Marriage Wage Premium in a Search Equilibrium[1]

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Abstract

In this paper we propose a new theoretical explanation for the existence of male marriage wage premium, based entirely on search frictions. We analyse the interaction of frictional labour and marriage markets. We present and explore a search equilibrium characterised by wage dispersion where only high earning men get married. We also examine other equilibria where the marriage market may or may not influence labour market outcomes.

"It is a truth universally acknowledged, that a single man in possession of a good fortune must be in want of a wife."

(J. Austen: Pride and Prejudice)

1 Introduction

There is widespread evidence that on average, married men earn higher wages than unmarried men - see Cohen and Haberfeld (1991), Nakosteen and Zimmer (1997); Kermit (1995) reports estimates of about 10 to 30 percent. This marriage wage premium persists after controlling for systematic differences in job attributes. The main objective of our paper is to provide an explanation for this phenomenon.

We analyse a model of inter-linked frictional labour and marriage markets and consider the job and marital search strategies of men and women, together with wage posting by firms. We show that there exists an equilibrium in which men find it optimal to accept jobs that preclude them from marrying (as women favour high earners). This is simply a consequence of the fact that well-paid jobs might be too difficult to find. As a result, there will be single men on relatively low wages and men who can marry because they have good jobs - all this a direct consequence of search frictions only. We look at the factors that determine the existence and affect the size of this marriage wage premium. We also characterise other types of equilibria where the marriage market may or may not have an influence on labour market outcomes.

The question of marriage wage premium has received a lot of attention in both the empirical and theoretical literature. Crucially, all existing studies rely on productivity differences between married and unmarried men. In this paper, we explain the marriage wage premium without relying on any kind of heterogeneity in male productivity. In particular, we examine the interaction between the labour market and the marriage market where there are no ex-ante productivity differences due to (observable or unobservable) skills and neither is there any ex-post heterogeneity (due to marriage).

Our model captures several salient aspects of the two markets. First, both the labour market and marriage market are characterised by frictions: it takes time and effort to locate jobs and potential partners. Therefore, we construct an equilibrium model using the search-theoretic framework. We model explicitly the job search process as well as the marital search and describe equilibria characterised by an endogenous distribution of wages earned by men, potentially with a marriage wage gap.[1] The focus is on the optimal decisions of single men and women who form marriage partnerships where the man is the only wage earner in the household.

Secondly, our model considers explicitly a woman's option outside marriage. One can think of this as the utility a woman gets from being single. This interpretation captures women's (and implicitly by comparison, men's) attitudes towards marriage and allows for possible asymmetries in how they value the benefits of a partnership. This is in line with Gould and Paserman (2003) who use empirical evidence to show that on average, men don't seem to care much about women's wages.

Alternatively, one could consider women's career opportunities explicitly. For example, Blau et al. (2000) interpret the value of women's participation in the labour market as their option outside marriage. Whichever way this is formalised, it is clear that an analysis of changes in the marriage wage premium would have to consider the effect of changes in women's outside options. We carry out such an analysis.

There is also extensive empirical evidence of a link between the value of women's option outside marriage, the spread of the male wage distribution, and changes in marriage rates. Loughran (2002) reports that male wage inequality rose during the 1980's, with a rise from 1.38 to 1.69 in the difference in log wages between the 90th and 10th percentile of the weekly wage distribution for men aged 22-65. Gould and Paserman (2003) find that women are more selective in the marriage market when the value of being single increases (higher female wages). They argue that 25% of marriage rate decline since the 1980's in the US can be explained by the increase in male wage inequality. Similarly, Blau et al.(2000) argue that better female labour market prospects have the effect of lowering marriage rates, both for 16-24 and 25-34 year old women. Finally, Loughran (2002) finds that rising male wage inequality accounts for up to 18% of the decline in the propensity to marry.

The interaction between marital decisions and the economic performance of men and women has also received much attention outside the economics literature. Several sociological studies test the validity of the "economic independence hypothesis", according to which women with good career prospects will be more selective in their marital choices. Bloom and Bennett (1990) conclude that increased economic independence leads both to a delay in marriage by women and a decrease in the proportion of women who will marry. Others, like Qian and Preston (1993) and Oppenheimer and Lew (1995) find that increased economic independence leads to a delay in marriage, but not to a substantial decrease in the proportion of women who will

[1] Loughran (2002) uses a simple search model in which only women's marital search is considered.

marry. The latter findings are consistent with what Oppenheimer (1988) calls the "extended spouse search" theory, according to which increased human capital gives women a greater incentive and ability to search longer for better partners. In all these studies, men's economic potential is positively related to likelihood of marriage.

In the main, the existing literature on marriage wage premium is based on two established theoretical approaches: the "selection" model and the "specialisation" model. As previously noted, they both rely on some sort of male heterogeneity.

Nakosteen and Zimmer (1997) are a good example of the first approach. According to the selection hypothesis, some unobservable characteristics of men are valued not only in the labour market but also in the marriage market. For example, if higher productivity is associated with family-oriented preferences, productive men may be perceived as more attractive partners. However, the empirical evidence on this is quite weak. Ginther and Zavodny (2001) find that only up to 10% of wage premium is a result of selection, whereas Chun and Lee (2001) go even further and argue that the selection effect is minimal.

The household specialisation model originates in the work of Becker (1993). The idea is that marriage increases a man's productivity: backed by the support of a wife, men are able to put more effort into work. Korenman and Neumark (1991) provide some empirical support for this hypothesis. They find that wages increase after marriage, men get better performance evaluations and are promoted more frequently. Nonetheless, the authors concede that the evidence is far from being conclusive.

Blackburn and Korenman (1994) and Gray (1997) assess the relative merits of the two theories by examining the decline in the earnings premium for married men during the 1970's and 1980's. Overall, the evidence is again quite mixed and it seems neither selection nor specialisation are sufficient explanations for the persistence of the male marriage wage gap.

As well as providing a new explanation for the marriage wage premium, we believe that our framework is of interest at a more general level as well. The theoretical literature on the explicit interaction between two frictional markets is small but growing.[2] Such models permit the analysis of long-term partnership formation between agents who are active in more than one search market. This framework can also explore potential externalities

[2] Rupert and Wasmer (2012) consider frictional labour and housing markets. Kaplan and Menzio (2012) analyse the interaction between frictional labour and goods markets, with interesting spillovers across the two. Jacquemet and Robin (2013) study individual labour supply with a frictional marriage market. Finally, Bonilla and Trejos (2013) endogenise labour market participation, wages and marital decisions in an economy with frictional labour and marriage markets.

between such frictional markets. We hope that our paper can contribute to this exciting research agenda.

