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RECRUITMENT POLICY WHEN FIRMS OBSERVE WORKERS' EMPLOYMENT STATUS: AN EQUILIBRIUM SEARCH APPROACH

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Abstract

This paper considers an equilibrium search model, where firms use information on a worker's labour market status when recruiting new hires, and all workers search for a job. We show that firms segment their workforce in two. Unemployed workers are offered a lower wage than the workers they recruit from employment in a competing firm even when these workers have the same productivity. The unique equilibrium is given by the Diamond outcome in the market for unemployed workers and the Burdett and Mortensen (B-M) outcome in the market for employed workers. We show that the offer and earnings distributions derived in the model are first order stochastically dominated by the ones given in B-M and all workers are worse off. We also show that in this environment information on employment status is sufficient for firms to obtain the same profits as if they had complete information about workers' reservation wages and outside offers.

Keywords: Search, wage dispersion, recruitment, discrimination.
JEL: J63, J64, J42, J71

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1 Introduction

A substantial and growing body of work establishes that unemployed workers are offered lower wages than those who come from employment.[1] Typical explanations based on human capital theory and signalling models suggest firms use a worker's unemployment history as a signal of skill depreciation and react accordingly.[2] This paper presents an alternative explanation: in the presence of search frictions, firms use information on employment status to discriminate against the unemployed but otherwise identical workers. Being unemployed reveals that the worker is at the bottom end of the wage distribution, thereby firms will find it profitable to offer a lower wage.

Search frictions give firms monopsony power.[3] Burdett and Mortensen (1998) (B-M) show this can give rise to a continuous wage distribution. Firms trade-off profits per worker with the size of their labour force when facing an upward sloping labour supply curve. Theoretical extensions and empirical applications of this model abound.[4]

This theory rests on a crucial assumption: a firm has no information about its prospective employees. Hence, it will always offer the same wage regardless of who knocks on its door.

[1] See Farber (1999) and Kletzer (1998) for a survey on the cost of job loss using displaced workers data for the US and Arulampalam (2001) and Gregory and Jukes (2001) for evidence using longitudinal data for the UK.

[2] Manning (2003) puts through an alternative explanation using an equilibrium search model á la Burdett and Mortensen (1998). Post-displacement earnings losses can be related to the depreciation of "search capital". When displaced, the worker losses his position in the earnings distribution and has to restart the search for "good" jobs from the left tail of this distribution. Hence, his post-displacement expected wage would be lower than his pre-displacement wage. This view is consistant with the observation that the average wage penalty faced by displaced workers after a spell of unemployment on future earnings increase with pre-displacement tenure, experience and position in the earnings distribution.

[3] Bontemps, Robin and Van den Berg (2000) and Manning (2003) show evidence of firms' monopsony power in the presences of search frictions using French, UK and US data.

[4] See Van den Berg (1999), Manning (2003) and Mortensen (2003) for interesting surveys and several applications.

Postel-Vinay and Robin (2002) (PV-R) were the first to point out this issue and extended the B-M model to an environment in which firms have complete information about their potential new hires. Given contact, they observe the reservation wage of all workers and optimally engage in offer matching when confronted with outside competition for their employees. All new recruits are hired at their minimum acceptable wage. Workers are able to increase their wages in the future by engaging their current employer with other potential ones into Bertrand competition. When agents are homogenous, the wage offer distribution degenerates to a mixture of two mass points: one at the common reservation wage and the other at the worker's marginal productivity. Heterogeneity is then required to restore a continuous wage distribution.

Many labour markets, however, do not appear to resemble these two extremes. Firms do discriminate between potential employees by observable characteristics and rarely engage in offer-matching. Asking a potential employee the details of his current employment contract is clearly not a good strategy when this information is not verifiable. The present paper contributes to this literature by extending the analysis to an environment in which workers possess some observable characteristics that change over time. Firms condition their offers upon these characteristics, but do not observe (or pre-commit not to counter-offer) any outside offer.

In our model firms post wages conditional on a worker's employment status when recruiting new employees, and all workers search for jobs. Unemployed workers are paid their reservation wage. The wage offer and earnings distributions for this market degenerate to a mass point at this wage. Once employed, the firm does not observe the details of a worker's contract and offers the same wage to any employed worker. The wage offer and earnings distributions are now described by B-M. This implies a foot-in-the-door effect that makes the unemployed accept a wage below the opportunity cost of employment. The offer and earnings distributions are first order stochastically dominated by the distributions in B-M, making all workers worse off. An important difference compared to the previous models is that we predict a bimodal earnings distribution, which can be used to test our theory empirically.

