proposal while refusing cohabitation.*
- (ii) **Pooling equilibrium with breaking.** *If (2) does not hold, then only a pooling equilibrium of the type $[a_S(\theta_H) = a_S(\theta_L) = c; a_R(c) = n]$ exists, where posterior beliefs are $\tilde{\lambda}(c) = \lambda$ (and possible out-of-equilibrium beliefs are $\tilde{\lambda}(a_S) = 0 \forall a_S \neq c$). In words: Sam proposes cohabitation irrespective of his type. No information transmission occurs and Robin refuses cohabitation so that the couple always breaks.*

When (2) is satisfied, signaling allows information disclosure so that partners whose utility from living together is high are able to benefit from their good prospects. Potential partners with a low matching quality optimally opt for the outside-option and their relationship breaks. In this case, the signaling mechanism is beneficial from a welfare perspective because it allows the potential partners to overcome the problem

of asymmetric information so that marriages between partners whose match is efficient are made possible. However, the information transmission comes at an (expected) cost, which the type- θ_H Sam has to pay to signal the good matching quality and separate from the low-quality match. From a welfare perspective this costly signal represents a loss and cohabitation would be preferable in case the matching ends since breaking the relationship is costless in that case. Still, the signaling and the associated information transmission brings about a welfare gain.¹¹ In the next section we show how a marriage subsidy affects this (virtuous) signaling mechanism.

Note that a separating equilibrium with cohabitation would exist if Sam's and Robin's preferences were fully aligned, implying that Sam does not need to pay any signaling cost in order to credibly transmit information. To illustrate this, consider the case where $\theta_H M_S > \underline{U}_S \geq \theta_L M_S$, meaning that Assumption 3 is violated so that both Sam and Robin would like to stay together only if Sam is strongly in love. A separating equilibrium with cohabitation emerges such that $[(a_S(\theta_H) = c, a_R(c) = y); (a_S(\theta_L) = 0, a_R(0) = n)]$ and with posterior beliefs $\tilde{\lambda}(c) = 1$ (and out-of-equilibrium beliefs $\tilde{\lambda}(a_S) = 0 \forall a_S \neq c$). In words, Sam asks Robin to go on living together when the matching quality is high and breaks the relationship when the matching quality is low. Robin infers Sam's type from his action and thus accepts cohabitation when asked for. In this case marriage never occurs in equilibrium.

The strategy we adopt for presenting our results is as follows. Proposition 1 has explained the signaling mechanism with neither bonus nor penalty, that is when $B = 0$. In Section 3 we show how equilibria in the region of the parameters where signaling is possible when $B = 0$ change when B becomes positive (Proposition 2). Then, in Section 4, we examine the same question when B becomes negative (Proposition 4). In addition,

¹¹In Proposition 1 we focus on separating and pooling equilibria. A natural hybrid or semi-pooling equilibrium in our setting would be the following: the high-type Sam always chooses the marriage proposal whereas the low-type Sam randomizes between a marriage proposal and cohabitation. By observing a marriage proposal Robin updates her beliefs according to Bayes' rule and accepts the proposal if the updated probability that the proposal comes from a high-type Sam is sufficiently high. Robin always refuses cohabitation because she correctly infers that it comes from a low-type. This equilibrium is less efficient than a separating one because also some low-quality matches realize. Considering mixed strategies would multiply the number of cases and equilibria to be considered without changing our main message.

Proposition 3 and 5 show that the bonus and the penalty can lead to the existence of a signaling equilibrium which otherwise would not be possible. We treat the bonus and the penalty separately because the counter-intuitive results and the parameter regions where they occur are different according to the sign of B .

3 Marriage or cohabitation under a marriage bonus

Suppose now that the tax regime of couples translates into a bonus $B > 0$ for married couples. Assume that B is equally shared between the two partners so that utilities in case of marriage become:

$$\begin{aligned} U_S &= \theta_S (M_S + B/2) - \varphi_S(m) \\ U_R &= [\tilde{\lambda}(m)\theta_H + (1 - \tilde{\lambda}(m))\theta_L] (M_R + B/2), \end{aligned}$$

Hence B reduces the expected cost of the marriage proposal to $\varphi_S^B(m) = (1 - \theta_S)D - \theta_S B/2$.

Sam's incentive constraints are now given by

$$\theta_H (M_S + B/2) - (1 - \theta_H)D \geq \underline{U}_S, \quad (IC_H^B)$$

and

$$\underline{U}_S \geq \theta_L (M_S + B/2) - (1 - \theta_L)D. \quad (IC_L^B)$$

Hence, a marriage bonus relaxes (IC_H^B) but reinforces (IC_L^B) . This does not come as a surprise. The bonus will make a proposal more attractive for the high-type Sam; this is a “good thing” and makes the existence of a separating equilibrium more likely. However, the bonus will also make a proposal more attractive for the low-type Sam which is a “bad thing” from this perspective.

The condition for separation on Sam's side is now

$$\theta_L (M_S + B/2) - (1 - \theta_L)D \leq \underline{U}_S \leq \theta_H (M_S + B/2) - (1 - \theta_H)D. \quad (3)$$

This expression shows that the introduction of a marriage bonus shifts the interval of \underline{U}_S values for which Sam can credibly signal his matching quality to the right while also increasing its length; see Figure 2.