The structure of the paper is as follows. Section 2 describes the general setup: job search, marital search and wage posting. Section 3 states the main results, while Section 4 contains the detailed analysis of all potential equilibria, with emphasis on the existence of an equilibrium with marriage wage premium. Section 5 provides a further discussion of the latter. Section 6 concludes.

2 The model

The economy consists of three types of agents: women, men and firms, all risk neutral. Time is continuous and agents discount the future at common discount rate r. There is a continuum of firms and men (both normalised to 1), and a measure W of single women.

2.1 Men and women:

Men enter the market unemployed and single and use costless random sequential search to locate firms. Contact with a firm occurs at rate λ_0 and the distribution of wages offered is denoted by $F(w)$ on the interval $[\underline{w}, \bar{w}]$. Search is noisy: with probability $1-\alpha$ the unemployed gets an offer from one firm only, but with probability α he receives offers from two firms.[3] When employed at wage w and single, a man has flow payoff w.

Single employed men also look for potential partners, and know the extent to which women are selective about whom they marry. Let N denote the measure of single men who are marriageable - that is, men whose wages are high enough. These men contact women at rate λ_m. A married man earning wage w enjoys flow payoff $w + y$, where $y > 0$ captures the non-material utility of love. There is no on-the-job search and men are faithful (no on-the-marriage search).

Women are single when they enter the economy but then look for potential partners. They use costless random sequential search. Let x denote the flow payoff of a woman when single. This captures the utility of being single, but also, implicitly the net value of the difference between being single and

[3] Consider the following mechanism: at rate λ_0, an unemployed has the opportunity to send an application letter. Conditional on having sent an application, with probability α this letter is duplicated and each letter is received by separate firms. With probability $1 - \alpha$ it is not duplicated and the letter is received by one firm only. The total number of letters received by firms is therefore $1 + \alpha$.

being married. Assume that women don't look for jobs[4] and do not marry unemployed men.[5] Let $G(w)$ describe the distribution of entry wages among single employed men. If selective about whom they marry (i.e. accept only men with relatively high wages) single women contact single eligible working men at rate λ_w. A married woman's flow payoff is equal to the man's wage (w). There is no on-the-marriage search (women are faithful too) and there is no divorce.

Singles and couples alike leave the economy at an exogenous rate δ. We only consider steady states, and let U denote the steady state unemployment rate. N_S is the overall number of employed single men. Assume a new single woman comes into the market every time a single woman gets married or exits the economy. Similarly, every time a man dies another man enters the market as unemployed and single. Together, these conditions ensure that the measure of women (W) and men (1) remain constant. The steady-state number of marriageable men (N) is of course endogenous.

For the marriage market, we assume a quadratic matching function with parameter λ that measures the efficiency of the matching process. Then, $\lambda_m = \frac{\lambda N W}{N} = \lambda W$. By the same token, $\lambda_w = \frac{\lambda N_S W}{W} \frac{N}{N_S} = \lambda N$.[6]

Sequential search and the fact that utilities are increasing in wages imply that the optimal strategy for both single men and women has the reservation wage property: men only accept jobs with wage $w \geq R$, whereas women will only marry if the man earns a wage $w \geq T$.

2.2 Firms and equilibrium wage dispersion:

All firms are homogenous, with flow productivity per worker denoted by p. We assume that $p > x$, as otherwise there would be no potential surplus from marriage. Firms post wages and contact unemployed men only. Each firm offers a single wage w to an unemployed worker, irrespective of his marital status.

The analysis is similar to Burdett and Judd (1983). With noisy search and conditional on having been contacted by an unemployed, a firm knows that the probability this worker holds one other offer is $\frac{2\alpha}{1+\alpha}$. Similarly, the

[4]There is evidence that, to some extent, women view marriage as an alternative to a career in the labour market. For example, Loughran and Zissimopoulos (2009) find that marriage reduces the probability that women work and negatively affects the wages of those who work.

[5]An assumption for now, but shown later to be consistent with rational behaviour in the equilibrium studied.

[6]Alternatively, $\lambda_w = \frac{\lambda N W}{W} = \lambda N$.

probability that he holds no other offer is equal to $\frac{1-\alpha}{1+\alpha}$. In a noisy search equilibrium with wage dispersion, firms employ all men who accept their wage offer and all firms earn the steady state expected profit Π.

If an unemployed accepts a wage offer w the firm's discounted profits are $\pi(w) = \frac{p-w}{r+\delta}$. Noisy search implies that the expected profits for a firm posting wage w are given by

$$\Pi(w) = \pi(w)q\left[\frac{1-\alpha}{1+\alpha} + \frac{2\alpha}{1+\alpha}F(w)\right],$$

where q is the number of letters per firm. For a non-degenerate equilibrium wage dispersion to exist, it has to be the case that all firms make equal expected profits, so $\Pi(\underline{w}) = \Pi(w)$. Standard arguments imply $F(w)$ has no mass points and $\underline{w} = R$, as no firm will post an offer lower than the reservation wage. Thus, in equilibrium

$$\pi(R)q\left[\frac{1-\alpha}{1+\alpha}\right] = \pi(w)q\left[\frac{1-\alpha}{1+\alpha} + \frac{2\alpha}{1+\alpha}F(w)\right].$$

From here, we get the distribution of wages posted by the firms:

$$F(w) = \left(\frac{1-\alpha}{2\alpha}\right)\left(\frac{w-R}{p-w}\right).$$

Making use of $F(\overline{w}) = 1$, one also obtains the highest posted wage $\overline{w}(R) = \frac{2\alpha p+(1-\alpha)R}{1+\alpha}$. From $F(w)$ above, the distribution of entry wages is simply $G(w) = (1-\alpha)F(w) + \alpha\left[F(w)\right]^2$.

3 Main results

Men utilise a reservation wage R in the labour market, while women use a reservation (match) wage T in the marriage market, rejecting men who earn wage $w < T$.

Let $\underline{R}$ denote the reservation wage of men in a pure labour market equilibrium when there is no marriage market. $\underline{R}$ is defined as the (unique) solution to

$$\underline{R} = \frac{\lambda_0}{r+\delta}\int_{\underline{R}}^{\overline{w}(\underline{R})}\left[1 - G(w|\underline{R})\right]dw.$$

The analysis in Section 4 establishes that this is the lowest reservation wage R in any equilibrium.