Furthermore, we show that when firms follow this recruitment strategy they obtain higher profits than in the original B-M case and the same profits as in the PV-R homogenous agents case. Hence, using information on employment status is always a better strategy than not using it. More importantly, the equal payoff result implies that complete information is not necessary for firms to extract maximum match rents when all workers search for jobs. Since the Diamond outcome (see Diamond, 1971) appears in both environments, with complete information firms can only extract these rents in the unemployed workers' market. When discriminating by employment status, competition for employed workers is not as fierce to drive profits in that market to zero. Firms are then able to extract the first part of those rents when hiring the unemployed and the second when hiring the employed.

The idea that firms can observe the worker's labour market status is not new in search theory. Vishwanath (1989) analyses an unemployed job search model in which firms have information on the worker's unemployment history and test the worker's ability before deciding on a hire. The implicit assumption, however, is that unemployment depreciates human capital. Her focus is to show that "true" negative-duration dependance of the escape rate out of unemployment can arise in a frictional environment. Lockwood (1991) follows a similar line of argument and analyses the corresponding equilibrium implications on a matching model. He shows that it is always in the interest of firms to discriminate against the workers with sufficiently long unemployment spells.

In this paper we assume firms can only condition their offers on a worker's labour market status and not on its duration. Although including this dimension would enrich the model, the complexity of the analysis increases considerably. Given that our aim is to provide an alternative explanation of why firms might want to offer unemployed workers lower wages other than for productivity reasons and to analyse the effects of this policy on the earnings distribution, we think this is a good starting point. We do not know of any other study that addresses these issues.

In the next sections we describe the general framework and discuss the worker's and firm's decision problems. In Section 5 we explain the nature of equilibrium and show the main results. Section 6 develops comparisons between the model presented here and the ones of B-M and PV-R. The last section concludes. All proofs are confined to the Appendix.

2 Basic Framework

Time is continuous and only steady states are considered. Suppose there is a unit mass of workers and of firms who participate in a labour market. Workers and firms are homogeneous in that any firm generates revenue p for each worker it employs per unit of time. Workers can be either unemployed (u) or employed (e). Firms do not search for workers but post job offers at a zero cost on a take it or leave it basis. Both unemployed and employed workers search for jobs. Let $0 < \lambda < \infty$ denote the common Poisson arrival rate of these offers.[5] For simplicity assume there

[5] For simplicity and to facilitate later comparisions with the B-M and PV-R frameworks we focus on the special case of equal arrival rates. However, the model can easily be generalised to the cases in which employed and unem-

is no recall should a worker quit or reject a job offer.

A job offer is described by a single wage. Upon meeting, firms are able to observe the worker's current labour market status and condition their offers on this information. Let w_i be the wage offered to a worker in state i (where $i = u, e$) and $F_i(w_i)$ denote the distribution of wages posted by firms in market i. An important assumption is that firms pre-commit not to counter-offer any outside offer the worker might receive in the future. That is, this assumption rules out the possibility of Bertrand competition when a competing firm wants to poach an employed worker. Random matching then implies $F_i(w_i)$ describes the probability a worker in state i receives a wage no greater than w_i. Let $\underline{w}_i$ and $\overline{w}_i$ denote the infimum and supremum of these distributions.

Firms and workers have a zero rate of time preference. Workers are risk neutral and finitely lived, where any worker's life is described by an exponential random variable with parameter $0 < \delta < \infty$. Note that δ also describes the inflow of new unemployed workers into the market. Assume unemployed workers obtain b per unit of time and that $p > b > 0$. For any given F_u and F_e that describe the wages posted by firms, the objective of any worker is to maximise total expected lifetime utility. In the next section we show that the worker's decision problem is a simple generalization of an optimal stopping problem. Firms are also risk neutral but infinitely lived. The objective of any firm is to choose a pair of wages $\{w_u, w_e\}$ such that it maximises expected steady state profit flow given the optimal strategy of workers and the wages posted by other firms.

ployed workers receive offers at different rates or employed workers, in their first job, receive offers at different rates than in subsequent ones, without changing the main results.