In addition, the introduction of the bonus B may affect Robin's best reply. Specifically, when no information is transmitted, or when she knows for sure that Sam's type is θ_L , she will continue to refuse marriage or cohabitation only as long as

$$E[\theta_S](M_R + B/2) = [\lambda\theta_H + (1 - \lambda)\theta_L](M_R + B/2) < \underline{U}_R, \quad (4)$$

$$\theta_L(M_R + B/2) < \underline{U}_R < \theta_H(M_R + B/2). \quad (5)$$

When $B = 0$ these conditions are satisfied from Assumption 1 and 2 but they may be violated when B is sufficiently large. Observe that (4) implies $\theta_L(M_R + B/2) < \underline{U}_R$ and that $\underline{U}_R < \theta_H(M_R + B/2)$ follows from Assumption 2 as long as $B > 0$. Consequently, Condition (4) implies Condition (5), but the opposite is not true. In words, (5) requires that Robin continues to refuse Sam's proposal to live together if she knew that his feelings are weak, which is a requirement for the separating equilibrium.

Comparing (2) and (3) and using (4)–(5) establishes the following proposition.

Proposition 2 (Signaling when moving from $B = 0$ to $B > 0$) *Under Assumptions 1–3, suppose that condition (3) holds for $B = 0$:*

(i) **Signaling continues to be possible.** *If $\theta_L B/2 \leq \min\{\underline{U}_S - \theta_L M_S + (1 - \theta_L)D; \underline{U}_R - \theta_L M_R\}$ conditions (3) and (5) are satisfied and the separating equilibrium $[(a_S(\theta_H) = m, a_R(m) = y); (a_S(\theta_L) = c, a_R(c) = n)]$ continues to exist with posterior beliefs $\tilde{\lambda}(m) = 1$ and $\tilde{\lambda}(c) = 0$ (and possible out-of-equilibrium beliefs as $\tilde{\lambda}(a_S) = 0 \forall a_S \neq m$).*

(ii) **Signaling is no longer possible.** *If either condition (3) or condition (4), or both do not hold, then signaling becomes impossible. Only pooling equilibria survive; specifically, we have:*

1. **Pooling equilibrium with breaking.** *If (4) is met but (3) is violated, i.e. if $\underline{U}_S - \theta_L M_S + (1 - \theta_L)D < \theta_L B/2 \leq E[\theta_S] B/2 < \underline{U}_R - E[\theta_S] M_R$, then only a pooling equilibrium with $[a_S = c \forall \theta_S, a_R(c) = n]$ exists, where posterior beliefs are $\tilde{\lambda}(c) = \lambda$ (and possible out-of-equilibrium beliefs are $\tilde{\lambda}(a_S) = 0$*

$\forall a_S \neq c$). Sam proposes cohabitation irrespective of his matching quality and Robin refuses cohabitation so that the couple always breaks.

2. **Pooling equilibrium with marriage.** If (4) is violated, i.e. if $E[\theta_S] B/2 > \underline{U}_R - E[\theta_S] M_R$, then only a pooling equilibrium with $[a_S = m \forall \theta_S, a_R(m) = y]$ exists, where posterior beliefs are $\tilde{\lambda}(m) = \lambda$ (and possible out-of-equilibrium beliefs are $\tilde{\lambda}(a_S) = 0 \forall a_S \neq m$). In words: Sam proposes marriage irrespective of his type, and Robin accepts so that all partners remain together.

The previous proposition first considers the case described in Proposition 1(i) where a separating equilibrium exists when $B = 0$. Not surprisingly, when B is sufficiently small, the equilibrium is not affected. More surprising results obtain for larger levels of B , when the incentive constraint of the low-type Sam is violated or when Robin's Condition (4) is not longer satisfied (Proposition 2(ii)). Only pooling equilibria exist in these cases; the bonus implies that no marriages at all or too many are being concluded. This means that the marriage subsidy deeply interferes with the virtuous signaling mechanism, where it otherwise corrects a "market failure" brought about by asymmetric information.

In case (1) we have a pooling equilibrium which is equivalent to the one described in point (ii) of Proposition 1. This occurs when B is sufficiently large to make a proposal attractive to the low-type Sam but not large enough for Robin to accept the proposal, without information transmission (so that Condition (4) holds).¹² Hence, Sam does not pay the cost of the marriage proposal and only proposes cohabitation which Robin refuses.

Case (2) occurs when the marriage bonus implies that (4) no longer holds and a new type of pooling equilibrium with marriage emerges. Here Robin prefers to remain with Sam even without information disclosure because of the bonus. Sam's optimal strategy is now $a_S = m \forall \theta_S$ and Robin accepts. In this pooling equilibrium all partners stay together even when the matching quality is poor. Figure 2 illustrates Proposition 2.

Observe that to assess the impact of B on welfare one has to account for the fact

¹²This is only possible when $\underline{U}_S - \theta_L M_S + (1 - \theta_L)D < \underline{U}_R - E[\theta_S] M_R$.