Also define $\overline{R}$ as

$$\overline{R} = \frac{\lambda_0}{r+\delta}\left[\int_{\overline{R}}^{\overline{w}(\overline{R})}\left[1 - G(w|\overline{R})\right] + \frac{\lambda W}{r+\delta+\lambda W}y\right].$$

Clearly, $\overline{R} > \underline{R}$ for $y > 0$. We establish below (Section 4) that $\overline{R}$ corresponds to the highest reservation wage R in any marriage equilibrium.

In what follows we show that equilibrium $R \in \left[\underline{R}, \overline{R}\right]$ for any parameter values Ω. Specifically, we consider how changing x (the flow value of being a single female) affects the equilibrium reservation wages (R, T). In particular, we identify two critical thresholds for x, denoted by $\underline{x}$ and $\widehat{x}$ and the following Theorem:

Theorem 1 *Given* $y < \frac{2\alpha p(r+\delta)(r+\delta+\lambda W)}{\lambda_0 \lambda W(1+\alpha)^2}$*, a search equilibrium exists, is unique and has the following properties:*

(a) $x \leq \underline{x}$ *implies the marriage market has no impact on labour market outcomes; i.e.* $R = \underline{R}$ *(pure noisy search) and* $T < \underline{R}$*, so that women accept all men.*

(b) $x \in (\underline{x}, \widehat{x}]$ *implies equilibrium* $T = T(x) > \underline{R}$ *and* T *is increasing in* x*. Equilibrium* $R = T(x)$ *as unemployed men insist on earning a wage at least as high as the reservation wage of women. At* $\widehat{x}$*, the marriage market yields peak wages where* $R = T(\widehat{x}) = \overline{R}$*.*

(c) $x \in (\widehat{x}, \overline{w}(\underline{R})]$ *implies women become so selective that* $T > \overline{R}$ *and* $R < \overline{R}$*. Therefore,* $R < T(< \overline{w}(\underline{R}))$*, so that women reject low-earning men. In this region equilibrium* R *decreases as* x *increases.*

(d) $x > \overline{w}(\underline{R})$ *implies the marriage market again has no impact on labour market outcomes :* $R = \underline{R}$ *(pure noisy search) and* $T = x$*, so that women reject all men.*

The above Theorem shows how marriage markets can distort wage outcomes in a frictional labour market. The results are due to an interesting non-monotonicity property.

For very low values of x (part (a) in the Theorem), women are so non-selective that they will marry anyone regardless of their wage (or indeed their employment status). The labour market is unaffected by the marriage market.

As the flow value of being a single woman (x) increases (part (b) in the Theorem), women become more selective in the marriage market. This in turn makes men more selective in the labour market: they need to earn a high wage in order to become attractive marriage partners, and will not accept anything less. Here, given a low female reservation match, any wage $w < T$ not only precludes marriage but is also too low - men will reject it. Women marry all employed men, but only employed men.

The feedback, however, is non-monotonic. For higher values of x (part (c) in the Theorem), the relationship changes. Since female reservation match increases with x, at some point (at $\widehat{x}$) a wage $w < T$ can still be high enough so that men accept it even if it precludes marriage. From here on, as women become even more selective, males tend to gradually give up on the marriage market. This is simply because they will find it increasingly difficult to encounter wages that attract women. As a consequence, the reservation wages in the labour market fall. In this equilibrium, $R < T$ and women reject low-earning men. As a result, the average wages of married and single working men will differ. We call this equilibrium the *marriage wage premium* (MWP) equilibrium.

Finally, if x is very high (part (d) in the Theorem), women are so selective that they never marry men. Consequently, the marriage market once again has no impact on market wages.

The presence of the married men's wage premium suggests that the MWP equilibrium is the empirically relevant case. Therefore, our focus is on this type of equilibrium, where some employed men - those earning $w \in [R, T]$ - never marry, while married employed men enjoy a marriage wage premium, in the sense that they are married *because* they earn a high wage.

4 Characterisation of equilibria

This section contains the detailed proof of Theorem 1, with emphasis on the equilibrium with marriage wage premium (section 4.1). We also provide a full characterisation of the other types of equilibria (section 4.2).

Overall, a man can be in one of three states: unemployed, employed at wage w and single (S), or earning a wage w and married (M). Denote his value of being unemployed by V_u and let $V_S(w)$ describe the value of being single and earning a wage w. Then, usual arguments imply that the Bellman equation solves

$$(r+\delta)V_u = \lambda_0 \int_{\underline{w}}^{\bar{w}} \max\left[V_S(w) - V_u, 0\right] dG(w).$$

As noted earlier, the optimal job search strategy has the reservation wage property. Anticipating that $V_S(w)$ is not a continuous function (see below), the reservation wage R can thus be defined as

$$R = min\{w : V_S(w) \geq V_u\}.$$

Recall that in a noisy search equilibrium $\underline{w} = R$, so λ_0 is also the rate at which an unemployed man finds a job.

With no divorce, the value of being married and earning a wage w is $V_M(w) = \frac{w + y}{r + \delta}$.

Given women's reservation wage strategy T, and using $\lambda_m = \lambda W$, we have

$$V_S(w) = \left\{ \begin{array}{lll} \frac{w}{r + \delta} & \text{if} & w < T \\ \frac{w}{r + \delta} + \frac{\lambda W}{(r + \delta + \lambda W)(r + \delta)} y & \text{if} & w \geq T \end{array} \right\} \tag{1}$$

Consider now the problem facing single women. They never marry unemployed men and meet potential partners at a rate equal to the measure of employed men (N_S). Each woman can be either single (S) or married (M) to a man earning wage w. Let V'_S denote the value of being a single woman, and let $V'_M(w)$ be the value of being married to a man who earns wage w. Then, the Bellman equation is

$$(r + \delta)V'_S = x + \lambda N_S \int_{\underline{w}}^{\bar{w}} \max\left[V'_M(w) - V'_S, 0\right] dG(w), \tag{2}$$

and the optimal strategy has the reservation wage property. With no divorce, $V'_M(w) = \frac{w}{r + \delta}$.

4.1 The equilibrium with marriage wage premium

In this equilibrium the reservation partner wage (match) of an unmarried woman (T) is strictly greater than the reservation wage of unemployed men (R).

