Marriage Premia and Classes*

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20 December, 2015

Abstract

We argue that search frictions play an important role in explaining the existence of male marriage wage premium. We show that (ex-ante) male productivity heterogeneity is neither a necessary nor a sufficient condition for such a wage premium. We analyse the interaction between frictional labour and marriage markets where men are heterogenous in the labour market, and establish the existence of a search equilibrium which exhibits male marriage premia which in turn can be ranked according to productivity. We then add female heterogeneity (in terms of attractiveness in the marriage market), and consider the endogenous formation of marital classes, also characterised by different male marriage premia. Finally, we carry out the first empirical test of the role of search frictions in generating marriage premia, by looking at data on male and female heterogeneity, wages and marital classes.

Keywords: frictional labour markets, frictional marriage markets, marriage premium, classes.

JEL classification: D83, J12, J64

*We are thankful for comments received from Jim Albrecht, Carlos Carillo-Tudela, Melvyn Coles, Marco Francesconi, Adrian Masters, Guido Menzio, Fabien Postel-Vinay, Alberto Trejos, Ludo Visschers and Susan Vroman, as well as participants at the Search and Matching Annual Meeting (Aix-en-Provence, 2015), Search and Matching Workshop (Essex, 2015) and seminar participants at SUNY Albany, Fribourg, Geneva, Munich and Neuchatel.

1 Introduction

The fact that on average, married men earn higher wages than unmarried men is well documented in the empirical literature. A wide range of studies have found that the so-called "marriage wage premium" is consistently around 10% or above (up to as high as 30%).[1]

In a recent paper, Bonilla and Kiraly (2013) show that a marital earnings gap can arise purely as a result of search frictions. Using a model of interlinked frictional labour and marriage markets, they prove the existence of a search equilibrium that exhibits marriage premium in a setup characterised by homogeneous male productivity.

The contribution of the present paper is two-fold. First, we extend the theoretical framework introduced in Bonilla and Kiraly (2013) and establish the existence of marriage premium in a search equilibrium, as well as the potential for marriage class formation. Crucially, we show that ex-ante male productivity heterogeneity is neither a necessary nor a sufficient condition for the existence of such male marital wage gap.

Second, we carry out an empirical test of the search theory of marriage premium, which - to our knowledge - is the first such investigation.[2]

We consider a model of two-sided search between women and employed men, together with job search by unemployed men who know that earnings determine whether or not they can get married (as women are assumed to prefer high earners). In this basic setup, we first incorporate male productivity differences, and then add female heterogeneity in the marriage market.

With one-sided heterogeneity (that is, male productivity differences), the main results of Bonilla and Kiraly (2013) carry through and the marriage premium is again an equilibrium outcome. The logic is quite intuitive: With random sequential job search, the optimal reservation wage may be set so

[1] For excellent surveys of this empirical literature, see Daniel (1995) or Grossbard-Shechtman and Neuman (2003).

[2] The need for such an empirical appraisal of the role of frictions in explaining male marriage premium is highlighted in Ponthieux and Meurs (2014). Interestingly, Bonilla et al.(2015) also provide evidence of the link between market frictions and marriage premium, but the focus there is on an empirical test of a search theoretical approach to beauty premium.

low that it precludes marriage. This is simply a consequence of the fact that well-paid jobs may 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.

It is important to stress that the ex-ante heterogeneity is not a necessary condition for the existence of marriage premium: such wage differentials can exist *within* each male productivity type. Furthermore, our search equilibrium displays marriage premia *across* productivity types as well, and in turn, these wage differentials can be clearly ranked.

With two-sided heterogeneity (women differ also, but in terms of attractiveness in the marriage market), our model lends itself naturally to the examination of marriage class formation. The seminal paper on endogenous formation of marriage classes in a model with search frictions is Burdett-Coles (1997). Crucially, their model and subsequent papers on the topic assume an exogenously given distribution of male wages. In contrast, we also model the ex-ante reservation wage decision of males of various types, making the range of wages endogenous. Given this, we construct an equilibrium with two marriage classes, with the objective of characterising them in terms of marriage wage premium patterns. Overall, this extended framework allows not only for a wider set of predictions, but also for the testing of the theory against a richer data-set and a fuller evaluation of the role of search frictions.

Our search theoretical explanation of male marriage wage premium is in stark contrast with the accepted views according to which the existence of such wage differentials must be due to some sort of productivity heterogeneity (before or after marriage). One such argument (the so-called *selection* theory) is that some unobservable traits of men which are valued in the marriage market are likely to also be correlated with productivity.[3] An alternative view, originally proposed by Becker (1993) is the so-called household *specialisation* theory, whereby thanks to the support of a wife, marriage increases a man's productivity.

Although the applied literature does indeed confirm a link between productivity differences and male marriage wage premium, the evidence in support of the above two theories is very mixed. The results of Chun and Lee

[3] For a good example of this approach, see Nakosteen and Zimmer (1997).

(2001) suggest that the selection effect is minimal, while Ginther and Zavodny (2001) find that only up to 10% of wage premium is the result of selection. Similarly, Loh (1996) and Hersch and Stratton (2000) argue that the effect of a potential productivity increase after marriage is also quite weak. Blackburn and Korenman (1994) consider evidence for both theories but conclude that neither seem to be sufficient explanations for the existence of marriage premium. In this context, we believe that the search theoretical approach contributes to this debate by providing a fresh angle.

The paper is structured as follows. Section 2 analyses the model with male heterogeneity and establishes the link between productivity and marriage premium. Section 3 considers the extension with two-sided heterogeneity and looks at a search equilibrium with two marriage classes, again characterised by marriage wage premia. An empirical section provides evidence in support of our theory. The final section concludes.

2 Male Heterogeneity and Marriage Premia

2.1 The Model

The economy consists of women (measure n) and men, all risk neutral. There are two types of men: low (L) productivity (measure u_L), and high (H) productivity (measure u_H). Time is continuous and agents discount the future at common discount rate r.

Unemployed men of type i (with $i = L, H$) search for wages from the exogenous distributions $F_i(w)$, with supports $[\underline{w}_i, \overline{w}_i]$. We assume that $\underline{w}_L < \underline{w}_H$, $\overline{w}_L < \overline{w}_H$ and $F_L(w) > F_H(w)$. Search is sequential, random and costless and contact with a firm occurs at rate λ_0. When employed at wage w and single, a man has flow payoff w. There is no job destruction, and no on-the-job search.

Single employed men also look for potential partners, and they meet a woman who is single at rate λ_m^i. They know the extent to which women are selective about whom they marry. In particular, a man knows that he is marriageable only if his wage is at least as high as a threshold level T demanded by a woman. A married man earning wage w enjoys flow payoff

$w + y$, where $y > 0$ captures the non-material utility of marriage (same for both types of men).

Women are single when they enter the economy and they don't look for jobs. Let x denote the flow payoff of a woman when single, interpreted as the net value of the difference between being single and being married. Alternatively, one could think of x as women's options in the labour market. Assume that $x < \overline{w}$ as otherwise there would be no potential surplus from marriage.

Women also use costless random sequential search to locate single men. Let λ_w^i be the rate at which a woman meets such a man. A married woman's flow payoff is equal to her partner's wage w.[4] Women, as well as men men are faithful (no on-the-marriage search), and there is divorce either. For now, we assume that women reject marriage with jobless men, but later will show that this is consistent with rational behaviour.

Given sequential search and the fact that utilities are increasing in wages, both men and women use optimal strategies characterised by the reservation wage property. Denote by R_i the reservation wage chosen by a man of type i in the job market. Similarly, let T be the reservation wage set by a woman in the marriage market, denoting a threshold earning level required from an eligible bachelor.

Singles as well as couples leave the economy at an exogenous rate δ. We only consider steady states. Every time an unemployed man of type i accepts a job or leaves the economy, he is replaced by another type i unemployed. This means that the fraction of unemployed men of each type (u_i) can be treated as exogenous. Let N_i denote the number of *marriageable* employed single males of type i (i.e. with a wage $w \geq T$). We assume a quadratic matching function with parameter λ that measures the efficiency of the matching process. Then, with the total number of matches equal to

[4] That is, we assume that a married woman gives up her job. Blundell et al. (2015) show that female attachment to the labour market weakens considerably after marriage. This has an immediate impact on their earnings (due to non-participation) , but also a lasting impact in the form lower future wages and part time work even after reattachment to the labour market. In turn, Gould and Passerman (2013), Openheimer (1988), Oppenheimer and Lew (1995), Loughran (2002) and Loughran and Zissimopoulos (2009) provide evidence that women build this into their expectations and behaviour in the marriage market.

$\lambda(N_H + N_L)n$, we have $\lambda_w^i = \frac{\lambda(N_H+N_L)n}{n}\frac{N_i}{(N_H+N_L)} = \lambda N_i$. Assume also that a new single woman comes into the market every time a single woman gets married or exits the economy. This means that n can be regarded as exogenous and, with quadratic matching, we have $\lambda_m^i = \frac{\lambda(N_H+N_L)n}{(N_H+N_L)} = \lambda n$. Both N_i and λ_w^i are of course endogenous. Finally, please note that with a quadratic matching function there are no congestion effects and, in what follows, we will make use of this useful property.

2.2 Optimal Search

In this section we characterise the optimal search strategies (reservation wages) used by women and men in the two markets.

2.2.1 Women

First, note that when a woman turns down an employed man, she returns to the same pool of potential partners. From her point of view, the expected value of continued search is therefore constant (computed to reflect the mix of high- and low productivity men). Second, as there is no job destruction and a married woman's instant utility is not affected directly by her partner's productivity, the lifetime utility of accepting a man with a wage w is simply the discounted value of that wage: $\frac{w}{r+\delta}$ (clearly increasing in w). Overall, this means that with sequential search, the optimal stopping strategy has the familiar reservation wage (match) property: a woman will accept a man as long as his wage is at least as high as T.

From the point of view of a single woman, the key considerations are: the number of single marriageable employed men of each type (N_i) and the distribution of earned wages across these eligible bachelors, captured by the distribution function $G_i(.)$. Therefore, in order to compute the value of being single for a woman, it is useful to determine (N_i) and $G_i(.)$ first.