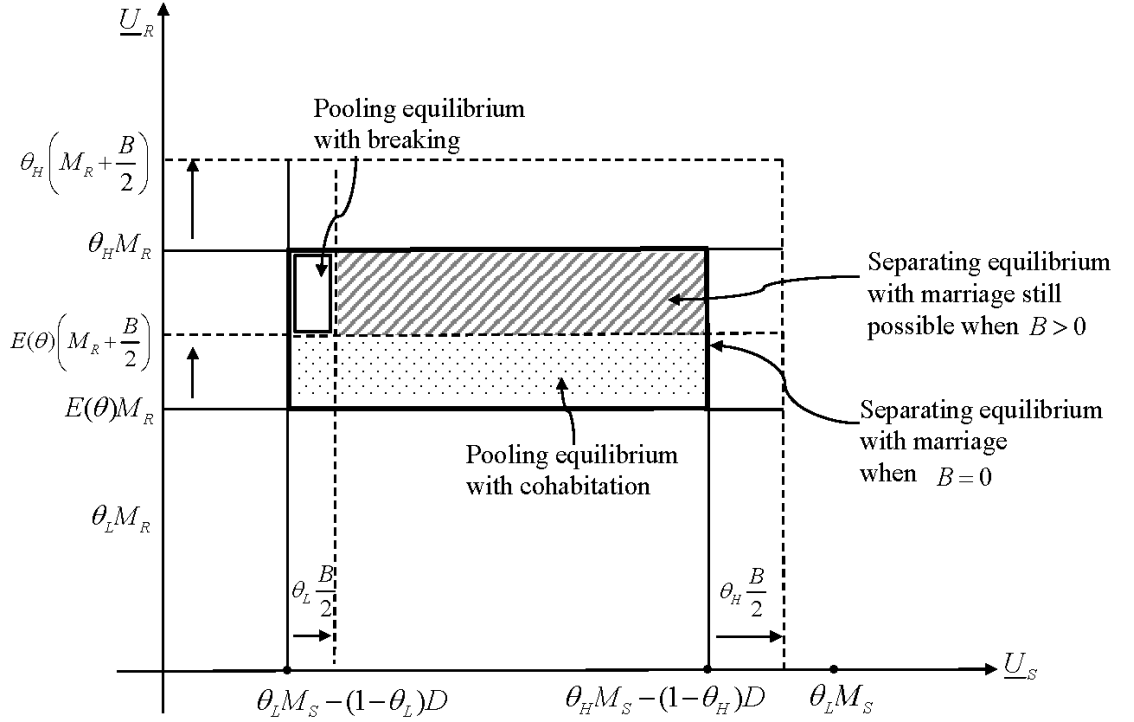


Figure 2: Impact of a marriage bonus. The region of the parameters where signaling is possible with $B = 0$ is depicted with a black bold boundary. When $B > 0$, the latter is divided in three parts: the shaded area indicates the region where signaling continues to exist, the light grey area is the region where “pooling with breaking” emerges, the dotted area is where “pooling with marriage” occurs.

that the bonus must somehow be financed. To measure welfare when the level of B is different from zero, we thus use the total surplus generated by the concluded marriages (including that due to B) minus the total cost of financing the bonus. This is equivalent to evaluating total surplus generated by marriages without counting the B 's in individual utilities.

The two outcomes described in Proposition 2(ii) are inefficient according to Definition 1. Specifically, the marriage bonus prevents signaling and efficient matches are not concluded (case 1), or inefficient matches are induced (case 2). In the second case, the welfare loss is particularly high because both high- and low-types pay the signaling cost but there is no information disclosure.

Proposition 2 provides a rather negative view of the marriage bonus. That a marriage bonus distorts the decision to get married is not surprising in itself; see the Kaplow quote in the Introduction. From that perspective two main lessons emerge from our proposition. First, unlike traditional distortions in taxation theory, the marriage distortion is not continuous in B ; once the critical threshold ($B/2 = \underline{U}_S/\theta_L - M_S + (1 - \theta_L)D/\theta_L$) is reached, we have a discrete switch involving a drastic change in regime and a complete destruction of information transmission.¹³ Second, the sign of the distortion may be at odds with intuition because the bonus may effectively lead to fewer marriages.

Recall that Proposition 2 assumes that condition (3) is satisfied when $B = 0$. When this is not true, a number of mostly trivial cases can arise. One interesting result emerges, though. Assume that (IC_H^B) is violated for $B = 0$. Then, a suitably designed marriage bonus may have a positive impact and make signaling possible. Recall, that the interval of \underline{U}_S for which condition (3) holds depends on B . For any given \underline{U}_S one can thus find levels of B for which (3) is satisfied. If this can be done without violating (4) and (5) then the bonus induces a separating equilibrium and thus enables information transmission.

Proposition 3 (From no signaling to signaling with $B > 0$) *Under Assumptions 1–3, suppose that condition (IC_H^B) does not hold for $B = 0$ so that signaling is impossible in the laissez-faire.*

If the interval $[(\underline{U}_S + (1 - \theta_H)D - \theta_H M_S)/\theta_H; (\underline{U}_R - E[\theta_S] M_R)/E[\theta_S]]$ is non-empty, then a tax bonus $B/2$ belonging to that interval makes the separating equilibrium $[(a_S(\theta_H) = m, a_R(m) = y); (a_S(\theta_L) = c, a_R(c) = n)]$, with posterior beliefs $\tilde{\lambda}(m) = 1$ and $\tilde{\lambda}(c) = 0$ (and out-of-equilibrium beliefs $\tilde{\lambda}(a_S) = 0 \forall a_S \neq m$), possible.

Now the sign of the effect is as expected (a bonus produces more marriages), and the marriage bonus impacts on the marriage decision in such a way that welfare increases. Specifically, by making signaling possible it induces efficient matches.

¹³Some smoothness may, however, be reestablished at an aggregate level when potential couples are heterogenous and the parameters, and particularly \underline{U}_S , are suitably distributed.

4 Marriage or cohabitation under a marriage penalty

The previous section has considered the introduction of a marriage bonus and has shown that it may produce some unexpected results. In particular, it may prevent some marriages from being concluded. We now examine the case where the income taxation implies a marriage penalty so that $B < 0$. As announced before, we study the two cases separately because it turns out that they are not exactly symmetrical. A marriage penalty will reinforce the incentive constraint of the high-type Sam but relax that of the low type. It won't affect the decision of Robin if she is uninformed, or believes for sure that the matching is of low quality; in either case she will continue to refuse the proposal. However, the penalty may also make a proposal unattractive which she firmly believes emanates from a Sam who is strongly in love, as Proposition 4(ii) shows.