4.1.1 Men:

Men's reservation wage strategy implies $V_u = V_S(R) = \frac{R}{r+\delta}$. Let $R(T|\Omega)$ describe the optimal reservation wage of unemployed men in an equilibrium where women have reservation match wage T and Ω describes the set of parameter values.

For a given T, and using $V_S(w)$ from (1) we have

$$R = \lambda_0 \int_R^T \left[\frac{w}{r+\delta} - \frac{R}{r+\delta}\right] dG(w) + \lambda_0 \int_T^{\bar{w}} \left[\frac{w}{r+\delta} + \frac{\lambda W}{(r+\delta+\lambda W)(r+\delta)} y - \frac{R}{r+\delta}\right] dG(w),$$

or

$$R = \frac{\lambda_0}{r+\delta} \int_R^{\bar{w}} [w - R]\, dG(w) + \frac{\lambda_0}{(r+\delta)} \int_T^{\bar{w}} \frac{\lambda W y}{(r+\delta+\lambda W)} dG(w).$$

The first part on the right hand side is the standard expected wage gain from continued search. The second part captures the additional expected utility gain which comes from having a wage that allows a man to get married.

Integration by parts of the first integral and simplification of the second imply

$$R = \frac{\lambda_0}{r+\delta} \left[\int_R^{\bar{w}} [1 - G(w|R)]\, dw + \frac{\lambda W [1 - G(T)]}{(r+\delta+\lambda W)} y \right]. \tag{3}$$

Again, the first term on the right hand side is standard: the reservation wage must compensate for the loss of the option of continued search for better wages. The second term relates to the man's marriage option. The possibility of contacting a firm (at rate λ_0) that offers a marriageable wage $w > T$ (with probability $1 - G(T)$), and subsequently meeting a woman (at rate λW) would leave him enjoying flow value y. If a worker were to accept a wage $w < T$, he would be giving up the option of happiness through marriage. Consequently, the reservation wage must compensate for this loss.

4.1.2 Women:

Note that for any $x > \overline{w}(\underline{R})$ the unique equilibrium is $R = \underline{R}$ and $T = x$. Men ignore the marriage market because $T > \overline{w}(\underline{R})$ and women set $T = x$ because $x > \overline{w}(\underline{R})$. In this (unique) pure noisy search equilibrium, women are so happy being single that they reject all men (who earn $w \leq \overline{w}(\underline{R}) < x$), and all men have reservation wage $\underline{R}$ and therefore earn wage $w \leq \overline{w}(\underline{R})$.

Consider now $x \leq \overline{w}(\underline{R})$. Conditional on meeting an employed man, this worker earns $w \geq T$ with probability $\frac{N}{N_S}$. The reservation match T satisfies $V_S' = V_M'(w)$. Making use of V_S' from (2) and $V_M'(w)$, we have

$$T = x + \frac{\lambda N}{r+\delta} \int_{T}^{\bar{w}} [w - T]\, dH(w), \tag{4}$$

where $H(w)$ denotes the distribution of wages across single employed men who earn more than T but less than w. The steady state number of workers earning a wage between T and w solves $U\lambda_0 [G(w) - G(T)] = H(w)N(\delta + \lambda_m)$. Using the steady state turnover condition for N, we get

$$N = \frac{U\lambda_0 [1 - G(T)]}{\delta \ + \ \lambda W},$$

and hence

$$H(w) = \frac{G(w) - G(T)}{1 - G(T)}.$$

Using $H(w)$ from above, integration by parts in (4) implies

$$T = x + \frac{\lambda N}{r+\delta} \int_{T}^{\bar{w}} \frac{[1 - G(w|R)]}{[1 - G(T|R)]} dw. \tag{5}$$

Please note that T is increasing in x for $x < \overline{w}(\underline{R})$.

First, observe that for R sufficiently small, satisfying $\overline{w}(R) \leq x$, we have $T(R|\Omega) = x$ and independent of R. For R satisfying $\overline{w}(R) > x$, the integrand on the right hand side is strictly increasing function of R and standard arguments imply $T(R|\Omega)$ is continuous and strictly increasing function of R. Indeed, for $\overline{w}(R) > x$, we have

$$\frac{\partial T}{\partial R} = \frac{\lambda \lambda_0 U}{(r+\delta)(\delta + \lambda W) + \lambda \lambda_0 U [1 - G(T|R)]} \int_{T}^{\bar{w}} \left[- \frac{\delta G(w)}{\delta R} \right] dw > 0,$$

and $T(R|\Omega)$ is bounded below as $T(R|\Omega) \geq x$ for all R.

4.1.3 Equilibrium:

A search equilibrium with $R < T$ is a system $\{F(.), G(.), R, T, N, U\}$ satisfying the following:

(i) Noisy search implies the equilibrium distribution of wages is:

$$F(w|R) = \left(\frac{1-\alpha}{2\alpha}\right)\left(\frac{w - R}{p - w}\right) \quad \text{for} \quad w \in [R, \overline{w}]\text{, where}$$

$F(.)$ is clearly independent of T and $\overline{w} = \frac{2\alpha p + (1-\alpha)R}{1+\alpha}$;

(ii) The distribution of entry wages is

$$G(w|R) = (1-\alpha)F(w|R) + \alpha \left[F(w|R)\right]^2;$$

(iii) The reservation wage R solves

$$R = \frac{\lambda_0}{r+\delta}\left[\int_R^{\bar{w}} \left[1 - G(w|R)\right] dw + \frac{\lambda W \left[1 - G(T)\right]}{(r+\delta+\lambda W)} y\right];$$

(iv) The reservation match T satisfies

$$T = x + \frac{\lambda N}{r+\delta}\int_T^{\bar{w}} \frac{\left[1 - G(w|R)\right]}{\left[1 - G(T|R)\right]} dw;$$

(v) Steady state turnover implies

$$N(\delta + \lambda_m) = U\lambda_0 \left[1 - G(T|R)\right]$$

and

$$U(\delta + \lambda_0) = \delta$$

Now, for $T > R$, and making use of the equilibrium distribution of entry wages, $R = R^*(T|\Omega)$ is given by the implicit function

$$R^* = \frac{\lambda_0}{r+\delta}\left[\int_{R^*}^{\overline{w}} \left[1 - G(w|R^*)\right] dw + \frac{\lambda W y}{r+\delta+\lambda W}\left\{1 - \left[(1-\alpha)F(T|R^*) + \alpha F(T|R^*)^2\right]\right\}\right]. \tag{6}$$