We obtain N_i from a standard equation of inflows and outflows. The rate at which a single woman meets a marriageable single man of type i is λ_w^i. We also know that marriageable men of type i get married at rate λn and die at rate δ, while unemployed men of type i find marriageable wages at rate $\lambda_0 [1 - F_i(T)]$. Therefore, the steady-state equation for N_i is

$$N_i(\lambda n + \delta) = u_i \lambda_0 [1 - F_i(T)],$$

which gives

$$N_i = \frac{u_i \lambda_0 \left[1 - F_i(T)\right]}{\lambda n + \delta} \tag{1}$$

In turn, $G(.)$ is obtained from N_i above, together with the steady-state equation

$$u_i \lambda_0 \left[F_i(w) - F_i(T)\right] = N_i G_i(w) \left[\delta + \lambda n\right]$$

From here, we get

$$G_i(w) = \frac{F_i(w) - F_i(T)}{1 - F_i(T)}$$

Let's denote the expected value of being a single for a woman by $W^S(w)$. Then,

$$\begin{aligned}(r+\delta)W^S(w) &= x + \lambda N_H \int_T^{\overline{w}_H} \left\{\frac{w}{r+\delta} - W^S\right\} dG_H(w) + \\ &\quad + \lambda N_L \int_T^{\overline{w}_L} \left\{\frac{w}{r+\delta} - W^S\right\} dG_L(w)\end{aligned}$$

Alternatively, using (1) from above and $G_i(w)$, we have

$$\begin{aligned}(r+\delta)W^S(w) &= x + \frac{\lambda u_H \lambda_0}{\lambda n + \delta} \int_T^{\overline{w}_H} \left\{\frac{w}{r+\delta} - W^S\right\} dF_H(w) + \\ &\quad + \frac{\lambda u_L \lambda_0}{\lambda n + \delta} \int_T^{\overline{w}_L} \left\{\frac{w}{r+\delta} - W^S\right\} dF_L(w)\end{aligned} \tag{2}$$

2.2.2 Men

Overall, a man of type i 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 U_i and let $V_i^S(w)$ describe the value of being single and earning a wage w. Then, usual arguments imply the Bellman equation

$$(r+\delta)U_i = \lambda_0 \int_{\underline{w}_i}^{\bar{w}_i} \max\left[V_i^S(w) - U_i, 0\right] dF_i(w)$$

Sequential search and the fact that utilities are increasing in wages imply that the optimal strategy for an unemployed has the reservation wage property: men only accept jobs with wage $w \geq R_i$. They choose R_i in the knowledge that women require T in the marriage market, rejecting men who earn wage $w < T$.

Anticipating that $V_i^S(w)$ is a *discontinuous* function (see below), the reservation wage R_i can be defined as

$$R_i = min\{w : V_i^S(w) \geq U_i\}$$

With no divorce, the value of being married and earning a wage w is $V^M(w) = \frac{w+y}{r+\delta}$. Given T, we have

$$V_i^S(w) = \frac{w}{r+\delta} + \Phi \frac{\lambda n}{(r+\delta+\lambda n)(r+\delta)} y, \tag{3}$$

where

$$\Phi = \left\{ \begin{array}{l} 0 \text{ if } w < T \\ 1 \text{ if } w \geq T \end{array} \right\}$$

Please note that if there is no marriage market ($\lambda n = 0$), we have $V_i^S(w) = \frac{w}{r+\delta}$ for any w. In this case, using (3) in the expression for U_i above, together with the definition of a reservation wage ($U_i = V_i^S(w)$) yields $R_i = \underline{R}_i$, where $\underline{R}_i$ solves the implicit function:

$$\underline{R}_i = \frac{\lambda_0}{r+\delta} \int_{\underline{R}_i}^{\overline{w}_i} [1 - F_i(w)]\, dw$$

Furthermore, for $T > \overline{w}_i$, a type i unemployed cannot ever hope to obtain a job with wage higher than T. In this case, once again $V_i^S(w) = \frac{w}{r+\delta}$ for all existing wages, and therefore $R_i = \underline{R}_i$. We ignore the case when $T < \underline{R}_i$ as it is uninteresting.

One can think of $\underline{R}_i$ as a kind of "benchmark" reservation wage. Within an isolated labour market, choosing a reservation wage above $\underline{R}_i$ is always costly. However, given the linkage with the marriage market (and since $y > 0$), men have an incentive to increase their reservation wage whenever $T > \underline{R}_i$. Whenever the optimal reservation wages turn out to be higher than $\underline{R}_i$, the derivations of such reservation wages capture this tension between the labour market costs and the expected marriage market benefits.

There are two interesting ranges of optimal reservation wages.

(**A**) $R_i < T < \overline{w}_i$.

In this range, it is implicit that the expected marriage market benefit from increasing the reservation wage up to T does not compensate the associated costs in the labour market. Assuming that such reservation wages $R_i < T$ exist, we find them using (3), U_i and the definition of a reservation wage.

Here, $V_i^S(R_i) = \frac{R_i}{r+\delta}(< \frac{T}{r+\delta})$, and therefore

$$\begin{aligned} R_i &= \lambda_0 \int_{R_i}^{T} \left[\frac{w}{r+\delta} - \frac{R_i}{r+\delta} \right] dF_i(w) + \\ &\quad \lambda_0 \int_{T}^{\bar{w}_i} \left[\frac{w}{r+\delta} + \frac{\lambda n}{(r+\delta+\lambda n)(r+\delta)} y - \frac{R_i}{r+\delta} \right] dF_i(w), \end{aligned}$$

or

$$R_i = \frac{\lambda_0}{r+\delta} \int_{R_i}^{\bar{w}_i} [w - R_i]\, dF_i(w) + \frac{\lambda_0}{(r+\delta)} \int_{T}^{\bar{w}_i} \frac{\lambda n y}{(r+\delta+\lambda n)} dF_i(w).$$

The first part on the right hand side is the standard expected wage gain from continued search, so the reservation wage must compensate the workers for foregoing this option. The second part captures the additional expected utility gain from having a wage that allows marriage. With $R_i < T$, accepting wages as low as this R_i implies the possibility of renouncing marriage altogether; as a consequence, the optimally set reservation wage must compensate for that eventuality also.

Integration by parts of the first integral and simplification of the second lead to

$$R_i = \frac{\lambda_0}{r+\delta} \left[\int_{R_i}^{\bar{w}_i} [1 - F_i(w)]\, dw + \frac{\lambda [1 - F_i(T)]}{(r+\delta+\lambda)} y \right]. \tag{4}$$

Again, the first term on the right hand side is standard. We can now also interpret the second term in more detail. For an unemployed man, the possibility of contacting (at rate λ_0) a firm that offers a marriageable wage $w > T$ (which happens with probability $1-F_i(T)$), and subsequently meeting (at rate λ) a woman would leave him enjoying flow value y once married. If a job searcher were to accept a wage $w < T$, he would be giving up this utility of marriage, and as a consequence, the reservation wage must compensate for this potential loss.

It is easy to show that $\frac{\partial R(T)}{\partial T} < 0$, and the intuition is quite straightforward: as T increases (ceteris paribus), the probability of finding a marriageable wage upon contact with a firm (as captured by $1-F(T)$) decreases. Consequently, the marriage market cost of accepting a wage $w < T$ decreases, and with it the optimal reservation wage.

Finally, please note that $R_i = T$ if and only if $T = \widehat{T}_i$, where

$$\widehat{T}_i = \frac{\lambda_0}{r+\delta}\left[\int_{\widehat{T}_i}^{\overline{w}_i} [1 - F_i(w)]\, dw + \frac{\lambda n \left[1 - F_i(\widehat{T}_i)\right]}{r + \delta + \lambda n} y\right] \tag{5}$$

When $T = \widehat{T}_i (= R_i)$, the marriage market benefit of holding out for a reservation wage that matches T is the same as the associated labour market cost. This means of course that for $T > \widehat{T}_i$ the potential labour market costs outweigh the marriage market benefits. It also means that for $T < \widehat{T}_i$, the $R_i < T$ does not survive as an optimal reservation wage strategy.

(B) $(\underline{R}_i <) R_i = T (< \widehat{T}_i)$

As mentioned above, for T in this region, a reservation wage $R_i < T$ is no longer optimal. The remaining options are therefore: $R_i > T$, $R_i = T$ or $R_i = \underline{R}_i$.

Any reservation wage $R_i > T$ can easily be discarded. The argument is as follows. If men assume that their optimally chosen reservation wage is above T, they implicitly assume not only that they are marriageable once employed, but also while unemployed. However, in that scenario, their optimal reservation wage is $\underline{R}_i$, which is less than T. This is clearly inconsistent.

Furthermore, we show below that $R_i = T$ is preferred to $R_i = \underline{R}_i$ for $\underline{R}_i < T < \widehat{T}_i$. First, note that

$$(r+\delta)U_i(R_i \mid R_i = T) = \lambda_0 \int_T^{\overline{w}_i} \left[V_i^S(w) - U_i\right] dF_i(w)$$

Then:

$i)$ Given that for $T = \widehat{T}_i$ the optimal reservation wage was shown to be $\widehat{R}_i = \widehat{T}_i$ (as opposed to $\underline{R}_i$), it must true that $U_i(\widehat{T}_i) > U_i(\underline{R}_i)$.

$ii)$ For $\underline{R}_i < T < \widehat{T}_i$, $U_i(R_i \mid R_i = T)$ is continuous and increasing in T. To see this, add and subtract $\frac{T}{r+\delta}$ in the equation above, then integrate by parts to get

$$U_i(R_i \mid R_i = T) = \frac{\lambda_0}{r+\delta+\lambda_0}\left[\frac{\int_T^{\overline{w}} [1-F(w)]\, dw}{r+\delta} + \frac{\lambda n}{(r+\delta)(r+\delta+\lambda n)} y + \frac{T}{r+\delta}\right]$$

From here,

$$\frac{dU_i(R_i \mid R_i = T)}{dT} = \frac{\lambda_0 F(T)}{(r+\delta+\lambda_0)(r+\delta)} > 0.$$

$iii)$ $U_i(R_i \mid R_i = T) = U_i(\underline{R}_i)$ for $T = \underline{R}_i$.

At this point, it is also clear why women don't marry unemployed men. If they did - and recall that there is no divorce - a man's reservation wage would drop to $\underline{R}_i$. Consequently, marrying an unemployed is inconsistent with only accepting men earning $w > T > \underline{R}_i$.

Claim 1 *(i)* $\underline{R}_L < \underline{R}_H$; *(ii)* $\widehat{T}_H > \widehat{T}_L$; *iii)* $\widehat{R}_i > \underline{R}_i$.

Proof. (i) and (ii) follow from $F_L(w) > F_H(w)$; $iii)$ is straightforward. ■

The above analysis provides a full characterisation of the optimal search strategies of the two types of men $R_H(T)$ and $R_L(T)$ for any given wage-related constraint T.

Figure 1 depicts both $R_H(T)$ and $R_L(T)$ and illustrates that the reservation wage functions $R_i(T)$ exhibit an interesting non-monotonicity property.

Starting from $T = \underline{R}_i$, as women become more selective in the marriage market (T increases), men also become more selective in the labour market, as they need to earn a high wage in order to become attractive marriage partners. As a consequence, they do not accept anything less, because the value gained from ensuring marriageability is higher than the potential labour market-related loss that stems from increasing the wage above $\underline{R}_i$.

At the cut-off points ($T = \widehat{T}_i$) the marriage market gain is equal to the labour market costs of choosing $R_i = T$. For any higher demands men start choosing a reservation wage that possibly preclude the option of marriage ($R < T$). From here on, as women become even more selective, males will gradually give up on the marriage market, since the probability of finding marriageable wages decreases. Subsequently, the reservation wages gradually fall, to the point where men give up completely and rely on pure luck.

2.3 Equilibrium with Marriage Premia

An equilibrium with zero marriage premium for both types of workers is less relevant from an empirical point of view. Therefore, we focus on equilibria that exhibit a positive marriage wage premium for at least one type. Importantly, such equilibria allow us to compare marriage premia *across* types.

Before we proceed with the analysis, please note that in order to obtain a measurable marriage wage premium in the first place, it must be true that at least some men are marriageable. That is, we need the additional assumption of $T < \bar{w}_i$ for $i = H, L$.

Our definition of marriage wage premium among men of type i is the difference between the unconditional average wages of married (superscript M) and single (superscript S) men of type i.