3 Workers' payoff and job search strategies

Let $V_u(w_u)$ denote the maximum expected lifetime utility of a worker employed at a wage w_u given he has been hired from unemployment and let $V_e(w_e)$ denote the maximum expected lifetime utility of the same worker at wage w_e given he has been hired from employment in a competing firm. The no recall assumption and standard dynamic programming arguments imply the following Bellman equations

$$\delta V_i(w_i) = w_i + \lambda \int_{\underline{w}_e}^{\overline{w}_e} \max[V_e(x) - V_i(w_i), 0] dF_e(x) \qquad \text{for } i = u, e. \tag{1}$$

Similarly, define U as the lifetime expected payoff of an unemployed worker when following an optimal search strategy in the future. The same arguments imply U satisfies

$$\delta U = b + \lambda \int_{\underline{w}_u}^{\overline{w}_u} \max[V_u(x) - U, 0] dF_u(x). \tag{2}$$

As changing jobs is costless, employed workers will accept a wage offer if and only if it is strictly greater than their current wage. Unemployed workers will accept a wage offer if and only if it is at least as great as the reservation wage, w_r. As V_u is increasing in w and U is independent of it, w_r is then defined by the intersection of $V_u(w_r)$ and U. Using equations (1) and (2) it is easy to show that

$$w_r = b + \lambda \left[\int_{w_r}^{\overline{w}_u} [V_u(x) - V_u(w_r)] dF_u(x) - \int_{\underline{w}_e}^{\overline{w}_e} \max[V_e(x) - V_u(w_r), 0] dF_e(x) \right]. \tag{3}$$

Note that (3) implies an unemployed worker will accept a wage below (above) b when the expected capital gains of receiving offers from F_e while he is in his first job are greater (less) than the expected capital gains of receiving offers from F_u while he is still unemployed.[6] Given these strategies lets now analyse the firms' decision problem.

4 Firms' payoff and optimal strategies

In what follows, assume that all firms will make acceptable offers to unemployed workers; i.e. $\underline{w}_i \geq w_r$. It will be shown later that this assumption is satisfied in equilibrium. Given w_r and F_i we first characterise the relevant steady states in which the inflow of workers into a particular state equals the outflow. Let μ denote the steady state number of unemployed workers. Note that $\lambda(1 - F_u(w_r))\mu$ describes the flow of workers out of unemployment and $\delta(1 - \mu)$ describes the inflow. Hence,

$$\mu = \frac{\delta}{\delta + \lambda}.$$

Now consider the market for employed workers. Let N_u denote the steady state number of employed workers that were hired from unemployment. Note it consists of all unemployed workers who received a job offer. Of these type of workers, define $G_u(w_u)$ as the steady state proportion that are earning a wage no greater that w_u.[7] Hence,

$$N_u(w_u) = N_u G_u(w_u) = \frac{\lambda F_u(w_u)\mu}{[\delta + \lambda(1 - F_e(w_u))]}, \tag{4}$$

describes the steady state number of workers hired from unemployment earning a wage no greater than w_u.

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[6] This result is similar to the one obtained in B-M when unemployed and employed workers receive job offers at different rates. If unemployed workers receive offers less frequently than employed workers, they will accept a wage $w < b$. By doing so they guarantee better future job opportunities.

[7] Note that $G(w) = G(w^-) + m(w)$, where $G(w^-)$ is the steady state proportion of workers earning a wage strictly less than w and $m(w)$ is the mass of workers earning exactly w.

By the same token, let $N_e = (1-\mu) - N_u$ describe the steady state number of employed workers that were hired from employment in a competing firm and define $G_e(w_e)$ as the steady state proportion of these workers that are earning a wage no greater than w_e. Steady state turnover implies

$$[\delta + \lambda(1 - F_e(w_e))]N_e G_e(w_e) = \lambda \int_{\underline{w}_u}^{w_e^-} [F_e(w_e) - F_e(x)] dN_u(x),$$

where the LHS describes the number of workers that flow out of employment at wages greater than w_e and the RHS the number of workers that flow in. Note that the latter is made up of those workers hired from unemployment earning a wage, $x < w_e$ that received a wage offer greater than their current wage but less than w_e. Hence,

$$N_e(w_e) = N_e G_e(w_e) = \frac{\lambda \int_{\underline{w}_u}^{w_e^-} [F_e(w_e) - F_e(x)] dN_u(x)}{[\delta + \lambda(1 - F_e(w_e))]} \tag{5}$$

denotes the steady state number of workers hired from employment earning a wage no greater than w_e.

Taking as given other firms' wage offers as described by F_u and F_e and workers' optimal search strategies, any firm's optimal strategy is then a pair of wages $\{w_u, w_e\}$ such that it maximises total expected steady state profit flow,

$$\Omega(w_u, w_e) = \Omega_u(w_u) + \Omega_e(w_e),$$

where $\Omega_i(w_i)$ denotes the expected steady state profit flow at market i when offering wage w_i. The no recall assumption, however, implies that the firm can maximise $\Omega(w_u, w_e)$ by choosing w_u and w_e independently such that each wage maximises the corresponding $\Omega_i(w_i)$.[8] Hence, define

[8] As workers are able to observe the wages posted by firms in both markets upon a meeting, the no recall assumption

$\overline{\Omega}_i = \max_{w_i} \Omega_i$ so that maximised total expected steady state profit flow is given by $\overline{\Omega} = \overline{\Omega}_u + \overline{\Omega}_e$.