Lemma 1 *$R^*(\overline{w}(\underline{R})) = \underline{R}$ and R^* is a continuous, decreasing function of $T \in [0, \overline{w}(\underline{R}]$ only if $y < \widehat{y} \equiv \frac{2\alpha p(r+\delta)(r+\delta+\lambda W)}{\lambda_0 \lambda W(1+\alpha)^2}$.*

Proof. *Notice that $\overline{w}(\underline{R})$ is the maximum wage in a distribution when men ignore the marriage market. It can be shown that the fixed point where $R^*(\overline{w}(\underline{R})) = \underline{R}$ exists only if $y < \widehat{y}$. Given this, one can show that $\partial R^*/\partial T < 0$ if $y < \widehat{y}$ for $T \in [0, \overline{w}(\underline{R}]$.* ∎

As women become more selective (T increases), men realise that they are less likely to encounter wages that women find attractive ($1 - G(T)$ decreases). Therefore, men are wiling to accept lower wages, and hence R^* decreases.

Furthermore, note that conditional on T, R^* doesn't depend on x; we will make use of this property throughout the analysis below.

Finally, $G(w|R) = (1-\alpha)F(w|R) + \alpha\left[F(w|R)\right]^2$ implies that $T = T^*(R|\Omega)$ is given by the implicit function

$$\begin{aligned} T^* = x + & \frac{\lambda_0 \lambda \delta}{4\alpha(r+\delta)\left(\delta+\lambda W\right)\left(\delta+\lambda_0\right)} \times \\ & \times \int_T^{\overline{w}(R)} \frac{\left[2p-(1-\alpha)R-(1+\alpha)w\right]\left[2\alpha p-(1+\alpha)w+(1-\alpha)R\right]}{\left(p-w\right)^2} dw. \end{aligned} \tag{7}$$

The following identifies equilibria where single women have reservation match value $T < \overline{w}(\underline{R})$ and so will marry sufficiently well paid men. Establishing existence of such an equilibrium requires identifying conditions under which the fixed point (R, T), which solves the equations $T = T^*(R|\Omega)$ and $R = R^*(T|\Omega)$, implies $T > R$.

First, one can show that such equilibria do not exist when x is sufficiently small. Indeed, it can be shown that $\overline{R}$ defined previously corresponds to the fixed point where $R^*(\overline{R}|\Omega) = \overline{R}$.

Define $\widehat{x}$ such that

$$\overline{R} = \widehat{x} + \frac{\lambda_0 \lambda U}{(r+\delta)(\delta+\lambda W)}\left[\int_{\overline{R}}^{\overline{w}(\overline{R})} \left[1 - G\left(w|\overline{R}\right)\right] dw\right]. \tag{8}$$

Inspection of equations (5) and (8) together with the turnover condition for N shows that for $x = \widehat{x}$, an equilibrium exists where $R = T = \overline{R}$. In other words, the pair of equations $T = T^*(R|\Omega)$ and $R = R^*(T|\Omega)$ have solution $(R, T) = (\overline{R}, \overline{R})$.

Now consider $x > \widehat{x}$. It has been established that $T^*(R|\Omega)$ is strictly increasing in x when $R = \overline{R}$. For any $x > \widehat{x}$, it has also been shown that $T^*(R|\Omega)$ is a continuous and strictly increasing function of R. Therefore, continuity implies an intersection between $T^*(.|\Omega)$ and $R^*(.|\Omega)$. Furthermore, we have $\partial R^*/\partial T < 0$, so in this equilibrium $R < \overline{R}$ and $T > \overline{R}$ (implying $R < T$).

Throughout, we have assumed that unemployed men cannot get married. To show this is true, consider what happens if women do marry unemployed men. Since there is no divorce, the marriage problem does not affect the man's job search strategy, so his reservation wage is lower than that of single men. If in equilibrium women only accept employed men earning $w \geq T > R$, this implies it is rational not to marry unemployed men. In other words, men cannot credibly commit to a high reservation wage. Such a promise becomes empty as soon as they tie the knot. With no divorce, women have no choice but to reject single unemployed men.

This establishes the existence of equilibrium for any $\widehat{x} < x < \overline{w}(\underline{R})$. Please note that in this equilibrium $V_u = V_S(R) = \frac{R}{r+\delta}$, so $R < T$ implies $V_u < \frac{T}{r+\delta}$.

The results are illustrated in Figure 1 below.

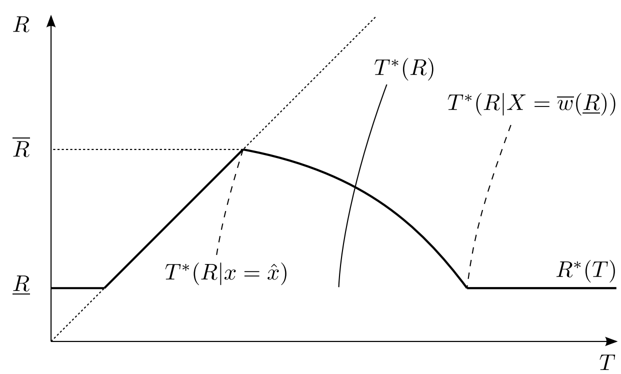

Figure 1

It is instructive to examine what happens if search frictions in the labour market vanish. In that case, the equilibrium with $R < T$ disappears, since $\lim\limits_{\lambda_0 \to \infty} \widehat{y} = 0$. Intuitively, this is because unemployed men will not accept anything less than p ($> x$). On the other hand, as frictions in the marriage market vanish, $\lim\limits_{\lambda \to \infty} \widehat{y} = \frac{2(r+\delta)\alpha p}{\lambda_0(1+\alpha)^2} \in (0, \widehat{y})$. Now the equilibrium with $R < T$ does not disappear, since the rate at which unemployed men get married is not infinite - they must get a good job first.

Furthermore, recall that when men ignore the marriage market, they set $R = \underline{R}$, and note that $\lim\limits_{\lambda_0 \to \infty} \underline{R} = p$. If $T < p$ men are always marriageable; if $T > p$, they are right to ignore the women since no firm will offer a wage higher than p.

4.2 The other equilibria:

We are left to consider the remaining three types of equilibria. The first one is characterised by men holding out for reservation wages that make them attractive enough in the marriage market ($R = T$). The second type of equilibrium is a pure noisy search equilibrium where all men are marriageable irrespective of their wages. In the third type of equilibrium once again the marriage market has no effect on the labour market as women reject all men.