Definition 1 *Let M_i denote the number of employed men of type i who will never marry (i.e. those with a wage w such that $R_i < w < T$), and let $J_i(w)$ be the distribution of wages earned by these men. Then, the marriage premium for men of type i is given by*

$$MP_i \equiv w_i^M - w_i^S,$$

where

$$w_i^S = \frac{M_i}{M_i + N_i} \int_{R_i}^{T} w dJ_i + \frac{N_i}{M_i + N_i} \int_{T}^{\overline{w}} w dG_i$$

and

$$w_i^M = \int_{T}^{\overline{w_i}} w dG_i$$

The next result establishes the link between reservation wages and marital wage differences.

Lemma 1 *$MP_i > 0$ for $R_i < T$, and $MP_i = 0$ for $R_i = T$.*

Proof. To get $J_i(w)$, use two steady state equations: one for the stock of men earning wages $w \in (R_i, T)$- denoted M_i, and one for the distribution $J_i(w)$.

$$u_i \lambda_0 [F_i(T) - F_i(R_i)] = M_i(\lambda n + \delta)$$

and

$$u_i \lambda_0 [F_i(w) - F_i(R_i)] = M_i J_i(w)(\lambda n + \delta)$$

From here, $J_i(w) = \frac{F_i(w) - F_i(R_i)}{F_i(T) - F_i(R_i)}$. Now, for $T = R$, we have $M_i = 0$ (and $J_i(w)$ collapses to zero), so $w_i^M = w_i^S$. On the other hand, for $T > R$, we have $M_i > 0$, and therefore $w_i^M > w_i^S$. ■

Please note the importance of the above result: a positive marriage premium is possible only if the region in which R_i decreases with T exists. In turn, this can occur only when there are search frictions in the labour market.

Furthermore, marriage market search frictions are also needed in order to be able to talk about a meaningful reservation match T.

Definition 2 *Let $\widehat{x}_i$ such that $T(\widehat{x}_i) = \widehat{T}_i$; $\underline{x}$ such that $T(\underline{x}) = \underline{R}_H$, and $\overline{x}$ such that $T(\overline{x}) = \overline{w}_L$.*

Assume for now that $\widehat{T}_H < \overline{w}_L$. As $\frac{\partial T}{\partial x} > 0$ and $\underline{R}_H < \widehat{T}_L < \widehat{T}_H$, it follows that $\underline{x} < \widehat{x}_L < \widehat{x}_H < \overline{x}$.

Theorem 1 *For $x \in [\underline{x}, \overline{x}]$, there always exists a non-empty set of parameter values for which a unique equilibrium exists where only employed men can get married and both productivity types do. The potential equilibra are as follows:*

(a) An equilibrium with $MP_L > MP_H > 0$ obtains iff $\widehat{x}_H < x < \overline{x}$;

(b) An equilibrium with $MP_L > MP_H = 0$ obtains iff $\widehat{x}_L < x < \widehat{x}_H$;

(c) An equilibrium with $MP_i = 0$ obtains iff $\underline{x} < x < \widehat{x}_L$.

Proof. We have established that R_H and R_L are continuous and non-monotonic, and it is easy to show that $\underline{R}_i < \widehat{T}_i < \overline{w}_i$. Furthermore, we know that T is independent of R_i. Together, these guarantee the existence of an unique equilibrium. Also, for $x \in [\underline{x}, \overline{x}]$ we have $\underline{R}_i < T < \overline{w}_L$ and therefore in this equilibrium only employed men can get married and both L and H types do.

For $\widehat{x}_H < x < \overline{x}$ we have $\widehat{T}_H < T < \overline{w}_L$, $R_H > R_L$ and $T > R_i$ $(i = H, L)$. From Lemma 1, $T > R_i$ implies there is a marriage premium for both types. Furthermore, $R_H > R_L$ implies that for a given T, the marriage premium is lower for H type men.

For $\widehat{x}_L < x < \widehat{x}_H$ we have $\widehat{T}_L < T < \widehat{T}_H$, $R_H \gtreqless R_L$, $T > R_L$ and $T = R_H$. Again given Lemma 1, $T > R_L$ implies that there is a marriage premium for L type men but, as $T = R_H$, the H types do not exhibit a marriage premium.

Finally, for $\underline{x} < x < \widehat{x}_L$ we have $\underline{w}_H < T < \widehat{T}_L$ and $R_i = T$. By Lemma 1, this implies no marriage wage premium for either type. ■

Outcome (a) is the more interesting one, and therefore Figure 1 plots T and R_i under this scenario. The intersection point between the relevant best response functions depict the equilibrium where both productivity types exhibit male wage premium.

Theorem 1 contains very strong results which predict that the marriage wage premium among more productive men is lower than that among less productive men. Such an equilibrium outcome is possible (and hence observable) only if there are search frictions in the labour market (as they are necessary for the non-monotonicity of the reservation wage function).

For completeness, please note that if $\widehat{T}_H > \overline{w}_L$, this only restricts the set of equilibria in which both types can potentially marry, but otherwise our qualitative results carry through. The full round-up of the potential equilibria in this case is relegated to Appendix A.

3 Two-Sided Heterogeneity and Classes

3.1 The Augmented Model:

Assume that women are characterised by a measure of attractiveness (denoted by y) in the marriage market, where y is distributed according to the cumulative distribution function $H(y)$ with support $[\underline{y}, \overline{y}]$.

Men are indexed by type (p), assumed to be uniformly distributed between $\underline{p}$ and $\overline{p}$. One could think of p as a productivity type. The measure of men of type p is given by u. (independent of p, i.e. the number of men of type p is the same for all p). Men of type p face an exogenous wage distribution $F_p(.)$ with minimum wage $[p, p+z]$, where $z > 0$.

Men and women choose reservation matches and subsequently, marriage classes form endogenously. To keep the analysis simple, we construct an equilibrium with two classes only: Class 1, with highly desirable women and very productive/high earning men, and Class 2 with less desirable women and less productive/low earning men. In other words, the population of men and women will endogenously divide into two sets, respectively: men from male Set 1 marry women from the female Set 1, and men from male Set 2 marry women from the female Set 2. The reservation match strategies for men and women are derived in detail below, but for now, a quick overview might be helpful:

Following our earlier analysis, men who ignore the marriage market set a reservation wage denoted by $\underline{R}(p)$. Employed or unemployed men from Set 1 who are accepted by all women choose reservation match y_1. In turn, employed or unemployed men from Set 2 who are only accepted by women from the female Set 2 choose reservation match y_2. These are such that $y_1 \in [\underline{y}, \overline{y}]$ and $y_2 < \underline{y}$. As unemployed men may now still be mariageable, let $y^*(p)$ denote the reservation match of an unemployed man of type p.

Similarly, women from Set 1 (measure n_1) choose reservation wage T_1, while women from Set 2 (measure n_2) choose reservation wage T_2. For obvious reasons, we limit our analysis to the case when $T_1 < \overline{p} + z$. Of course, n_1 and n_2 are endogenously determined. To keep the dynamics simple, we assume that a woman is cloned whenever she gets married or exits the market. Consequently, we can treat the total measure of women as exogenous and normalise it to 1. Following this, we obtain that the number of women in Set 1 (n_1) is $[1 - H(y_1)]$, while the measure of Set 2 women (n_2) is given by $H(y_1)$.

Given the reservation wage strategies of men, as well as $\underline{R}(p)$ and T_1 and T_2 as defined above, the male population will be divided into the following categories (based on type/wage):

Men with $p \in [\widetilde{p}, \overline{p}]$, who do not need to care about the marriage market, since $\underline{R}(\widetilde{p}) = T_1$. These men can marry anyone, even when unemployed, and for them it is also true that $y^* = y_1$.

Men with $p \in [\widehat{p}, \widetilde{p})$ who set $R(p) = T_1$ because $\widehat{T}(\widehat{p}) = T_1$. These men can - once they get a job - marry women from Set 1. While unemployed, they may be willing to marry a Set 2 woman if her y is high enough: higher than $y^*(p)$.

Men with $p \in [\widehat{\widehat{p}}, \widehat{p})$, where $\widehat{\widehat{p}} = T_1 - z$ chance it. They set $R(p) < T_1$, so if they are lucky and land a wage $w \geq T_1$, they can marry women from Set 1.

A man with $\widehat{\widehat{p}}$ has $\overline{w}(\widehat{\widehat{p}}) = T_1$, and hence no men below $\widehat{\widehat{p}}$ can ever hope to marry women from Set 1. Their only chance is women from Set 2. As we will show later that $\underline{p} < \widehat{\widehat{p}}$ is a necessary condition for the existence of our equilibrium, we work under this condition.

Define p^* such that a Set 2 woman is indifferent between staying single or marrying an unemployed p^* man. We work with the scenario where $p^* < \widehat{\widehat{p}}$, meaning that set 2 women are willing to marry the lowest type men when these men cannot hope to marry Set 1 women. As we will see, this condition ensures there is a second class in which some types (with $p < \widehat{\widehat{p}}$) have zero marriage wage premium. Note, however, that constructing such a bottom class is not trivial, as both p^* and $\widehat{\widehat{p}}$ are endogenous. Furthermore, women from Set 2 could potentially find partners from *three* pools of single men: those with $p \in [\underline{p}, \widehat{\widehat{p}})$, those with $p \in [\widehat{\widehat{p}}, \widehat{p})$ who are chancing it and are either unemployed or unlucky, as well as those who while holding out for a wage that ensures marriageability to a Set 1 woman, may still be willing to marry some Set 2 women. Indeed, women from Set 2 with attractiveness y will be accepted by men with productivity no higher than p', where $p' \in [\widehat{p}, \widetilde{p})$ is defined as the productivity p for which $y^*(p) = y$.

3.2 Optimal Search

Here we characterise the optimal reservation wage and/or match strategy for men and optimal reservation match strategy for women, given $\overline{p} < T_1 < \overline{p} + z$.

3.2.1 Men

Employed men with $w \geq T_1$ These are single men with $p \in \left[\widehat{\widehat{p}}, \overline{p}\right]$, and the pool contains those who are very high type (so can ignore the marriage market), those who held out for a wage no lower than T_1, and those who chanced it and were lucky. Having access to all women, these men only accept women with $y \geq y_1$.

Let $V_1^S(w)$ denote their value of being single and employed at wage $w \geq T_1$, and $V^M(w, y)$ denote their value of being married to a woman of type y. Then $V^M(w, y) = \frac{w+y}{r+\delta}$ and

$$
\begin{aligned}
(r+\delta)V_1^S(w) &= w + \lambda n_1 \int_{y_1}^{\overline{y}} [V^M(w,y) - V_1^S(w)] dH_1(y), \text{ where} \\
H_1(y) &= \frac{H(y) - H(y_1)}{1 - H(y_1)} \quad \text{and} \quad n_1 = 1 - H(y_1).
\end{aligned}
$$

The interpretation is straightforward: a single man who earns a wage w meets an desirable woman at rate λn_1 and gets married. Alternatively,

$$
V_1^S(w) = \frac{w}{r+\delta} + \frac{\lambda}{\{r+\delta+\lambda[1-H(y_1)]\}(r+\delta)} \int_{y_1}^{\overline{y}} y dH(y) \qquad (6)
$$

From the definition of a reservation match

$$
V^M(w, y_1) = V_1^S(w)
$$

we get

$$
y_1 = \frac{\lambda}{r+\delta} \int_{y_1}^{\overline{y}} [1 - H(y)] \, dy \qquad (7)
$$

This reflects the opportunity cost of continued search in the marriage market.