Once again we start with a situation where condition (3) holds for $B = 0$ so that there is a separating equilibrium with marriage. This yields the following counterpart to Proposition 2.

Proposition 4 (Signaling when moving from $B = 0$ to $B < 0$) *Under Assumptions 1–3, suppose that (3) holds for $B = 0$.*

- (i) **Signaling continues to be possible.** *If $\theta_L B/2 \geq \underline{U}_S - \theta_H M_S + (1 - \theta_H)D$ (so that (3) is still satisfied because IC_H^B holds despite the penalty) and if $\underline{U}_R < \theta_H (M_R + B/2)$ (so that Robin accepts a marriage proposal from a high-type Sam despite the penalty) the separating equilibrium $[(a_S(\theta_H) = m, a_R(m) = y); (a_S(\theta_L) = c, a_R(c) = n)]$ continues to exist with posterior beliefs $\tilde{\lambda}(m) = 1$ and $\tilde{\lambda}(c) = 0$ (and possible out-of-equilibrium beliefs as $\tilde{\lambda}(a_S) = 0 \forall a_S \neq m$).*
- (ii) **Pooling equilibrium with breaking.** *If $\theta_L B/2 < \max\{\underline{U}_S - \theta_L M_S + (1 - \theta_L)D; \underline{U}_R - \theta_H M_R\}$ so that either (3) or the second inequality in (5) is violated, signaling becomes impossible and only the pooling equilibrium $[a_S = c \forall \theta_S, a_R(c) = n]$ exists where posterior beliefs are $\tilde{\lambda}(c) = \lambda$ (and possible out-of-equilibrium beliefs are $\tilde{\lambda} = 0 \forall a_S \neq c$). Sam proposes cohabitation irrespective of the matching quality and Robin refuses cohabitation so that the couple always breaks.*

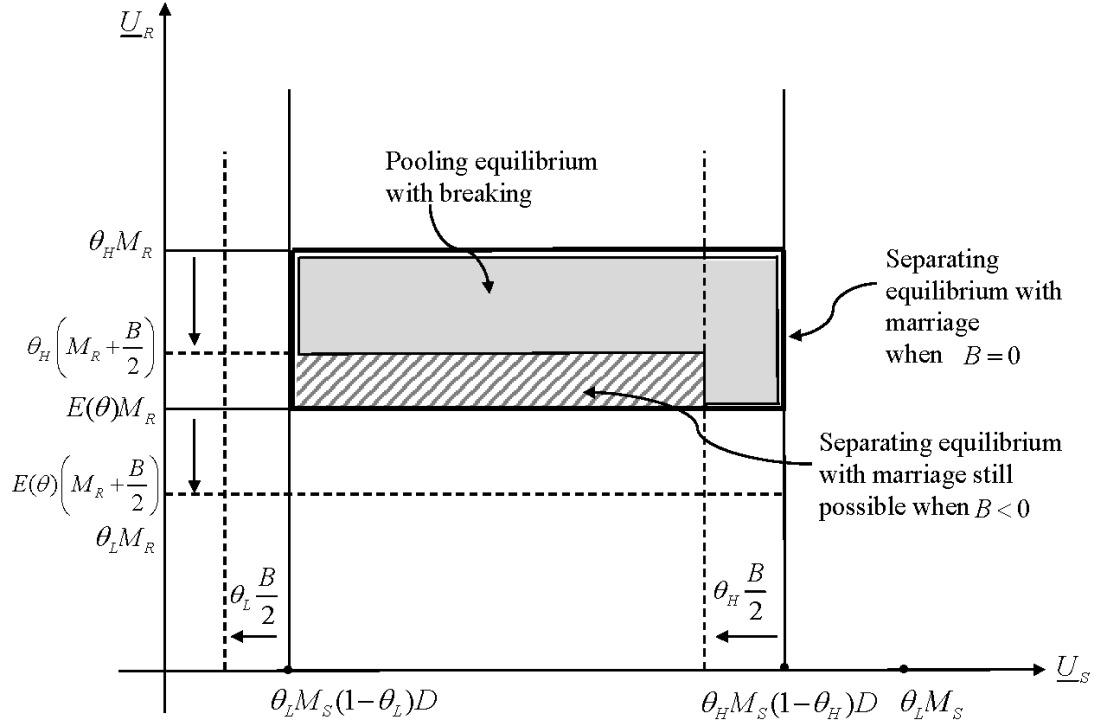


Figure 3: The impact of a marriage penalty. The region of the parameters where signaling is possible with $B = 0$ is depicted with a black bold boundary. When $B < 0$, the latter is divided in two parts: the shaded area indicates the region where signaling continues to exist whereas the light grey area is the region where “pooling with breaking” emerges.

While Proposition 2 described the surprising property that a marriage bonus may actually prevent some marriages from being concluded, Proposition 4 states the intuitive result that a penalty may reduce the number of marriages. Note that Proposition 2 and Proposition 4 are not fully symmetric because a pooling equilibrium with marriage does not emerge when B decreases from zero. Figure 3 illustrates Proposition 4

However, a penalty can also produce less expected results if we consider a different reference point. This is illustrated by the following proposition which is the counterpart to Proposition 3.

Note the asymmetry between bonus and penalty. When $B > 0$, more marriages are possible if we start from the situation where condition (IC_H^B) , the incentive constraint of the *high* type Sam does not hold for $B = 0$. When $B < 0$, on the other hand, more

marriages are possible if we start from the situation where condition (IC_L^B) , that is the incentive constraint of the *low* type Sam is violated for $B = 0$.