The rather technical exposition below shows that an $\underline{x}$ exists such that equilibrium with $R = T$ obtains for $\underline{x} < x < \widehat{x}$. The reasoning is this: given a low x, women are relatively non-selective, so they choose a low reservation match T. In that case, any $w < T$ is not only lower than the minimum match women accept, but it is in fact so low (relative to all other wages) that it is not acceptable for men either.

Recall that for $\widehat{x} < x < \overline{w}(\underline{R})$ the equilibrium (characterised by $R < T$) implies $V_u < \frac{T}{r+\delta}$. For $x \leq \widehat{x}$, that type of equilibrium does not survive. We then consider the equilibrium with $R = T$, where it must be true that $V_u \geq \frac{T}{r+\delta}$. The following establishes that such an equilibrium exists for $x \leq \widehat{x}$ as long as the implied equilibrium value for T is $T \geq \underline{R}$. In any such equilibrium, optimal search behaviour by women implies equilibrium $T = T(x)$, where

$$T = x + \frac{\lambda_0 \lambda U}{(r+\delta)(\delta+\lambda W)} \int_T^{\overline{w}(T)} [1 - G(w|T)]\, dw,$$

and therefore uniquely determined.

Inspection of the above expression and (8) shows that $T = \overline{R}$ when $x = \widehat{x}$. Straightforward algebra establishes that $dT/dx > 0$. Women become less selective with a decrease in their flow value of being single.

Hence, we can define $\underline{x}$ where $T(\underline{x}) = \underline{R}$ and restrict attention to $x \in [\underline{x}, \widehat{x}]$. As previously stated, this equilibrium requires $V_u \geq \frac{T}{r+\delta}$. In such an equilibrium it is also true that $V_u \leq V_S(T)$ because R is not obtained from $V_u = V_S(R)$. Therefore men will use reservation wage $R = T$ if and only if V_u satisfies

$$\frac{T}{r+\delta} \leq V_u \leq \frac{T}{r+\delta} + \frac{\lambda W y}{(r+\delta)(r+\delta+\lambda W)} = V_S(T), \tag{9}$$

where the last equality follows because when $T = R (= \underline{w})$ we have $[1 - G(T)] = 1$ (i.e. all employed men are marriageable).

Now we define the value of being a single unemployed man (V_u). As $R = T$ in equilibrium, this is given by

$$(r+\delta)V_u = \lambda_0 \int_T^{\overline{w}(T)} \left[V_S(w) - V_u\right] dG\left(w\right), \tag{10}$$

where $V_S(w)$ follows from (1) with $w \geq T$. The value of unemployment reflects the fact that all single working men are eligible to marry. Using $V_S(w)$, (10) becomes

$$V_u = \frac{\lambda_0}{(r+\delta+\lambda_0)} \left[\int_T^{\overline{w}(T)} \frac{w}{r+\delta} dG(w) + \frac{\lambda W y}{(r+\delta)(r+\delta+\lambda W)}\right].$$

Adding and substracting $\frac{T}{r+\delta}$, we get

$$V_u = \frac{\lambda_0}{(r+\delta+\lambda_0)} \left[\int_T^{\overline{w}(T)} \left(\frac{w-T}{r+\delta}\right) dG(w) + \frac{\lambda W y}{(r+\delta)(r+\delta+\lambda W)} + \frac{T}{r+\delta}\right].$$

Finally, integrating by parts, one obtains

$$V_u = \frac{\lambda_0}{(r+\delta+\lambda_0)} \left[\frac{\int_T^{\overline{w}(T)} \left[1-G(w)\right] dw}{r+\delta} + \frac{\lambda W y}{(r+\delta)(r+\delta+\lambda W)} + \frac{T}{r+\delta}\right], \tag{11}$$

from where it follows that $\frac{dV_u}{dT} = \frac{\lambda_0 G(T)}{(r+\delta+\lambda_0)(r+\delta)} < \frac{1}{r+\delta}$.

Consider the second inequality in (9). By definition (see above), at $x = \underline{x}$

$$T = \frac{\lambda_0}{r+\delta} \int_{\underline{R}}^{\overline{w}(\underline{R})} \left[1-G(w)\right] dw \quad (= \underline{R}).$$

From here, $\frac{T}{\lambda_0} = \frac{\int_{\underline{R}}^{\overline{w}(\underline{R})} [1-G(w)]dw}{r+\delta}$, and since $T = \underline{R}$, this can be used to substitute out the first term in the brackets from (11) to get

$$V_u = \frac{T}{r+\delta} + \frac{\lambda_0 \lambda W y}{(r+\delta)(r+\delta+\lambda_0)(r+\delta+\lambda W)},$$

which is indeed less than $\frac{T}{r+\delta} + \frac{\lambda W y}{(r+\delta)(r+\delta+\lambda W)}$.

Turn now to the first inequality in (9). By definition (see above), at $x = \widehat{x}$

$$T = \frac{\lambda_0}{r+\delta} \int_{\overline{R}}^{\overline{w}(\overline{R})} [1 - G(w)]\, dw + \frac{\lambda_0 \lambda W y}{(r+\delta)(r+\delta+\lambda W)} \quad (= \overline{R}).$$

It follows that $\frac{T}{\lambda_0} = \frac{\int_{\underline{R}}^{\overline{w}(\underline{R})}[1-G(w)]dw}{r+\delta} + \frac{\lambda W y}{(r+\delta)(r+\delta+\lambda W)}$, and since $T = \overline{R}$, this can be used to substitute out the first term in the bracket from (11) to get

$$V_u = \frac{T}{r+\delta}.$$

Therefore, (9) holds for any $x \in [\underline{x}, \widehat{x}]$ with $T = T(x)$ given by

$$T = x + \frac{\lambda_0 \lambda U}{(r+\delta)(\delta+\lambda W)} \int_T^{\overline{w}(T)} [1 - G(w|T)]\, dw.$$

We have thus established that an equilibrium of type $T = T(x)$ and $R = T$ exists for all $x \in [\underline{x}, \widehat{x}]$.

Consider what happens for x in this interval. Women are relatively non-selective, so they choose a low reservation match T. Since $R = T$ in equilibrium, a low T implies a high spread in the distribution of wages.[7] Hence, any wage $w < T$ is not only rejected by women, but it is in fact so low (relative to all other wages) that it is not acceptable for men either.