Employed men with $w < T_1$ These are single men with $p \in [\underline{p}, \widehat{p})$ - men (those with $p \in [\widehat{\widehat{p}}, \widehat{p})$) who chanced it but were unlucky and ended up with such a wage, as well as those (with $p < \widehat{\widehat{p}}$) who were hopeless to start with. All these men can only marry women earning $y < y_1$. By construction, they will accept them all, so there is no *third* class. This means that $V^M(w, \underline{y}) \geq V_2^S(w)$, where $V_2^S(w)$ is their value of being single, given by

$$(r+\delta)V_2^S(w) = w + \lambda n_2 \int_{y_2}^{y_1} [V^M(w,y) - V_2^S(w)] dH_2(y),$$

where $H_2(y) = \frac{H(y)}{H(y_1)}$ and $n_2 = H(y_1)$. Alternatively,

$$V_2^S(w) = \frac{w}{r+\delta} + \frac{\lambda}{[r+\delta+\lambda H(y_1)]\,(r+\delta)} \int_{\underline{y}}^{y_1} y dH(y) \tag{8}$$

Again, equating $V_2^S(w)$ and $V^M(w, y_2)$, one obtains the reservation match implicitly:

$$y_2 = \frac{\lambda}{r+\delta} \int_{y_2}^{y_1} [H(y_1) - H(y)] dy \tag{9}$$

Given the above, in order to satisfy $y_2 < \underline{y}$, we need:

$$\underline{y} > \frac{\lambda}{r+\delta+\lambda H(y_1)} \int_{\underline{y}}^{y_1} y dH(y)$$

Unemployed men These are single men who choose a reservation match $y^*(p)$ as well as a reservation wage $R(p)$. From our previous discussion, we know that there are two important ranges of relevant reservation wages.

(a) *Unemployed men with* $p \in [\widehat{p}, \widetilde{p})$ *who choose* $R(p) = T_1$.

It is important to note that as soon as an unemployed gets married, he subsequently sets $R(p)$ equal to $\underline{R}$. As a consequence, Set 1 women do not marry them in the first place. Nonetheless, while unemployed, these men do set a reservation match $y^*(p)$ which may or may not be lower than y_2.

Also note that for these men, once they find a wage higher than or equal to T_1, the value of unemployment is lower than the value of employment: $U_1(p) < \frac{T_1}{(r+\delta)}$. After finding such a wage, their reservation match becomes y_1 and therefore, while unemployed their reservation match $y^*(p)$ must be less than y_1.

For these men, the value of being married while still jobless is

$$V^M(\underline{R}(p), y) = \frac{\underline{R}(p) + y}{r + \delta},$$

The discounted lifetime utility of being married while still jobless reflects the fact that once married the reservation wage drops to $\underline{R}(p)$.

In turn, their value of being unemployed is

$$\begin{aligned}(r+\delta)U_1(p) &= \lambda_0 \left[1 - F_p(T_1)\right] \int_{T_1}^{\overline{w}(p)} [V_1^S(w) - U_1(p)] dF_p(w|w > T_1) + \\ &+ \lambda n_2 \left[H(y_1) - H(y^*(p))\right] \int_{y^*(p)}^{y_1} \left[V^M(\underline{R}(p), y) - U_1(p)\right] dH(y|y_1 > y > y^*(p))\end{aligned}$$

Women from Set 1 do not accept these men while they are unemployed. Nonetheless, they can look for a job and only accept it if the wage is above T_1 (so they become marriageable to Set 1 women).

Alternatively, they could meet a Set 2 woman who will accept them despite the fact that they are unemployed. Of course, these men will only accept such women if they have a sufficiently high y. This particular $y^*(p)$ solves

$$V^M(\underline{R}(p), y^*(p)) = U_1(p)$$

From the definition of a reservation wage, a jobless man is indifferent between continued job search and working with a wage $\underline{R}(p)$.

Next, using $V_1^S(w) = V^M(w, y_1)$ together with $U_1(p) = V^M(\underline{R}(p), y^*(p))$ and integrating by parts, we obtain y^* implicitly:[5]

[5] We present the implicit version as it has a more intuitive explanation, but please note that $y^*(p)$ can easily be derived explicitly.

$$y^*(p) = \frac{\lambda_0}{r+\delta}\int_{T_1}^{\overline{w}(p)}[1-F(w)]\,dw + \\ +\frac{\lambda_0}{r+\delta}[1-F_p(T_1)][y_1-y^*(p)] + \\ +\frac{\lambda n_2}{r+\delta}\int_{y^*(p)}^{y_1}[H(y_1)-H(y)]\,dy - \underline{R}(p) \tag{10}$$

This reservation match has to compensate for: (i) the standard option of continued search for better wages while unemployed (first integral); (ii) the possibility of an utility gain (in terms of y) from potentially finding a wage higher than T_1 that allows for partnership with a Set 1 woman; (iii) the option of continued search for women with higher y (second integral). These three effects are mitigated by the option of dropping the reservation wage down to $\underline{R}$ if able to get married while unemployed.

Below, we further characterise this reservation match.

Claim 2 *(i) $\frac{\partial y^*(p)}{\partial p} > 0$; ($ii$) If $y_2 \leq \underline{y}$, then $y^*(p) \leq \underline{y}$ for $p \in (\widehat{\widehat{p}}, \widehat{p}]$.*

Proof. Part i) follows from a simple implicit derivation of the y^* equation. To prove (ii), consider men with $p \in (\widehat{\widehat{p}}, \widehat{p}]$. Their value while unemployed is $V_2^S = \frac{R(p)}{r+\delta} = U_2(p)$. If their reservation match when employed (i.e. when enjoying value V_2^S) is y_2, then it is also y_2 when unemployed (i.e. enjoying value $U_2(p) = V_2^S$). ■

Please note that in principle $y^*(p)$ can be higher or less than $\underline{y}$. To explore this further, let's define p' such that $y^*(p') = \underline{y}$. From Claim 2, $p' > \widehat{p}$.[6] For $p' > \widetilde{p}$, all men with $p \in (\widehat{p}, \widetilde{p})$ set $y^*(p) < \underline{y}$ and are willing to marry all women. For $p' < \widetilde{p}$, men with $p \in (\widehat{p}, p')$ also set $y^*(p) < \underline{y}$, while men with $p \in (p', \widetilde{p})$ set $y^*(p) > \underline{y}$ and are willing to marry only women with $y > y^*(p')$, where $y^*(p') > \underline{y}$.

[6]For $p = \widehat{p}$ we have $R(\widehat{p}, T_1) = T_1$ so it is true that $V_1^s(R(\widehat{p})) = \frac{R(\widehat{p})}{r+\delta} = U(\widehat{p})$. The reservation match of these men is $y_2 < \underline{y}$.

(b) *Unemployed men with* $p \in [\widehat{\widehat{p}}, \widehat{p})$, *who choose* $R(p) < T_1$.

These men are willing to accept wages that put them in the male Set 2. Of course, they may still be be lucky and find wages that get them into Set 1 (making them marriageable to Set 1 women).

Their value of unemployment is $U_2(p)$, where $(r+\delta)U_2(p) =$

$$
\begin{aligned}
\lambda_0 \left[F(T_1) - F(R(p))\right] \int_{R(p)}^{T_1} [V_2^S(w) - U_2(p)] dF_p(w|R(p) &< w < T_1) + \\
+\lambda_0 \left[1 - F(T_1)\right] \int_{T_1}^{\overline{w}(p)} [V_1^S(w) - U_2(p)] dF_p(w|w &> T_1) + \\
+\lambda n_2 \int_{\underline{y}}^{y_1} \left[V^M(\underline{R}(p), y) - U_2(p)\right] dH(y|y &< y_1)
\end{aligned}
$$

These men face the following scenario: they can either accept a job with wage less than T_1 that puts them in Set 2, or find a job that puts them in Set 1, or find an acceptable Set 2 woman and get married. The above implicitly captures that for these men, $y^*(p) \leq \underline{y}$: jobless or not, all these men find Set 2 women acceptable. Having accepted $R(p)$, they set $y^*(p) \leq \underline{y}$ and they are indifferent between unemployment and employment at wage $\overline{R}(p)$.

Recall that if a jobless man succeeds in getting married, his reservation wage then drops to $\underline{R}(p)$, so the value of being married while unemployed is again $V^M(\underline{R}(p), y) = \frac{\underline{R}(p)+y}{(r+\delta)}$. From the definition of a reservation wage and using $V_1^S(w)$ and $V_2^S(w)$, as well as $n_2 = H(y_1)$, we obtain:

$$R(p) = \frac{\lambda_0}{r+\delta+\lambda H(y_1)} \int_{R(p)}^{\overline{w}(p)} [1 - F_p(w)]\, dw + \tag{11}$$
$$+ \frac{\lambda_0 (r+\delta)}{r+\delta+\lambda H(y_1)} [1 - F(T_1)] \left[V_1^S(w) - V_2^S(w)\right] +$$
$$+ \frac{\lambda}{r+\delta+\lambda H(y_1)} \int_{\underline{y}}^{y_1} [\underline{R}(p) + y] dH(y) \quad (< T_1).$$

The terms on the right hand side reflect that the reservation wage has to compensate for the following: (i) the standard option of continued search for better wages, (ii) the foregoing of the potential to marry a Set 1 woman (and the acceptance of only being able to marry Set 2 women), and (iii) the option of marrying a Set 2 woman while unemployed.

(c) *Unemployed men with* $p \in [\widetilde{p}, \overline{p}]$ and *unemployed men with* $p \in [\underline{p}, \widehat{\widehat{p}})$.

Recall that $\widetilde{p}$ is such that $\underline{R}(\widetilde{p}) = T_1$. Consequently, men with $p > \widetilde{p}$ need not worry about marriage, since $\underline{R}(p) > T_1$, so they set their reservation wage equal to $\underline{R}(p)$.

3.2.2 Women

Women in Set 1 These women only marry men whose wages are higher than T_1. The pool of such eligible bachelors is made up of the following men:

i) a measure N_p of single and employed men with $p > \widetilde{p}$, whose wages are higher than T_1;

ii) a measure $u\,[\overline{p} - \widetilde{p}]$ of single and unemployed men with $p > \widetilde{p}$, who have reservation wages $\underline{R}(p) > T_1$;

iii) a measure N_p' of single and employed men with $p \in [\widehat{p}, \widetilde{p})$, who have held out for a wage at least as high as T_1;

iv) a measure N_p' of single and employed men with $p \in [\widehat{\widehat{p}}, \widehat{p})$, who chanced it, were lucky and are now earning a wage $w \geq T_1$.[7]

[7] Since the distributions of posted wages are exogenous, the last two measures are the same.