Proposition 5 (From no signaling to signaling with $B < 0$) *Under Assumptions 1–3, suppose that condition (IC_L^B) does not hold for $B = 0$ so that signaling is impossible in the laissez-faire.*

If the interval $[(\underline{U}_R - \theta_H M_R)/\theta_H; (\underline{U}_S - \theta_L M_S + (1 - \theta_L)D)/\theta_L]$ is non-empty, then a tax bonus $B/2$ belonging to that interval makes the separating equilibrium $[(a_S(\theta_H) = m, a_R(m) = y); (a_S(\theta_L) = c, a_R(c) = n)]$, with posterior beliefs $\tilde{\lambda}(m) = 1$ and $\tilde{\lambda}(c) = 0$ (and out-of-equilibrium beliefs $\tilde{\lambda}(a_S) = 0 \forall a_S \neq m$), possible.

When the incentive constraint of the low-type Sam (IC_L^B) is not satisfied, both types want to propose and signaling is impossible. Now, a marriage penalty may lead to an outcome where a proposal is no longer attractive for a low-type Sam (when $\theta_L B/2 < \underline{U}_S - \theta_L M_S + (1 - \theta_L)D$), while remaining the best strategy for a high-type Sam, and where Robin continues to accept a proposal from a high-type Sam despite the penalty ($\theta_H B/2 > \underline{U}_R - \theta_H M_R$). In this situation, the penalty leads to a separating equilibrium with efficiency enhancing information transmission, which was otherwise not possible.

5 Possible extensions

In this section, we show that the key property of the game holds in richer set-ups as well. In particular, we show that information disclosure during cohabitation, separation costs when a cohabiting couples splits, and labor supply effects do not impact our main result: a marriage penalty can increase the probability of marriage due to efficiency enhancing information transmission. Finally, in the last subsection, we suggest how our results might contribute to the empirical debate about the effects of marriage penalties and bonuses on the decision to get married.

Cohabitation discloses information on the quality of the match Recall that we do not rule out that the partners are already cohabiting and that *some* information

has already been revealed. But this admittedly does not account for the possibility that partners strategically choose cohabitation to obtain more information.

To introduce this issue one can extend the model assuming that Sam has the choice between proposing marriage immediately or after one period of cohabitation, which discloses some information on the quality of the match. Specifically, if Robin accepts this period of cohabitation, she receives an exogenous signal about the quality of the match and updates her beliefs. Sam observes the signal too and can then propose to Robin to go on with cohabitation, to marry or to split. Outside options may decrease during this additional period of cohabitation.

Appendix A.1 studies this extension. We show that signaling with a marriage proposal continues to be possible, provided information disclosure is limited. This is in line with the evidence provided by Bumpass and Sweet (1989). Using the 1987–1988 National Survey of Families and Households in the U.S., they report that cohabiting unions and marriages preceded by cohabitation are more likely to break up than are unions initiated by marriage. Balakrishnan *et al.* (1987) and Seltzer (2000)’s results are less drastic, but they also conclude that information disclosure through cohabitation is far from effective and does not appear to enhance the stability of marriage.

We do not explicitly consider tax bonuses or penalties within this extended model. When bonuses or penalties are introduced, the number of possible equilibria increases. However, the main message we convey is not affected: marriage remains an efficient signal of the quality of the match and the tax penalty/subsidy impacts its signaling mechanism in a possibly counter-intuitive way.

Cohabitation also entails a splitting cost We have assumed that breaking up cohabitation is costless to Sam. In reality it is likely to be costly, particularly because cohabitation is increasingly a childrearing institutions (Seltzer 2000, Lundberg *et al.* 2016). If a cohabiting couple splits, Sam may be responsible for child support.

When breaking up cohabitation also involves a cost, which is lower than the cost of divorce, one could think about D as the differential in break-up costs under marriage and under cohabitation. With this interpretation in mind, the model shows that a

marriage proposal is a more effective signal than a cohabitation proposal.

To see this formally, assume that cohabitation implies a breaking cost of D_c , whereas marriage implies a breaking cost of D_m , with $D_c < D_m$. Signaling is possible when

$$\theta_L M_S - (1 - \theta_L) D_k \leq \underline{U}_S \leq \theta_H M_S - (1 - \theta_H) D_k \text{ with } k = c, m.$$

Consequently the interval of Sam's reservation utilities where signaling is possible is larger under marriage; the extra segment has length $(\theta_H - \theta_L)(D_m - D_c) = (\theta_H - \theta_L)D$. This implies that proposing marriage can induce efficient matches more often than proposing cohabitation. In addition, starting from $B = 0$, separating equilibria with marriage continue to be possible for larger levels of the bonus/penalty.

To sum up, if proposing cohabitation entails an expected cost, then the game becomes richer and many new equilibria emerge (including signaling with cohabitation) but the main message we convey is not affected: marriage remains the most efficient signal of the quality of the match and, again, the tax penalty/subsidy impacts its signaling mechanism in a non-trivial way.

Labor supply is affected by marriage and taxation Our model is admittedly highly stylized and preferences represent a reduced form. Consequently B is to be understood as *net* bonus or penalty accounting for any induced change in labor supply. Observe that with our quasi-linear specification, everything is expressed in terms of monetary equivalent so that one can think of B as the utility cost or benefit.