Note that the firm's expected steady state profit flow in each market equals the hiring rate times the expected profit per new hire. When offering w_u to an unemployed worker a firm makes

$$\Omega_u(w_u) = \left[\frac{\lambda\delta}{(\delta+\lambda)}\right]\left[\frac{(p-w_u)}{\delta+\lambda(1-F_e(w_u))}\right]. \tag{6}$$

Since $\lambda\left[N_u(w_e^-)+N_e(w_e^-)\right]$ describes the firm's hiring rate, (4) and (5) imply the expected steady state profit flow in the market of employed workers when offering w_e is given by

$$\Omega_e(w_e) = \left[\frac{\lambda^2 F_u(w_e^-)\mu}{\delta+\lambda(1-F_e(w_e^-))} + \frac{\lambda^2\int_{\underline{w}_u}^{w_e^-}[F_e(w_e^-)-F_e(x)]dN_u(x)}{\delta+\lambda(1-F_e(w_e^-))}\right]\left[\frac{p-w_e}{\delta+\lambda(1-F_e(w_e))}\right]. \tag{7}$$

Having specified the firms' and workers' decision problems lets now turn to define and analyse equilibrium.

5 Market Equilibrium

DEFINITION: *A Market Equilibrium is defined by a triple* $\{w_r, F_u, F_e\}$ *such that*

a) Given a w_r, *a pair of wage offer distributions* $\{F_u, F_e\}$ *consistent with the steady state constant profit condition*

$$\begin{aligned} \overline{\Omega}_i &= \Omega_i(w_i) \quad \text{for all } w_i \text{ in the support of } F_i, \\ \overline{\Omega}_i &\geq \Omega_i(w_i) \quad \text{otherwise, for each } i = u, e. \end{aligned} \tag{8}$$

b) Given a pair $\{F_u, F_e\}$, w_r *satisfies (3).*

rules out the possibility that these workers accept employment and quit in the future to be re-hired by the same firm under a more generous wage. Although a possibility in the decision theory of a firm, it will be shown that in equilibrium this never happens.

First we show that for any given w_r such that $p > w_r$ there exists a unique equilibrium offer distribution for each market and that these can be fully characterised. Note that if $w_r \geq p$ neither markets would open and any analysis would be trivial.[9] We will show later, however, that in equilibrium firms make positive expected steady state profits in each market and so the restriction imposed on w_r is not binding.

CLAIM 1: *Given a $w_r < p$, any market equilibrium implies $p > \overline{w}_e \geq \overline{w}_u$ and $\underline{w}_e \geq \underline{w}_u \geq w_r$.*

Proof: See Appendix.

Claim 1 shows that given there are positive match rents, in equilibrium firms can always make positive profits in each market. The next result establishes that any equilibrium wage offer distribution F_e exhibits no mass points and has connected support. That is, in equilibrium there is no positive measure of firms offering the same wage to employed workers and all firms offer some wage $w_e \in [\underline{w}_e, \overline{w}_e]$.

CLAIM 2: *Given a $w_r < p$, any equilibrium F_e is continuous and has connected support.*

Proof: See Appendix.

This proof follows closely the one used in B-M. It relies on showing that if F_e is discontinuous at $\widetilde{w}_e$ or that has a support which is not connected between $[w_{e1,}w_{e2}]$, a firm offering $\widetilde{w}_e$ or w_{e2} can always post a different wage such that it strictly increases its profits. In the former case this deviation is possible because the firm's hiring rate exhibits a discontinuous jump at $\widetilde{w}_e,$ while the profit per worker is continuous around $\widetilde{w}_e$. In the latter case, a profitable deviation is possible since F_e is constant between $[w_{e1,}w_{e2}]$. As both situations contradict the constant profit condition (8),

[9] If $w_r = p$ all firms will make zero profits in both markets and again the analysis would be trivial.

the implied F_e cannot be an equilibrium. We now establish a crucial result: any positive measure of firms will offer different wages to unemployed and employed workers; i.e. $w_u \neq w_e$, such that $w_e > w_u$.

PROPOSITION 1: *Given a $w_r < p$, any market equilibrium implies $\underline{w}_e \geq \overline{w}_u \geq w_r$.*

Proof: See Appendix.