Given the above, for a woman in Set 1 the value of marriage is

$$
\begin{aligned}
(r+\delta)W_1^S \;=\;& \Psi \int_{\widetilde{p}}^{\overline{p}} N_p \left[\int_{\underline{R}(p)}^{\overline{w}_p} \left(\frac{w}{r+\delta} - W_1^S \right) dG_p(w) \right] dp + \qquad (12)\\
&+\Psi u \left[\overline{p} - \widetilde{p}\right] \int_{\widetilde{p}}^{\overline{p}} \left[\frac{\underline{R}(p)}{r+\delta} - W_1^S \right] dp + \\
&+ \int_{\widehat{p}}^{\min(\widetilde{p},\overline{p})} N_p' \left[\int_{T_1}^{\overline{w}_p} \left(\frac{w}{r+\delta} - W_1^S \right) dG_p(w) \right] dp + \\
&+ \int_{\widehat{\widehat{p}}}^{\min(\widehat{p},\overline{p})} N_p' \left[\int_{T_1}^{\overline{w}_p} \left(\frac{w}{r+\delta} - W_1^S \right) dG_p(w) \right] dp,
\end{aligned}
$$

where $\Psi = 1$ for $\overline{p} > \widetilde{p}$ and $\Psi = 0$ otherwise. In the above, $G_p(w) = \frac{F_p(w)-F_p(T_1)}{1-F_p(T_1)}$, while $N_p = \frac{u\lambda_0[1-F_p(\underline{R}(p))]}{\lambda n_1+\delta}$ and $N_p' = \frac{u\lambda_0[1-F_p(T_1)]}{\lambda n_1+\delta}$, all three derived from steady-state conditions analogous to the ones in Section 2.

From (12), and using the definition of a reservation wage $W_1^S = \frac{T_1}{r+\delta}$ we obtain T_1 implicitly:

$$
\begin{aligned}
\left[r+\delta+u(\overline{p}-\widetilde{p})\right] \frac{T_1}{r+\delta} \;=\;& \Psi \int_{\widetilde{p}}^{\overline{p}} \left[\frac{u\lambda_0}{(\lambda n_1+\delta)(r+\delta)} \int_{\underline{R}(p)}^{\overline{w}_p} \left[1-F_p(w)\right] dw \right] dp + \\
&+\Psi u(\overline{p}-\widetilde{p}) \int_{\widetilde{p}}^{\overline{p}} \frac{\underline{R}(p)}{r+\delta} dp + \qquad (13)\\
&+ \int_{\widehat{p}}^{\min(\widetilde{p},\overline{p})} \left[\frac{u\lambda_0}{(\lambda n_1+\delta)\,(r+\delta)} \int_{T_1}^{\overline{w}_p} \left[1-F_p(w)\right] dw \right] dp + \\
&+ \int_{\widehat{\widehat{p}}}^{\min(\widehat{p},\overline{p})} \left[\frac{u\lambda_0}{(\lambda n_1+\delta)\,(r+\delta)} \int_{T_1}^{\overline{w}_p} \left[1-F_p(w)\right] dw \right] dp
\end{aligned}
$$

Women in Set 2 These women have no access to Set 1 men. As a consequence (and allowing for $\underline{p} \lesseqgtr p^*$), a Set 2 woman with level of attractiveness y will only marry the following men:

i) a measure N_p'' of single and employed men with $p \in [\widehat{\widehat{p}}, \min(\widehat{p}, \overline{p})]$ who chanced it but were unlucky and now earn $w < T_1$;

ii) a measure $u\left[\widehat{p} - \max(\underline{p}, p^*)\right]$of single and unemployed men with $p \in [\max(\underline{p}, p^*), \widehat{p})$ who - while unemployed - cannot marry Set 1 women. These are men who are yet to find a job: either men with $\widehat{\widehat{p}} < p < \widehat{p}$ who are chancing it, or men with $p > \widehat{p}$, who set their reservation wage equal to T_1;

iii) a measure $u\left[(p'(y) - \widehat{p}\right]$of single unemployed men with $p \in [\widehat{p}, p'(y)]$, where $p'(y)$ is the productivity p for which $y^*(p) = y$. These are men who - while unemployed - are once again not acceptable to Set 1 women, and whose productivity is low enough so they accept a woman with attractiveness y.

Note that p^*, as previously defined, is implicitly given by $\frac{\underline{R}(p^*)}{r+\delta} = W_2^S$. With $p^* < \widehat{\widehat{p}}$, and given the relevant pool of single men, the value of being single for a Set 2 woman is:

$$
\begin{aligned}
(r+\delta)W_2^S(y) \quad = \quad & \int_{\widehat{\widehat{p}}}^{\min(\widehat{p},\overline{p})} N_p'' \int_{R(p)}^{T_1} \left[\frac{w}{r+\delta} - W_2^S\right] dG_p'(w)dp + \\
& + u\left[\widehat{\widehat{p}} - \max(\underline{p}, p^*)\right] \int_{\max(\underline{p},p^*)}^{\widehat{\widehat{p}}} \left[\frac{\underline{R}(p)}{r+\delta} - W_2^S\right] dp + \\
& + \Omega u\left[(p'(y) - \widehat{p}\right] \int_{\widehat{p}}^{p'(y)} \left[\frac{\underline{R}(p)}{r+\delta} - W_2^S\right] dp, \qquad (14)
\end{aligned}
$$

where $\Omega = 1$ for $p'(y) > \widehat{p}$ and $\Omega = 0$ otherwise.

Note that $p^* > \underline{p}$ implies that $\frac{\underline{R}(p^*)}{r+\delta} = W_2^S$, and therefore $T_2 = \underline{R}(p^*)$. On the other hand, for $p^* < \underline{p}$, we have $W_2^S > \frac{\underline{R}(p^*)}{r+\delta} (= \frac{T_2}{r+\delta})$.

In the above, $G_p'(w) = \frac{F_p(w) - F_p(R(p))}{F_p(T_1) - F_p(R(p))}$ and $N_p'' = \frac{u\lambda_0[F_p(T_1) - F_p(R(p))]}{\delta + \lambda n_2}$, where $G_p'(w)$ and N_p'' come from the steady-state conditions

$$
u\lambda_0\left[F_p(w) - F_p(R(p))\right] = G_p'(w)N_p''\left(\delta + \lambda n_2\right)
$$

and

$$u\lambda_0 \left[F_p(T_1) - F_p(R(p))\right] = N_p^{''} (\delta + \lambda n_2).$$

3.3 Equilibrium with marital classes

Below, we first define an equilibrium with two classes, where the bottom class is characterised by zero marriage premium. This is essentially a summary of the best response strategies and steady-state variables derived in the previous section. Following that, we discuss the necessary existence conditions, and show (using a numerical solution) that such an equilibrium indeed exists. We also show that our qualitative results hold for more than two classes. Finally, we provide a full characterisation of possible marriage premia patterns across male productivity types as well as marriage classes.

3.3.1 Definition

A steady-state search equilibrium with two classes is a system[8]

$$\left\{G_p(.), G_p^{'}(.), N_p, N_p^{'}, N_p^{''}, T_1, T_2, \underline{R}(p), R(p), y_1, y_2, y^*(p), \widehat{\widehat{p}}, \widehat{p}, \widetilde{p}, p^*, H_1(y), H_2(y), n_1, n_2\right\}$$

such that:

(i) The distributions of wages earned by men of type p are:

$$G_p(w) = \frac{F_p(w) - F_p(T_1)}{1 - F_p(T_1)} \qquad \text{for men who can marry set 1 women,}$$

and

$$G_p'(w) = \frac{F_p(w) - F_p(R(p))}{F_p(T_1) - F_p(R(p))} \qquad \text{for men who can marry set 2 women only;}$$

[8]Please note that since $G_p(.), G_p^{'}(.), N_p, N_p^{'}, N_p^{''}, H_1(y), H_2(y), n_1, n_2$ are obtained from steady-state conditions and are used to derive the other endogenous variables, one could omit them from the above exhaustive description of the search equilibrium, so we are left with $\left\{T_1, T_2, \underline{R}(p), R_p, y_1, y_2, y^*(p), \widehat{\widehat{p}}, \widehat{p}, \widetilde{p}, p^*\right\}$.

(ii) Women's reservation matches satisfy:

$$T_1 = (r+\delta)W_1^S(w),$$

and

$$\begin{aligned} T_2 &= \underline{R}(p^*) \quad \text{for} \quad p^* > \underline{p}, \quad \text{or} \\ T_2 &< (r+\delta)W_2^S(w) \quad \text{for} \quad p^* < \underline{p} \end{aligned}$$

where $W_j^S(w)$ as defined $(j = 1, 2)$.

(iii) Type p unemployed men's reservation wages depend on whether or not they take the marriage market into account:

(a) If they ignore the marriage market:

$$\underline{R}(p) = \frac{\lambda_0}{r+\delta} \int_{\underline{R}(p)}^{\overline{w}_p} [1 - F_p(w)]\, dw$$

(b) If they take the marriage market into account:

$$R(p) = T_1 \quad \text{and}$$

$$\begin{aligned} y^*(p) &= \frac{\lambda_0}{r+\delta} \int_{T_1}^{\overline{w}(p)} [1 - F(w)]\, dw + \frac{\lambda_0}{r+\delta} [1 - F_p(T_1)] [y_1 - y^*(p)] + \\ &\quad + \frac{\lambda n_2}{r+\delta} \int_{y^*(p)}^{y_1} [H(y_1) - H(y)]\, dy - \underline{R}(p) \end{aligned}$$

or

$$\begin{aligned} R(p) &= \frac{\lambda_0}{r+\delta+\lambda H(y_1)} \int_{R(p)}^{\overline{w}(p)} [1 - F_p(w)]\, dw + \\ &+ \frac{\lambda_0 (r+\delta)}{r+\delta+\lambda H(y_1)} [1 - F(T_1)] \left[V_1^S(w) - V_2^S(w)\right] + \\ &+ \frac{\lambda}{r+\delta+\lambda H(y_1)} \int_{\underline{y}}^{y_1} [\underline{R}(p) + y] dH(y) \quad (< T_1). \end{aligned}$$

(*iv*) Employed men's reservation matches (in terms of female attractiveness) are:

$$y_1 = \frac{\lambda}{r+\delta} \int_{y_1}^{\overline{y}} [1 - H(y)]\, dy \qquad \text{if } w \geq T_1$$

and

$$y_2 = \frac{\lambda}{r+\delta} \int_{y_2}^{y_1} [H(y_1) - H(y)] dy \qquad \text{if } w < T_1.$$

(*v*) Threshold male types $\widehat{\widehat{p}}, \widehat{p}, \widetilde{p}$ and p^*satisfy:

$$\widehat{\widehat{p}} = T_1 - z$$

$$\widehat{T}(\widehat{p}) = T_1$$

$$\underline{R}(\widetilde{p}) = T_1$$

and

$$\frac{\underline{R}(p^*)}{r+\delta} = W_2^S$$

(*vi*) Steady state turnover conditions:

$$N_p \left[\delta + \lambda n_1\right] = u\lambda_0 \left[1 - F_p(\underline{R}(p)\right]$$

$$N_p^{'} \left[\delta + \lambda n_1\right] = u\lambda_0 \left[1 - F_p(T_1)\right]$$

$$u\lambda_0 \left[F_p(w) - F_p(T_1)\right] = N_p G_p(w) \left[\delta + \lambda n_1\right]$$

$$N_p^{''} \left[\delta + \lambda n_2\right] = u\lambda_0 \left[F_p(T_1) - F_p(R(p))\right]$$

$$u\lambda_0 \left[F_p(w) - F_p(R(p))\right] = G_p^{'}(w) N_p^{''} \left[\delta + \lambda n_2\right]$$

$$n_1 = 1 \left[1 - H(y_1)\right]$$

$$n_2 = 1[H(y_1)]$$

3.3.2 Characterisation and existence:

Having already constructed an equilibrium with two marriage classes with zero marriage premium in the bottom class, we are now in a position to state necessary conditions, and highlight another important property of such an equilibrium. This leads to the existence theorem.