To be more precise this can be illustrated as follows. Individuals when single solve

$$\begin{aligned} \max_{y_R} V_R &= u_R[y_R - T_R(y_R)] - v_R(y_R/w_R) \\ \max_{y_S} V_S &= u_S[y_S - T_S(y_S)] - v_S(y_S/w_S). \end{aligned}$$

Where y_i ($i = R, S$) indicates labor income, $T_i(y_i)$ the tax function and w_i the wage, so that labor supply is given by $\ell_i = y_i/w_i$. A (unitary) couple, on the other hand solves

$$\begin{aligned} \max_{y_R, y_S} V_C &= u_C [c_R, c_S] - v_C(y_R/w_R, y_S/w_S) + K \\ \text{s.t.} \quad &y_R + y_S - T_C(y_R, y_S) = c_R + c_S. \end{aligned}$$

This is just an illustration; one can think of alternative specifications, for instance for a collective couple. The term K includes all the match related benefits (including complementarities utilities from consumption and leisure) as well as the expected cost of divorce. Furthermore the functional form of T_R and T_S may be the same for instance due to political constraints. Using a $*$ to denote the indirect utilities, our B is then given by

$$B = (V_C^* - K) - (V_R^* + V_S^*);$$

so that it already accounts for changes in labor supply that may be induced by the joint taxation of couples.

To sum up, while our reduced form approach obscures some of the underlying adjustments, this has no impact on our results.

Empirical evidence and implications Throughout the paper we have concentrated on a single couple identified by given parameter values. In reality, these parameters are likely to differ across couples. While any conjecture about their distribution would be highly speculative, one can expect that the different cases we have considered (as well as the “trivial” cases we have neglected) coexist in reality. Consequently, positive and negative effects of the bonus or penalty may at least in part cancel out through aggregation. This can explain that the empirical studies mentioned in the Introduction typically find that the tax regime applied to married couples appears to have little impact on the decision to get married. Some studies like Alm and Whittington (2003) do find a statistically significant effect particularly for the transition from cohabitation to marriage, but they concede that the effect is quite small and that other factors appear to have a more sizeable impact. More recent studies exploiting exogenous changes in the Earned Income Tax Credit (EITC) eligibility yield more mixed results (but concern only a subset of the population).¹⁴ Michelmore (2018) finds the penalties discourage marriage probabilities for single mothers by about 2.5 percentage points. Isaac (2018) and Bastian (2017), on the other hand, obtain estimates that suggest a more complex

¹⁴Namely those (potential) couples where at least one of the spouses has a sufficiently small income to qualify for the tax credit. We thank the reviewer who brought these studies to our attention.

relationship: the effect may not go in the expected direction and depend on the specific income levels.

Testing whether, in a given country, the effects of the tax policy cancel out in aggregation is not a trivial endeavour. A possible approach would be to compare the behavior of subgroups in the population which differ only with respect to a single characteristic (such as the socioeconomic status, education, the prevailing social norm, etc.) to examine whether, after a change in policy, they move in opposite directions.

A possible avenue is the following. Take the partners' outside options as a source of heterogeneity in the couple's reaction to a marriage penalty and consider education as a proxy for \underline{U}_S and \underline{U}_R . Better-educated men and women in the US are today more likely to live in a marital union than less-educated men and women but the association between education and marriage was negative some decades ago (see Lundberg *et al.* 2016). First, this evidence suggests that past reforms may have affected more and less-educated US citizens in a different way. Second, considering that the US marriage penalty seems to have modest effects overall, this evidence also suggests that a positive effect of the penalty on marriages of the more-educated individuals may have partially compensated a negative effect of the penalty on marriages of the less-educated individuals. In our model, this may translate into the two following simultaneous patterns: $B < 0$ reduces the signaling value of a marriage proposal, and thus the number of marriages, for the less-educated (so that Proposition 4(ii) would hold for the less-educated) whereas it might allow the more-educated to move from a situation where signaling was not feasible to the opposite situation (Proposition 5 would hold for the more-educated).

As a last observation, the impact of the income levels and specifically a scenario where $B < 0$ reduces the number of marriages for the less-educated seems in line with the evidence based on changes in EITC eligibility. In particular, Isaac (2018) and Micheltore (2018) show that low-income people are affected by penalties in the expected way.

6 Concluding comments

Our model delivers the striking result that a marriage bonus may actually reduce the probability that a couple gets married. If the bonus is sufficiently large, the signal becomes uninformative. Partners whose match is efficient may split up, while others, whose match is inefficient, might get married. Similarly, a marriage penalty may induce marriages with high-quality matches. The penalty may lead to a separating equilibrium with efficiency enhancing information transmission, which would otherwise not be possible.

Turning to policy implications, our results also mean that marriage decisions in the *laissez-faire* are not necessarily privately optimal. In some cases a bonus or a penalty may effectively make the marriage decision more efficient. However, when the signaling mechanism is operative both bonuses or penalties—unless too small to have an impact—will make the marriage decision less efficient.

As pointed out by Kaplow the fact that the tax system potentially “distorts” a privately optimal marriage decision should be accounted for when studying the design of couples’ taxation. From that perspective, our results have two important implications. First, the “distortion” may go in an unexpected direction. Second, the violation of what is often referred to as “marriage neutrality” may make the marriage decision more efficient and thus does not effectively represent a “distortion” in the traditional sense of the word.

Incorporating these features into an optimal tax model represents quite a challenge. A possible setting could be the following. Potential partners choose between getting married, implying a joint income tax, or not to getting married, implying individual taxation. Using the notation from the previous section, marriage would imply the tax rule $T_C(y_R, y_S)$, while singles face the tax schedules $T_R(y_R)$ and $T_S(y_S)$, which may be gender neutral so that $T_R(y) = T_S(y) = T(y)$. The tax system affects marriages unless $T_C(y_R, y_S) = T_R(y_R) + T_S(y_S)$, that is couple taxation is individual based. Recall that the parameter K represents the net benefit from the marriage, which is likely to be the partners’ private information. The tax design problem is here independent of the

partners' choice of which type of living arrangement to enter. The latter can be studied as an indirect mechanism, because no report on K is required. Given the tax schedule designed by the government, we can find the indirect utilities of the partners who truthfully report their labor productivity and we can use them to tackle the partners' self-selection problem, which depends on K . This approach is based on Lehmann *et al.* (2014) who consider two competing governments designing (individual) income taxes for singles who may migrate. In the setting we are suggesting there would be a single government and two options for partners, who can "migrate" from one status to the other. This is just suggestive of a possible direction for research and at this point we can only make conjectures about the results.