To complete the picture, consider what happens if $x < \underline{x}$ or $x > \overline{w}(\underline{R})$. In the former case, we have an equilibrium where $R = \underline{R}$ and $T < \underline{R}$. All men are marriageable and hence the marriage market has no effect on the labour market outcome.

Finally, for any $x > \overline{w}(\underline{R})$ the unique equilibrium is $R = \underline{R}$ and $T = x$. Men ignore the marriage market because $T > \overline{w}(\underline{R})$ and women set $T = x$ because $x > \overline{w}(\underline{R})$. In this (unique) pure noisy search equilibrium, women are so happy being single that they reject all men (who earn $w \leq \overline{w}(\underline{R}) < x$), and all men have reservation wage $\underline{R}$ and therefore earn wage $w \leq \overline{w}(\underline{R})$.

This concludes the proof of Theorem 1.

[7] See Remark 1 in section 5.2.

5 Discussion of the equilibrium with marriage wage premium

In the above, we have established the existence of an equilibrium characterised by male marriage wage premium. We have found an endogenous link between wages and marital status, where all men accept low wages but women are selective about whom they marry. As a consequence, some employed men stay single while others, who are lucky to find high wages, get married.

The conditions for the existence of such an equilibrium have been described in terms of parameters that capture the preferences of men and women who look for jobs and/or partners. First, as long as the value of remaining single (x) is not too high, women will look for a partner. However, as long as the value of staying single is not too low, women will be selective about whom they tie the knot with. They will only accept marriage proposals from well paid employed men.

At the same time, as long as single men value marriage but not "above all" (i.e. y is not too high), they will be willing to accept lower paid jobs. Intuitively, this is because it becomes increasingly difficult for a man to land a job that potential partners find attractive enough.

Together, these imply that the economy will consist of unemployed single men, single women, low paid men who stay single, well paid single men who are looking for a wife and happy couples where the man is a relatively high earner. Crucially, some men are married *because* they are lucky to be earning high wages, and not the other way around! Overall, there will be a gap between the observed (average) wage of married and single employed men - the marriage wage premium.

In what follows, we provide further insights into the determinants of marriage wage premium as an equilibrium phenomenon. First, we briefly comment on what happens if men's utility when married (y) is relatively high (so the condition in Lemma 1 doesn't hold). More importantly, we further investigate the effect of women's outside option (x) on the equilibrium characterised by male marriage wage premium.

5.1 What if y is high?

One might consider what happens if $y \geq \widehat{y}$. Then, $R^*(T|T = \overline{w}(\underline{R}) > \underline{R}$. What this means is that $\overline{w}(\underline{R})$ is lower than the maximum wage implied by $G(.)$. Hence, $G(T) < 1$ and the equilibrium where men give up completely on the marriage market breaks down. It is probably helpful to see what happens at the other extreme, with $y = p$. In that case, it is straightforward to show that $R^*(T) > T$ for $T < p$ and $R^*(T|T = p) = p$. Therefore the only two possible equilibria are the ones with $R = T$ and $R = \underline{R}$ (i.e. when women are not selective at all).

When $x = p$, women choose $T = p$ and we are in an equilibrium with $R = T = p$. This in turn implies a degenerate wage distribution where all firms offer p.

On the other hand, for any $\underline{x} < x < p$, the equilibrium has $R = T$ (with a non-degenerate wage distribution). This suggests that for $y \in [\widehat{y}, p)$ equilibria of the type $R < T$ (and hence with marriage wage premium) might still survive.

5.2 A closer look at the effect of x:

Recall that x is meant to capture in general terms the flow value of being single for a woman. Of course, natural interpretations of x would include the wages of women who participate in the labour market or indeed any other utility that females derive outside marriage.

First, we ask what happens to the equilibrium wage distribution and steady state marriage rates when there is an increase in women's value of being single. The results are summarised below:

Remark 1 *In a search equilibrium with $R < T$, an increase in x leads to*
(a) an increase in the spread of the equilibrium wage distribution, and
(b) a decrease in steady state marriage rates.

In order to establish (a), one could use the coefficient of variation (CV) as a measure of the spread of the wage distribution. This is defined as $CV = \frac{\sqrt{\int_R^{\bar{w}} (w-\mu)^2 dG(w)}}{\mu}$, where $\mu = \int_R^{\bar{w}} w dG(w)$. One can show that $\frac{dCV}{dR} < 0$: as T increases with x, the equilibrium has a lower R and the spread increases. The same results if one uses the ratio of percentile wages instead. Observe that $0 < \frac{d\bar{w}}{dR} < 1$ and therefore $\bar{w} - R$ increases.

To show (b), please note that as T increases $G(T)$ increases, and the number of steady state marriageable men (N) decreases. Men with wages higher than T marry at the same rate λW as before, but the rate at which unemployed men find jobs with marriageable wages decreases. Finally, the rate at which single women marry also decreases.

Throughout the paper, we referred to an equilibrium characterised by marriage wage premium as being one where $R < T$ (so that men accept wages that preclude marriage). A simple and intuitive alternative formulation of the marriage wage premium would be in terms of the gap between average wages of married and single employed men.

Indeed, define the marriage wage premium (MWP) as

$$MWP = \frac{1}{1-G(T)} \int_T^{\bar{w}} wg(w)dw - \frac{\frac{N'}{G(T)} \int_R^T wg(w)dw + \frac{N}{1-G(T)} \int_T^{\bar{w}} wg(w)dw}{N' + N}, \tag{12}$$

where N was computed earlier, and $N' = \frac{U\lambda_o G(T)}{\delta}$ is the steady state proportion of employed men who never marry. The marriage wage premium (MWP) is simply the difference between the conditional expected wages of married men and the conditional expected wages of single men (some of whom have low wages that preclude marriage, whereas others have high wages but no partners).

This formulation leads to further insights into the effect of x but also provides an elegant framework for potential measurement and empirical tests.

Remark 2 *Given the definition of marriage wage premium (MWP) in* (12)*, we have:*
(a) $MWP > 0$ for $R < T < \overline{w}$ and $MWP = 0$ for $R = T$.
(b) MWP is non-monotonic in x.