Claim 3 *A two-class search equilibrium with zero male marriage premium in the bottom class exists only if*
(a) $\underline{y} > \underline{y}'$*, where* $\underline{y}' = y_2(\underline{y}')$*, and*
(b) $\underline{p} < \widehat{\widehat{p}}$*.*

Proof. The condition $\underline{y} > \underline{y}'$ simply says that Set 2 men are willing to marry all women not in Set 1, so there is no third female set. Note that y_2 is positive and independent of $\underline{y}$ when $\underline{y} < y_2$. In addition, y_2 is increasing in $\underline{y}$ when $\underline{y} > y_2$. Then $\underline{y}' > 0$. Therefore it is always possible to choose a $\underline{y} \in \left(\underline{y}', y_1\right)$ such that $\underline{y} > y_2$. Then, set 2 men are willing to marry all women not in Set 1, and hence Set 2 is the only other (bottom) female set. This also rules out a third class.

Assume that $\underline{p} > \widehat{\widehat{p}}$. Then, even the lowest type men chance it, and therefore there is always a positive marriage premium. On the other hand, with $\underline{p} < \widehat{\widehat{p}}$ we have $T_1 > \underline{R}(\underline{p})$, so set 1 women reject some men. In particular, a set 1 woman will never marry an unemployed of type $\widehat{\widehat{p}}$, so she will clearly never marry any unemployed of lower type. From the equation for T_1 it is clear that $T_1 < \overline{p} + z$ as long as λ is not infinite. Since $\widehat{\widehat{p}} = T_1 - z$, we have $\overline{p} > \widehat{\widehat{p}}$. This ensures that there are unemployed men who chance it, and hence it rules out a one-class equilibrium. Note that $\overline{p} < \widehat{\widehat{p}}$ would mean that all unemployed men ignored T_1, which would make this T_1 sub-optimal for women. They would set it lower and in turn, this lower T_1 would lead to the existence of a second class. Since $\frac{\partial \widehat{\widehat{p}}}{\partial \underline{p}} = 0$ when $\underline{p} < \widehat{\widehat{p}}$, one can always choose a low enough $\underline{p}$ that satisfies this condition. Together with $\underline{y} > \underline{y}'$, this ensures that the second class is in fact the bottom class.

When $\underline{p} < \widehat{\widehat{p}}$ holds, it is also true that some men in set 2- those with $p \in \left(\underline{p}, \widehat{\widehat{p}}\right)$ - cannot hope to marry set 1 women, and therefore ignore T_1. Nonetheless, these men are able to marry set 2 women even when unemployed, and consequently the men in the second (bottom class) have zero marriage wage premium. ■

We can further characterise such an equilibrium:

Claim 4 *In any two-class search equilibrium with zero marriage premium in the bottom class, we have* $p^* < \widehat{\widehat{p}}$*.*

Proof. Assume that $p^* > \widehat{\widehat{p}}$. All men in Set 2 - those with $p \in (p^*, \widehat{\widehat{p}})$ - will chance it, so for these men the marriage premium is positive. Some men (with $p < p^*$) would constitute a *third* set of men, but men in this set would never marry. ∎

Finally, although explicit sufficient conditions for existence have proved to be elusive, we are nonetheless able to provide an existence theorem which relies on the twice-differentiability of equilibrium equations.

Theorem 2 *The set of parameters for which a two-class search equilibrium with zero male marriage premium in the bottom class exists is non-empty.*

Proof. All choice variables are continuous. To show that the range of parameters for which our equilibrium exists is non-empty, it is enough to find a set of such parameters. This is done by providing a numerical solution (please consult Appendix B). ∎

Overall, in such an equilibrium there are two potential scenarios under which the bottom class men have zero marriage premium, as shown below.

Lemma 2 *Bottom class men have a zero marriage premium if either* $\underline{p} < p^* < \widehat{\widehat{p}}$ *, or* $p^* < \underline{p} < \widehat{\widehat{p}}$*.*

Proof. If $\underline{p} < p^* < \widehat{\widehat{p}}$, men with $p \in (p^*, \widehat{\widehat{p}})$ cannot marry Set 1 women but are able to marry Set 2 women even while unemployed. The MP amongst these men is then zero. In addition, men with $p \in (\underline{p}, p^*)$ can never get married. If $p^* < \underline{p} < \widehat{\widehat{p}}$, there is no male Set 3. All men (including those still looking for a job) who have $p \in \left(\underline{p}, \widehat{\widehat{p}}\right)$ are able to marry Set 2 women, and therefore the MP of these men is also zero. ∎

For the sake of analytical tractability, so far we have only focused on a two-class search equilibrium. However, this is without any loss of generality in terms of endogenous class formation[9] and the fact that men in a bottom class (bottom among any number of classes) will always have a zero marriage wage premium.

Corollary 1 *Let K be the number of marriage classes and let p_K^* defined by $T_K = \underline{R}(p_K^*)$. In any search equilibrium with K classes, $p_K^* < T_K - z$ and the men in the bottom class have zero marriage premium.*

Proof. Assume K classes. Then, any equilibrium with $p_K^* < T_K - z$ is such that $MP = 0$ amongst some men in the K^{th} class, simply because $\underline{p}$ can always be chosen such that one of the two scenarios discussed in Lemma 2 holds. With two classes, $p_K^* < T_K - z$ is actually $p^* < T_1 - z = \widehat{\widehat{p}}$. ■

3.3.3 Marriage premia across productivities and classes

In this section we summarise the patterns of marriage premia that characterise males with different productivities as well as across classes.

First: men with extremely high productivity ($p > \tilde{p}$, for whom $\underline{R}(p) > T_1$) can ignore the labour market. They qualify for male Set 1 even when unemployed. Consequently, they only marry women with $y > y_1$ and form Class 1 partnerships with such Set 1 women. The marriage premium of these men is zero, simply due to the fact that labour market status is irrelevant as far as their prospects in the marriage market are concerned.

Second: highly productive men (with $\hat{p} \leq p < \tilde{p}$) will not accept wages that put them in Set 2. They choose $R(p) = T_1$. If (and only if) they find such an acceptable wage, they are able to marry Set 1 women and hence form Class 1 partnerships. There is no marriage wage premium associated with marriage to Set 1 women. However, there is a marriage wage *penalty* associated with marriage to Set 2 women. Recall that although these men only accept wages that put them in Set 1, while unemployed they belong to Set 2, as only Set 2 women would marry them. Given this, they could end up marrying a Set 2 woman who has a high enough y. Following that, however, their reservation wage goes down to $\underline{R}(p)$, which in turn generates the marriage penalty.

[9] As shown by Burdett and Coles (1997).

Third: mid-productivity men (with $\widehat{\widehat{p}} \leq p < \widehat{p}$). These men choose $R(p) < T_1$ and are therefore willing to accept wages that put them in Set 2. Nonetheless, they can still be lucky and find a wage that puts them in Set 1. In that case, there is a positive marriage premium associated with marrying Set 1 women (and forming Class 1 partnerships). In contrast, marriage to a Set 2 woman leads to a marriage penalty. However, note that this penalty is lower than that of highly productive men discussed above. The reson is that it pertains to employed men with wages between $R(p)$ and T_1: these men found a job first, and only following that, a Set 2 partner. This is in addition to those men who find a Set 2 partner first, subsequently drop their reservation wage to $\underline{R}(p)$ and then find a job.

Fourth: (i) with $p^* < \underline{p} < \widehat{\widehat{p}}$, the highest available wage for these low productivity men (who have $p \in (\underline{p}, \widehat{\widehat{p}})$) is lower than T_1. As a consequence of this, they ignore T_1 and choose $\underline{R}(p)$ as their reservation wage. This is higher than T_2 for all of these men, so Set 2 women marry them irrespective of whether they are employed or unemployed. This leads to the formation of Class 2 partnerships. Importantly, there is no marriage premium associated with these men.

(ii) with $\underline{p} < p^* < \widehat{\widehat{p}}$, men with $p \in (p^*, \widehat{\widehat{p}})$ cannot marry Set 1 women but are accepted by Set 2 women, even if jobless. The marriage wage premium amongst these men is zero. Sadly, men with $p \in (\underline{p}, p^*)$ can never get married.

4 Empirical evidence

Theorem 1 offers clear predictions about the ranking of marriage premia across men of different productivity. In turn, the results in Section 3 strongly suggest that in a marriage market characterised by classes, the bottom class should be statistically different from other classes and include men with zero marriage wage premium. Together, these theoretical predictions offer a good basis for an empirical test.

Our primary aim in this section is to estimate the marriage wage premium (MP) for a heterogeneous male workforce. We use educational attainment as proxy for productivity, with higher levels of education representing higher levels of productivity. We estimate our MP by regressing wages on marital status, controlling for a range of other factors, using both OLS and fixed effects. The latter method uses the within-transformation to sweep out time-invariant individual heterogeneity and is recommended for estimating the MP (see Cornwell and Rupert, 1995).

In addition, we also look for patterns of classes on the marriage market that exhibit the male wage premia suggested by our theoretical model.

4.1 Data

We use two sources of data from the UK: the National Child Development Survey (NCDS) and the British Household Panel Survey (BHPS). The NCDS is a cohort study that has followed a cohort of 17,000 individuals born in a single week in 1958 in England, Scotland and Wales. Data were collected on individuals throughout their lives and we use data from waves 4, 5, 6, 7 and 8 when the individuals were aged 23, 33, 42, 46 and 50. The BHPS was collected between 1991 and 2008 and covered England and Wales, as well as parts of Scotland (later all of Scotland) and Northern Ireland. Data were collected initially on around 5,000 households, leading to around 10,000 interviews. Individuals were followed over time, and as individuals moved into new households all individuals in the new households were also interviewed. We use data from all 18 waves of the BHPS.

There are several advantages to using these two datasets. Firstly, since they are longitudinal, it is possible to control for time invariant unobservable heterogeneity by using fixed effects estimations methods. Secondly, they contain information required for the estimation of wage equations, including information on individual educational attainment. Thirdly, they provide different insights into the empirical problem. The BHPS contains individuals from different ages, meaning that for different age cohorts there may be different labour market experiences. The NCDS contains individuals of the same age, so the cohort experience will be common across all individuals.

For our estimation we have focussed on men who are either single or are in their first marriage and who are working full time. Individuals are categorised into four groups by education status. The four groups are 1) No qualifications, 2) School leavers qualifications (qualifications obtained at the school leaving age of 16), 3) Higher school leavers qualifications (these are qualifications that are above those for age 16 but lower than degree level, and 4) Higher education qualifications - degree and above.

The key outcome variable for this study is wages. In the NCDS individuals are asked to report their usual net pay and the period that this applies to allowing us to calculate net pay per week which we then deflate (to 1987 prices) and log. For the BHPS we construct logged, deflated (to 1987 prices) monthly income. We also include controls for age (BHPS), region of residence, social class (a marker of status based on occupation), health status[10], sector of employment and wave dummies. For the BHPS we also have full information across waves on size of employer, experience and union status. Summary statistics for the two samples are given in Table 1.