From that perspective, two practical lessons emerge. First, one might think that ensuring marriage neutrality is an argument to move to a more individual based tax. It would mitigate the marriage distortion, which for the rest has to be balanced against the redistributive benefits of a non-individual tax. This argument certainly applies when potential couples have full information so that marriage decisions are (hopefully) privately optimal, at least from an *ex ante* perspective. In our incomplete information setting it continues to go through for the couples where, for instance, the signaling becomes uninformative because of a bonus, or where efficient marriages are crowded out by a penalty. However, our results show that for other couples it may play in the opposite direction. So overall, the way the optimal tax system is affected by endogenous marriage decisions depends on the distribution of parameters in the population. To sum up, marriage neutrality does not in itself imply that a more individual based tax system is desirable.

Second, and looking at the marriage decision from a broader perspective, it is often argued that (hopefully stable) marriages provide a positive externality to society and should be encouraged.¹⁵ According to conventional wisdom this in turn would plead for a bonus and against a penalty. However, our results suggest that this argument may not stand under closer scrutiny because these incentives may backfire.

¹⁵Kaplow (2008) and Leturcq (2012) mention this argument, but it is more prominently discussed in the law and economics literature; see for instance Cohen (2004).

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Appendix

A.1 Information disclosure during cohabitation

We add two more stages to the game in such a way that each of the two partners takes at most two actions. The extensive form of this new game is represented in Figure 4. Timing is as follows. Nature draws the type of the matching quality. Then, Sam chooses $a_S^1 \in \{0^1, c^1, m^1\}$. After observing Sam’s action, Robin chooses $a_R^1 \in \{y^1, n^1\}$. If $a_S^1 \in \{0^1, m^1\}$ the game is as before. If instead Sam proposes cohabitation, meaning that $a_S^1 = c^1$, and Robin accepts, meaning that $a_R^1 = y^1$, Nature draws a partially informative signal. The (symmetric) exogenous signal on Sam’s type is $\delta_S \in \{\delta_H, \delta_L\}$, where δ_H (δ_L) is good (bad) news about Sam’s type. After observing the realization of the signal, Robin updates her beliefs according to Bayes’ rule. Then, Sam has a second

opportunity to propose either marriage or the *status quo* and chooses $a_S^2 \in \{0^2, m^2, c^2\}$. Finally Robin chooses $a_R^2 \in \{y^2, n^2\}$.

If the realization of the exogenous signal is δ_H , Robin's updated beliefs are such that

$$E[\theta_S|\delta_H] = \lambda\theta_H + (1 - \lambda)\theta_L + \Delta;$$

whereas, if the realization of the exogenous signal is δ_L , Robin's beliefs are such that

$$E[\theta_S|\delta_L] = \lambda\theta_H + (1 - \lambda)\theta_L - \Delta.$$

where Δ is the increase (decrease) in the expectation of θ_S if the realized signal is δ_H (δ_L).¹⁶

The cost of a marriage proposal is the same as before but we assume that, if the new stage of the game is reached, then the outside option decreases of the amount $\omega \geq 0$, because of the depreciation of the two players' value in the marriage market.

If signal $\delta_S \in \{\delta_H, \delta_L\}$ is not too informative and ω is sufficiently low, then Assumptions from 1 to 3 can be adjusted as follow.

Assumption 4: $E[\theta_S|\delta_H] M_R = [\lambda\theta_H + (1 - \lambda)\theta_L + \Delta] M_R < \underline{U}_R - \omega,$

Assumption 5: $\theta_L M_R < \underline{U}_R - \omega < \theta_H M_R,$

Assumption 6: $\underline{U}_S - \omega \leq \theta_L M_S < \theta_H M_S.$

Assumption 4 states that, once she receives good news about the quality of the match, Robin still prefers her outside option. Assumption 5 indicates that Robin prefers to remain with Sam if the quality of the match is high and to break the relationship if the quality of the match is low. Assumption 6 states that Sam prefers to remain with Robin no matter his type.

If $a_S^1 \in \{0^1, m^1\}$ the payoff functions described in (1) still hold. After the new stage

¹⁶A signal consistent with this representation is characterized by a pair of conditional probabilities (π_H, π_L) where π_S , with $\pi_S \in [1/2, 1]$ and $S = H, L$, is the probability of observing the realization of the signal δ_S conditional on the type being θ_S : $\pi_S = \text{prob}(\delta_S|\theta_S)$. The signal is symmetric, thus we have $\pi_H = \pi_L = \pi$. $\text{Prob}(\theta_H|\delta_H) = \frac{\lambda\pi}{\lambda\pi + (1-\lambda)(1-\pi)} > \lambda$, confirming that δ_H is good news about Sam's type. The closer π is to one and the more informative the signal δ_S is.

of the game, the two partners' utilities are instead given by

$$\begin{aligned} U_R^2 &= (1 - I) (\underline{U}_R - \omega) + I\theta_S M_R, \\ U_S^2 &= (1 - I) (\underline{U}_S - \omega) + I [\theta_S M_S - \varphi_S(a_S)]. \end{aligned}$$

If Assumptions from 4 to 6 hold, then the following separating equilibrium exists.