Part (a) follows directly from (12) and confirms that in an equilibrium with $R < T$ the male marriage wage premium is positive. To understand the effect of x on the equilibrium marriage wage gap, recall that $\frac{\partial T^*}{\partial x} > 0$ and $\frac{\partial R^*}{\partial x} < 0$ (which in turn implies that $\frac{\partial \overline{w}}{\partial x} < 0$). Unfortunately, an explicit computation of $\frac{\partial MWP}{\partial x}$ is difficult, but numerical simulations show that for low values of x, $\left|\frac{\partial T^*}{\partial x}\right|$ is high while both $\left|\frac{\partial R^*}{\partial x}\right|$ and $\left|\frac{\partial \overline{w}}{\partial x}\right|$ are low. In this case, the overall effect of x on MPW comes mainly from the increase in T^*. In turn, as T^* increases, the expected wages of both married and unmarried men increase.

On the other hand, for high values of x, $\left|\frac{\delta T^*}{\delta x}\right|$ is low while $\left|\frac{\delta R^*}{\delta x}\right|$ and $\left|\frac{\delta \overline{w}}{\delta x}\right|$ are high. In that case, an increase in x leads to a leftward shift in the support of the equilibrium wage distribution, and this proves to be the dominant effect.

The aggregate effect on MWP is non-monotonic, and the numerical simulations confirm a hump-shaped MWP: the marriage wage premium increases in x when x is relatively low, while for very high values (but still less that $\overline{w}(\underline{R})$), a further increase in x has a negative effect on MWP.

Recall that in our model the marriage wage premium arises because the probability of getting married is strictly higher than 0 if $w \geq T > R$, whereas it is zero if $R < w < T$. The implied discontinuity is a consequence of the assumptions of the model, and it allows us to obtain our results using the simplest possible framework. Having said that, this discontinuity is not necessarily appealing from an empirical point of view.

One way to relax this in our model would be by introducing explicitly single women's participation in the labour market. Then, higher earning women would require higher partner wages in order to compensate for earnings losses due to marriage. From a man's point of view this means higher wages imply a higher probability of marriage. This interpretation would permit the undertaking of various empirical tests of the existence and dynamics of marriage wage premium as defined above.

Using data from Public Use Micro Samples (PUMS) of the US Census, Gould and Paserman (2003) construct a probit model in order to explain the marriage status of men. They conclude that men get married more easily when their labour market prospects improve relative to women's. This is in line with the predictions of our model.

One could adapt their framework and estimate the following regression:

$$M_{ij} = \alpha + \beta_1 \widetilde{w}_{ij} + \beta_2 \widetilde{w}_{ij} x_j + \beta_3 x_j + \beta_4 \Gamma_i + \beta_5 \Theta_j + \varepsilon,$$

where M_{ij} is the probability individual i in region j gets married.

On the right-hand side, $\widetilde{w}_{ij} \equiv \frac{w_{ij}}{\overline{w}_j}$ is the wage of individual i in region j relative to the average wage in region j, whereas $x_j \equiv \frac{\overline{x}_j}{\overline{w}_j}$ is the average female wage relative to average male wage for region j. Finally, Γ_i and Θ_j are vectors of individual and region specific characteristics. Please note that the above specification incorporates the effect of the interaction between male wages and female wages (as captured by β_2).

For an equilibrium with marriage wage premium, one would expect that $\hat{\beta}_1 > 0$, $\hat{\beta}_2 \lesseqgtr 0$ and $\hat{\beta}_3 < 0$. Given that, it is possible to compute the change in wage required to maintain a constant probability of getting married (as x changes). Using the regression above (and ignoring subscripts), we have:

$$dM = \beta_1 dw + \beta_2 w dx + \beta_2 x dw + \beta_3 dx$$

From here, $dM = 0$ requires $dw = \frac{-dx(\beta_2 w + \beta_3)}{(\beta_1 + \beta_2 x)} (\equiv d\widehat{w})$. A result consistent with the MWP equilibrium would have $d\widehat{w}$ and dx sharing the same sign for all observed $[\widetilde{w}_{ij}, x_j]$ pairs: if x increases, a higher wage is required to keep the probability of marriage constant. Overall, this would constitute a test of both the existence of male marriage wage gap and of whether the female outside utility affects this premium.

On the other hand, $\hat{\beta}_1 = \hat{\beta}_2 = \hat{\beta}_3 = 0$ would be consistent with the equilibrium in part (a) of Theorem 1 (where women marry all men regardless of wage) and the equilibrium in part (d), where women reject everybody. Finally, this would also be consistent with the equilibrium in part (b) of the Theorem, since in that equilibrium the probability of marriage is the same for all observed wages.

Alternatively, one could look at a natural experiment constructed across regions and/or time. This strategy would identify two (or more) treatment groups across which women's outside options differ for exogenous reasons (either female wages or policy changes that affect the utility of single females).

6 Conclusion

We have considered a theoretical model that examines how marriage market incentives affect labour market outcomes (and vice versa). We have shown the existence and characterised search equilibria where the marriage market may or may not have an effect on wages.

In particular, we have established the existence and analysed in detail a search equilibrium with wage dispersion and male marriage wage premium. Our results rely entirely on the frictional nature of the two markets and on the relative preferences of men and women towards marriage. In contrast with existing theories, we have shown that male heterogeneity (such as productivity differences) is not required for the explanation of the marriage wage premium. With women being selective about whom they marry, men might find it too difficult to encounter wages that are high enough to be deemed acceptable by females. Men might therefore accept wages that preclude marriage. This leads to a gap between the average wages of married and single employed men - the male marriage wage premium.

We have also looked at how changes in women's options outside marriage affect the equilibrium wage distribution, marriage rates and the marriage wage premium. As women become more selective, men will find it even more difficult to find good enough jobs. As a consequence, they are willing to accept even lower wages, thereby gradually giving up on their marriage prospects. However, the effect on the marriage wage premium is ambiguous.

The predictions of the model seem to be compatible with the existing empirical evidence. In addition, we also suggest a framework for an empirical test of the existence of male marriage wage premium, as well as of whether or not the female option value outside marriage affects it. Of course, an overall estimation of the extent to which market frictions explain the marriage wage gap is still required.

Our theoretical framework could also be used to incorporate other stylised facts and provide further insights into the interaction between labour and marriage markets. For instance, one could re-examine the effect of differences in men's productivity. Alternatively, one could introduce non-productivity related male heterogeneity in order to study how non-labour market characteristics affect labour market outcomes via the marriage market.[8] Also, introducing households where both marriage partners work could be interesting. Finally, allowing for divorce seems to be a natural extension as well.

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