Table 1: Summary statistics

Variable	**Mean NCDS**	**Std. Dev.**	**Mean BHPS**	**Std. Dev**
log real weekly income	5.166	0.514		
log real monthly income			6.828	0.49
married	0.739	0.439	0.591	0.492
education - degree	0.127	0.333	0.217	0.412
education - below degree	0.353	0.478	0.341	0.474
education - school leaver (16)	0.431	0.495	0.32	0.467
education - no qualifications	0.089	0.284	0.122	0.327
age			33.45	8.559
excellent health	0.826	0.379	0.329	0.47
private sector	0.702	0.458	0.821	0.383
social class 1 (high)	0.071	0.257	0.081	0.272
social class 2	0.305	0.46	0.327	0.469
social class 3 non-manual	0.166	0.372	0.153	0.36
social class 3 manual	0.31	0.463	0.281	0.45
social class 4	0.113	0.316	0.129	0.336
social class 5 (low)	0.035	0.184	0.029	0.168
experience (days)			1712.769	2054.811
union			0.416	0.493
N	7380		19775	

In Table 1 we see that individuals in the NCDS sample are more likely to

[10]For the BHPS in wave 9 the health question was different from the other waves, we estimate models including and excluding wave 9 data and find that it makes little difference to the results.

be married than those in the BHPS. This may be due to the age difference between the two datasets, with. the average age in the BHPS sample being around 34, whereas the NCDS sample were all 50 in 2008. Other differences include the proportion of the population with a degree, reflecting greater educational opportunities for younger age groups in the BHPS data. Also, the proportion of individuals reporting excellent health is higher in the NCDS, reflecting the different categories available when answering the self-assessed health question. Lastly we can see that in the BHPS a greater proportion work in the private sector and that there has been some overall movement up the social class bands.

Tables 2, 3, 4 and 5 give the summary statistics by each of the education groups. We can see that individuals with degrees have, on average higher incomes, are in better health, less likely to be in the private sector and more likely to be of high social class. As we move down the educational groups income falls and individuals are more likely to be in a lower social class classification.

Table 2: Summary statistics - Education, degree

Variable	**Mean NCDS**	**Std. Dev.**	**Mean BHPS**	**Std. Dev**
log real weekly income	5.487	0.544		
log real monthly income			7.104	0.526
married	0.748	0.434	0.544	0.498
age			34.483	8.18
excellent health	0.875	0.331	0.385	0.487
private	0.553	0.497	0.711	0.453
social class 1 (high)	0.232	0.422	0.238	0.426
social class 2	0.568	0.496	0.553	0.497
social class 3 non-manual	0.096	0.295	0.129	0.335
social class 3 manual	0.035	0.184	0.048	0.214
social class 4	0.045	0.207	0.03	0.171
social class 5 (low)	0.025	0.155	0.002	0.043
experience (days)			1182.465	1493.498
union			0.378	0.485
N	937		4294	

Table 3: Summary statistics - Education, below degree

Variable	Mean NCDS	Std. Dev.	Mean BHPS	Std. Dev
log real weekly income	5.267	0.506		
log real monthly income			6.847	0.461
married	0.742	0.438	0.592	0.491
age			34.174	8.524
excellent health	0.848	0.359	0.345	0.476
private	0.690	0.462	0.810	0.392
social class 1 (high)	0.086	0.281	0.062	0.242
social class 2	0.38	0.485	0.371	0.483
social class 3 non-manual	0.172	0.377	0.189	0.392
social class 3 manual	0.274	0.446	0.28	0.449
social class 4	0.07	0.255	0.084	0.277
social class 5 (low)	0.018	0.134	0.014	0.117
experience (days)			1655.475	1956.731
union			0.437	0.496
N	2606		6746	

Table 4: Summary statistics - Education, school leaver (16)

Variable	Mean NCDS	Std. Dev.	Mean BHPS	Std. Dev
log real weekly income	5.056	0.444		
log real monthly income			6.71	0.421
married	0.741	0.438	0.576	0.494
age			33.342	8.499
excellent health	0.808	0.394	0.297	0.457
private	0.735	0.441	0.876	0.33
social class 1 (high)	0.022	0.148	0.02	0.141
social class 2	0.208	0.406	0.213	0.409
social class 3 non-manual	0.199	0.399	0.163	0.37
social class 3 manual	0.399	0.49	0.378	0.485
social class 4	0.134	0.341	0.193	0.395
social class 5 (low)	0.037	0.189	0.033	0.18
experience (days)			1848.803	2121.498
union			0.417	0.493
N	3183		6329	

Table 5: Summary statistics - Education, no qualifications

Variable	**Mean NCDS**	**Std. Dev.**	**Mean BHPS**	**Std. Dev**
log real weekly income	4.834	0.466		
log real monthly income			6.591	0.436
married	0.702	0.458	0.714	0.452
age			38.561	8.263
excellent	0.755	0.43	0.265	0.442
private	0.797	0.403	0.905	0.293
social class 1 (high)	0.017	0.129	0.009	0.093
social class 2	0.099	0.299	0.104	0.306
social class 3 non-manual	0.086	0.28	0.066	0.248
social class 3 manual	0.414	0.493	0.445	0.497
social class 4	0.277	0.448	0.267	0.443
social class 5 (low)	0.107	0.309	0.109	0.312
experience (days)			1848.803	2121.498
union			0.417	0.493
N	654		2406	

4.2 Methods

Initially, we estimate the marriage wage premium for all individuals using fixed effects, which controls for unobservable heterogeneity and also removes all time invariant variables, such as education status, from the model. We follow Cornwell and Rupert (1995) and estimate a wage equation of the form:

$$\ln(w_{it}) = \beta M_{it} + \gamma' X_{it} + \alpha_i + \varepsilon_{it},$$

where the dependent variable is the log of income, M_{it} is an indicator showing whether an individual is married, and X_{it} is a matrix of control variables. In turn, α_i captures time-invariant individual heterogeneity and ε_{it} is the standard idiosyncratic error term. The unknown parameter β is to estimated and interpreted: if a marriage wage premium exists then β will be positive and significant.

4.3 Results

We estimated the equation above for the full sample and for each of education categories, bearing in mind that our theoretical model predicts that the marriage premium should be lower among men with higher productivity.

The results are presented in Table 6. The first row of results shows the marriage wage premium for the whole samples for the NCDS and the BHPS. The remaining rows show the results for each of the education groups.

Table 6: Marriage wage premium results

	NCDS		**BHPS**	
	β	**N**	β	**N**
Full sample				
Marriage wage premium	0.091***	7380	0.073***	19775
	(0.018)		(0.037)	
Education - degree				
Marriage wage premium	0.022	937	-0.032	4294
	(0.046)		(0.073)	
Education - below degree				
Marriage wage premium	0.062**	2606	0.083*	6746
	(0.029)		(0.047)	
Education - school leaver				
Marriage wage premium	0.081***	3183	0.164*	6329
	(0.024)		(0.091)	
Education - no qualifications				
Marriage wage premium	-0.011	654	0.041	2406
	(0.069)		(0.066)	

*, **, *** represent 10%, 5% and 1% levels of significance

All models include controls for region of residence, wave dummies, sector of employment, social class, health status and family size. BHPS models also include controls for age, size of employer, experience and union status.

Overall, we can see the existence of a marriage wage premium and that is highly significant, for the whole sample. When we consider the estimation by education group, and starting with the most educated men, we observe the gradient as predicted by our model. In both samples, the estimate is close to zero and not significant among men with degree. It becomes significant and increasing as we move to men with "below degree" and this pattern continues as we move to "school leavers".

However, there is a break in this pattern as we move to men with no qualifications, for whom the estimates are again insignificant, reflecting no MP among these men. This finding suggests the existence of classes, whereby women in the lowest class and men with lowest productivity/education have no option except to marry each other. The logic is as follows: given the relatively low wage expectations among these men, women's decision to marry is not affected by the men's labour market status. In our model, this would then result in an observed zero marriage wage premium.

In Table 7 we investigate the characteristics of men's partners in order to check if they differ across the productivity range. In particular, we focus on the characteristics of the partners of men in the lowest productivity group. Our conjecture regarding classes and the existence of no marriage wage premium for the lowest productivity group would be supported if women married to these men display worse characteristics, on average, than women married to men in the other productivity groups.

For the NCDS study we have data on the partner's years of education and the partner's social class. For the latter measure we simply use the 6 point scale (where 1 is the highest social class and 6 is the lowest social class) in our regression. Since our aim is simply to highlight differences between prodictivity groups, it does not matter that we linearise this variable. For the BHPS we have information on a partner's highest education qualification, a partner's hourly income and a partner's parental social class. For education we focus on those with no qualifications and those with a degree (the extremes of the education qualifications) and for social class we, as with the NCDS, linearise the 6 point scale, where 1 is the highest social class and 6 is the lowest social class.

Table 7: Partner's Characteristics

	NCDS		BHPS			
	Partner's years of Education	Partner's Social Class	Partner has no qualifications	Partner has a degree	Partner's hourly income	Partner's parental social class
Education - degree	20.10***	2.403***	0.027***	0.508***	6.382***	2.765***
	(0.105)	(0.034)	(0.003)	(0.011)	(0.024)	(0.029)
Education below degree	18.31***	2.886***	0.111***	0.145***	6.031***	3.542***
	(0.086)	(0.021)	(0.005)	(0.006)	(0.018)	(0.022)
Education - school leaver	16.89***	3.070***	0.168***	0.079***	5.909***	3.757***
	(0.047)	(0.019)	(0.006)	(0.005)	(0.019)	(0.021)
Education - no qualifications	16.35***	3.349***	0.377***	0.037***	5.824***	4.078***
	(0.113)	(0.048)	(0.012)	(0.005)	(0.025)	(0.031)
N	5365	4646	10776	10776	8724	9602

*, **, *** represent 10%, 5% and 1% levels of significance

Examining Table 7, we can see that in both data sets, the lowest productivity men (those with no qualifications) are married to women with the worst characteristics, whichever way they are measured. Men with no qualifications are married to women with lower average years of education (in the NCDS) or women who are less likely to have a degree and more likely to have no qualification (in the BHPS). These women have, on average, lower social class status (NCDS) or their parental social class status is significantly lower (BHPS). For the BHPS we can also see that if these women are working they earn, on average, a lower average wage than women married to men in higher productivity groups. These results provide empirical support for the existence of classes, where men in the lowest productivity group and women in the lowest class have no option but to marry each other. A consequence of that marriage pattern is of course the absence of any male marriage wage premium in the bottom class, a conjecture which our empirical results also seem to support.

5 Conclusion

In this paper we argue that search frictions in labour and marriage markets can explain the puzzling phenomenon of male marriage premium. If men looking for jobs also take into account the expectations of women in the marriage market, their optimal reservation wages could end up being less than the wage required to make them marriageable. This is simply because, if the male wage that ensures success in the marriage market is too high, men may end up setting a relatively low reservation wage. Of course, this in itself does not mean that they are all confined to remain single. Some of them may still land jobs with marriageable wages. This, together with the low reservation wage creates a wedge between wages earned by married and single men: the male marriage premium.

At the heart of our explanation lies the fact that behaviour and outcomes in the labour market may be determined by expectations in the marriage market (and vice-versa). As in frictional labour markets earned wages are essentially determined by reservation wages set by job seekers, and in turn these earned wages affect the marriage prospects of men, the marriage premium arises naturally in a search equilibrium.

Importantly, in our story men are able to get married *because* they earn high enough wages, and not the other way round. In other words, we rule out the scenario according to which married men earn higher wages (due to an ex-post productivity increase generated by specialisation with a household household specialisation).