No matter his type, Sam proposes cohabitation in the first stage and Robin accepts. After the realization of the exogenous signal δ_S Sam plays again and now his strategy depends on his type. The high-type proposes marriage while the low-type proposes again cohabitation. Robin infers that the marriage proposal comes from a high-type and optimally accepts the offer. In the same way she infers that the proposal to go on with cohabitation comes from a low-type and optimally breaks the relationship. Formally, this separating equilibrium with marriage writes: $[(a_S^1(\theta_S) = c^1 \forall \theta_S, a_R^1(c^1) = y^1); (a_S^2(\theta_H) = m^2, a_R(m^2) = y^2); (a_S^2(\theta_L) = c^2, a_R^2(c^2) = n^2)]$, posterior beliefs are $\tilde{\lambda}(m^2) = 1$ and $\tilde{\lambda}(c^2) = 0$; and possible out-of-equilibrium beliefs are $\tilde{\lambda}(a_S^1) = 0 \forall a_S^1 \neq c^1$ and $\tilde{\lambda}(0^2) = \text{prob}(\theta_H|\delta_j)$, where δ_j is the realized signal.

If the opposite of Assumption 4 holds instead and, moreover,

$$E[\theta_S|\delta_L] M_R = [\lambda\theta_H + (1 - \lambda)\theta_L - \Delta] M_R < \underline{U}_R - \omega,$$

then a semi-pooling equilibrium with cohabitation and no signaling costs emerges where equilibrium strategies depend on the realization of the exogenous signal δ_S . In such equilibrium, Sam proposes cohabitation when the signal is δ_H and splits otherwise. Robin accepts cohabitation after observing signal δ_H . Note that, in this semi-pooling equilibrium, some inefficient matches are concluded.

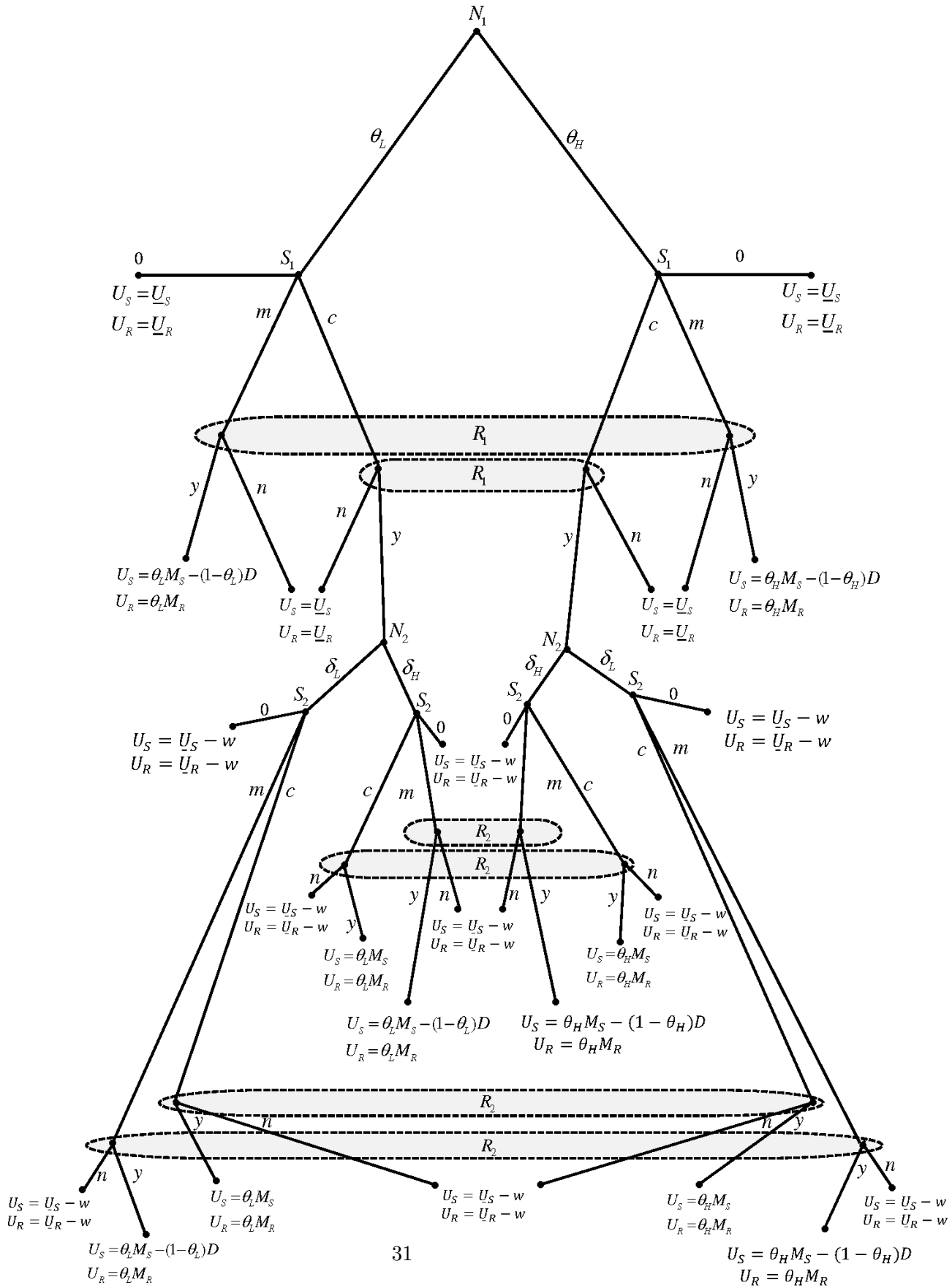


Figure 4: The extended game