Equally importantly, the model allows us to examine the role of ex-ante productivity differences. Using a framework that incorporates male productivity heterogeneity, we establish that the marital wage gap can be an equilibrium outcome. This suggests that productivity differentials are not necessary for explaining such marital premia. Indeed, the wage gap can occur within each productivity type. Nonetheless, differences between the wages of married and single men remains a possibility across types too, and in that case these premia can be ranked in an empirically relevant manner. Furthermore, this also shows that productivity heterogeneity is not a sufficient condition either for a positive marriage premium: male reservation wage may very well match the level required for successful marriage, in which case the marital wage gap is zero.

Allowing for two-sided heterogeneity (where women also differ but this time in terms of attractiveness in the marriage market), leads to further insights in terms of the endogenous formation of marriage classes, which in turn displays patterns of male marital premia that can again be tested using data. More specifically, by considering the reservation wage strategies of men, we endogenise the range of characteristics (i.e. wages) on the male side, which in turn leads to the emergence of marital classes. We construct and establish the existence of a search equilibrium with class formation, fully characterise it in terms of marriage wage patterns across classes, and show that the bottom class will always contain men with zero marriage premium.

All these predictions offer a rich basis for an empirical test of the theoretical model. We carry out such an empirical investigation and the results seem to support the search theoretical explanation of marriage premium. In particular, we find evidence that marriage premia follow the patterns across productivity types suggested by our model, while men with very low socioeconomic characteristics exhibit zero marriage premium and are in partnerships with similarly below average women (pointing to the existence of a bottom marital class).

It is also worth pointing out that our empirical analysis constitutes (as far as we know) the first attempt at finding evidence for the search theoretic explanation of marriage premium. Given the simplicity of our model and the strenght of its theoretical predictions, more empirical tests are needed. We believe that further work (both theoretical and applied) that investigates various outcomes in the context of inter-linked frictional markets represents a very promising research project.

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Appendix A: Other equilibria

Assume $\widehat{T}_H > \overline{w}_L$. With $\frac{\partial T}{\partial x} > 0$ and $\underline{R}_H < \widehat{T}_L < \overline{w}_L < \widehat{T}_H$, it follows that $\underline{x} < \widehat{x}_L < \overline{x} < \widehat{x}_H$.

Now assume $\widehat{T}_H < \overline{w}_L$. For $x \in [\underline{x}, \widehat{x}_H]$, there is always a unique equilibrium where only employed men can get married and both types do. The range of possible equilibra and the necessary and sufficient conditions in terms of x are as follows:

(a) An equilibrium with $MP_L > MP_H > 0$ obtains iff

$$\widehat{x}_H < x$$

(b) An equilibrium with $MP_L > 0$ and $MP_H > 0$ obtains iff

$$\overline{x} < x < \widehat{x}_H$$

(c) An equilibrium with $MP_L > 0$ and $MP_H = 0$ obtains iff

$$\widehat{x}_L < x < \overline{x}$$

(d) An equilibrium with $MP_i = 0$ $(i = H, L)$ obtains iff

$$\underline{x} < x < \widehat{x}_L.$$

Appendix B: Proof of Theorem 2 (numerical solution)

As all choice variables are continuous, it is enough to show that a two-class equilibrium with the desirable properties exists for a given set of parameters.

Consider the following values for the relevant parameters of the model:

$$\begin{aligned}
\lambda_0 &= 1.5 \\
\delta &= 0.1 \\
r &= 0.1 \\
\lambda &= 1 \\
\overline{p} &= 200 \\
z &= 200 \\
u &= 0.1 \\
\underline{y} &= 0.4 \\
\overline{y} &= 1
\end{aligned}$$

Assume y is uniformly distributed. As far as men are concerned, for a range of productivities $[\underline{p}, \overline{p}]$ where each productivity has the same number u of unemployed, we are essentially dealing with an uniform distribution of types of men also.

We have

$$n_1 = (\overline{y} - \underline{y})\left[1 - H(y_1)\right]$$

and, given that we construct only two classes,

$$n_2 = (\overline{y} - \underline{y})H(y_1)$$

Finally, let the distribution of wages be uniform as well, with support on $[p, p + z]$ for each type p.

Also, note that women's arrival rate is very sensitive to changes in u and the productivity range.

Equilibrium:

We pick the equilibrium that is most difficult to construct, i.e. the one with $\widehat{p} > \overline{p}$. Since $\widehat{p}$ is endogenous, showing that such an equilibrium exists is not trivial precisely because of this constraint on $\overline{p}$.

With the above inequality constraint, some of the indicator functions in our value functions will be zero.

We need $y_2 < \underline{y}$. With our numbers, this inequality is satisfied. Next, we compute y_1 and it is

$$y_1 = 0.615619$$

Now we can compute T_1, using that $\widehat{\widehat{p}} \equiv T_1 - z$. Then,

$$T_1 = 327.08844$$

and clearly lower than the highest wage in the market, which is $\overline{p} + z = 200 + 200 = 400$.

Next, we can compute $\widehat{p}$ and will have to show that this computed value of $\widehat{p}$ is indeed higher than $\overline{p}$. We write down the equation for $R(p)$ and equate it to T to get $\widehat{T}(p)$, then solve $\widehat{T}(p) = T_1$. This gives $\widehat{p}$:

$$\widehat{p} = 258.944839$$

which is clearly higher than $\overline{p}$.

We know that $\widehat{\widehat{p}}$ is $T_1 - z = 127.08844$. This is enough to compute the value of being single for a woman from Set 2 (W_2^S), as a function of $\underline{p}$ (whatever that is). We can then compare that with the value of being married to a $\underline{p}$ man (where this value is given by $\frac{R(p)}{r+\delta}$).We obviously need the latter to be greater than the former.

The explicit solution to W_2^S is

$$W_2^S = \frac{\int_{\widehat{\widehat{p}}}^{\overline{p}} \left[N_p'' \int_{R(p)}^{T_1} \frac{w}{r+\delta} dG_p'(w)\right] dp + u \int_{\underline{p}}^{\overline{p}} \frac{R(p)}{r+\delta} dp}{r + \delta + u(\overline{p} - \underline{p}) + \int_{\widehat{\widehat{p}}}^{\overline{p}} N_p'' \left[G_p'(T_1) - G_p'(R(p))\right] dp},$$

where $G_p'(T_1) - G_p'(R(p)) = 1 - 0 = 1$.

We find $W_2^S < \frac{R(p)}{r+\delta}$ holds for $\underline{p} > -61.786371 (= p^*)$. This means that there is no lower class if $\underline{p} > -61.786371$. All men with p between $\underline{p}$ and $\widehat{\widehat{p}} = 127.08844$ constitute a subset of Set 2, the subset of men with zero marriage premium. These men are born in Set 2.

Overall, the condition on y and the fact that the set $\left(p^*, \widehat{\widehat{p}}\right)$ is non-empty ensure the existence of the equilibrium for a broad range of parameters.

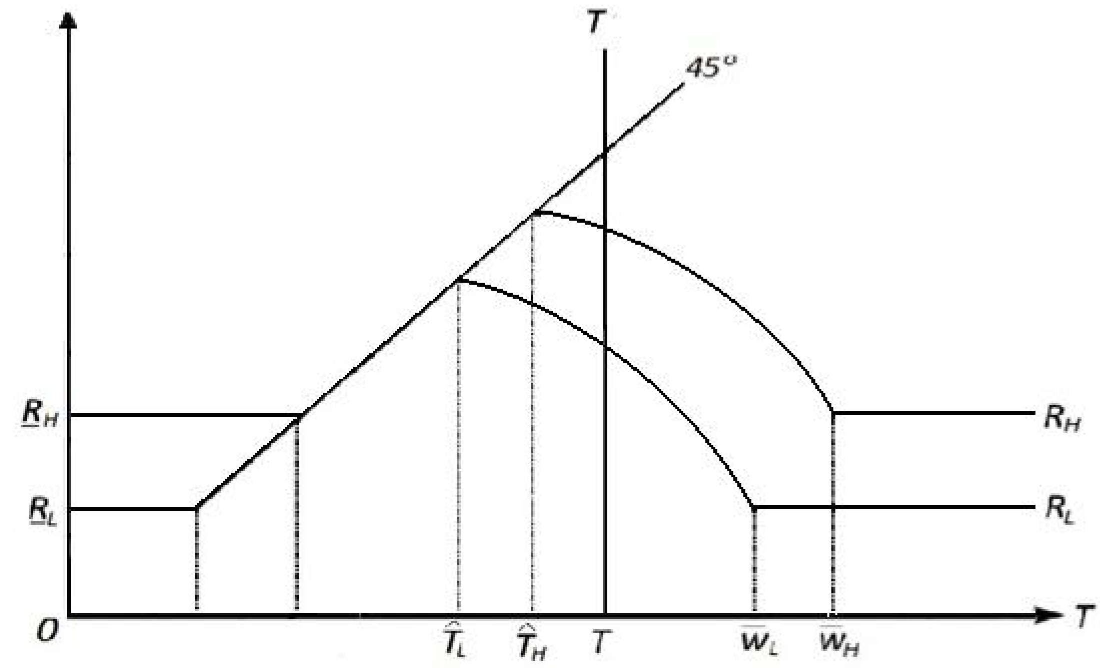

Figure 1

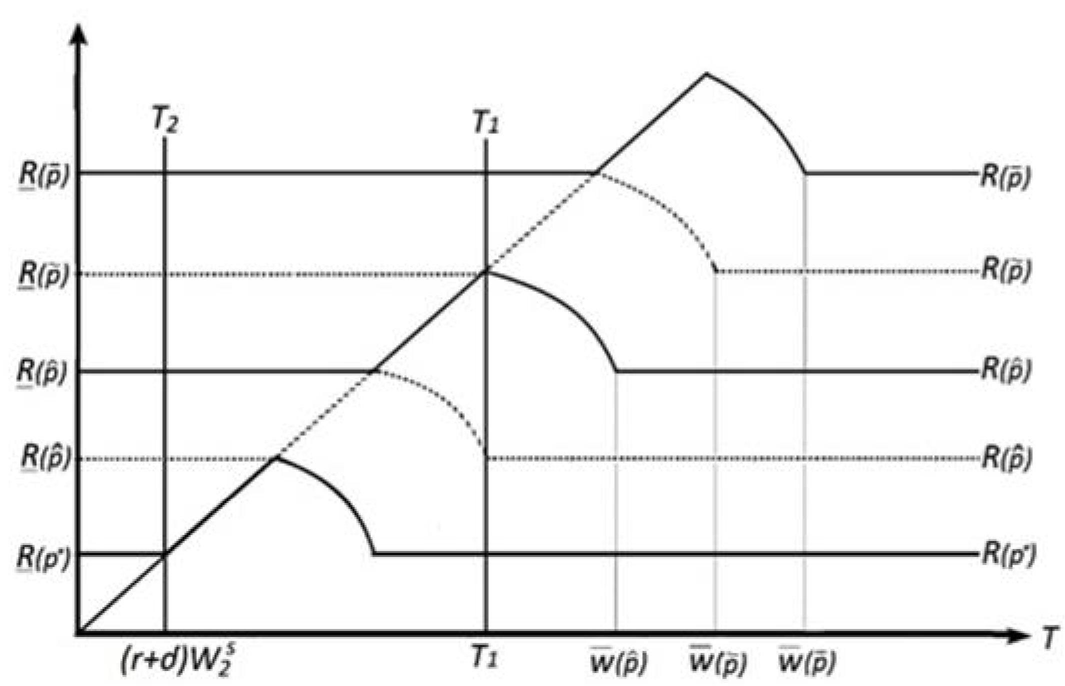

Figure 2