This result relies on showing that if the supports of F_u and F_e overlap such that $\overline{w}_e \geq \overline{w}_u > \underline{w}_e \geq \underline{w}_u$, a firm offering $w_e = \overline{w}_u$ to an employed worker will make strictly greater profits than a firm offering $w_e = \underline{w}_e$ in the same market. The main point is that under the overlapping supports assumption, the F_e derived from (6) using the constant profit condition cannot be an equilibrium offer distribution as it has a constant density. As shown by B-M, worker's on-the-job search implies any equilibrium distribution F_e must have an increasing and convex density. It is only in this case that firms can achieve equal steady state profit flow by trading-off expected profits per new hire with their hiring rate.

Given Proposition 1, it is now easy to characterise the equilibrium distribution functions F_u and F_e. First, Claim 3 shows that when firms use information on employment status as part of their recruitment strategies, the Diamond outcome (Diamond (1971)) emerges in the market for unemployed workers.

CLAIM 3: *Given a $w_r < p$, in any equilibrium F_u is degenerate at w_r.*

Proof: See Appendix.

Note this result follows from the fact that firms in the unemployed workers' market have a constant hiring rate, $\lambda\mu$, and workers will leave these firms as soon as they receive an outside offer. The optimal strategy for all firms is then to offer the worker's reservation wage. Next Claim 4 shows that for any $w_r < p$ the market for employed workers is described by the B-M outcome.

CLAIM 4: *Given a $w_r < p$, there exists a unique equilibrium F_e such that it is described by the B-M wage offer distribution*

$$F_e(w_e) = \left(\frac{\delta + \lambda}{\lambda}\right)\left[1 - \left(\frac{p - w_e}{p - \underline{w}_e}\right)^{1/2}\right], \tag{9}$$

where the infimum of the support $\underline{w}_e = w_r$ and the supremum is given by

$$\overline{w}_e = p - (p - w_r)[\delta/(\delta + \lambda)]^2$$

Proof: See Appendix.

Since a poaching firm does not observe the details of a worker's contract (i.e. the wage he is earning and hence the identity of his current employer), it offers the same wage to all employed workers. Equilibrium then implies any firm trades-off profit per worker with the size of its labour force. As in B-M, a non-degenerate offer distribution then arises.

Up to this point we have shown that for any $w_r < p$, the constant profit condition implies there exists a unique $F_u(. \mid w_r)$ and $F_e(. \mid w_r)$ such that the former is degenerate at w_r and the latter satisfies (9). Hence, part (a) of the definition of a market equilibrium has been satisfied. Lets now turn to part (b) and show that these F_i are such that w_r satisfies (3). First note that both the continuity of F_e and (1) imply $V_u(w_r) = V_e(\underline{w}_e)$. Using Claim 3 and integrating by parts, (3) can be expressed as

$$b - w_r = \int_{w_r}^{\overline{w}_e} \frac{1 - F_e(x)}{\delta + \lambda(1 - F_e(x))} dx. \tag{10}$$

Furthermore, by substituting out F_e and $\overline{w}_e$ using Claim 4 and then integrating, the unique equilibrium reservation wage is given by

$$w_r = \frac{b(1+\lambda/\delta)^2 - p(\lambda/\delta)^2}{1+2(\lambda/\delta)}. \tag{11}$$

Since $p > b$ by assumption and (11) implies $b > w_r$ the existence of equilibrium is then guaranteed. Firms make strictly positive expected steady state profit flow in both markets and $\underline{w}_i \geq w_r$. Also note that (11) implies workers face a foot-in-the-door effect. They will accept a wage below the value of leisure (or UI payments) to have the possibility of moving up the wage ladder in the future. Moreover, it is easy to show that unemployed workers will accept a negative wage if $p/b > [(\delta+\lambda)/\lambda]^2$.

Hence there exists a unique market equilibrium $\left\{w_r^E, F_u^E, F_e^E\right\}$ in which firms maximise expected steady state profit flows by offering a different wage to unemployed and employed such that $F_u^E(w_r^E) = 1$ and F_e^E is given by (9) and workers maximise expected lifetime utility using a reservation wage strategy where w_r^E is given by (11).

6 Interpretation and Comparative Statics

To further develop the intuition of our results lets compare them with those found in similar versions of the B-M and PV-R frameworks. First we analyse the reservation wages derived from these models. In the B-M and PV-R frameworks they are $w_r^{B-M} = b$ and $w_r^{PV-R} = b - (\lambda/\delta)(p-b)$;[10] while in our framework w_r is given by (11). Comparing these expressions, it is easy to see that $w_r^{PV-R} < w_r^E < w_r^{B-M}$.

[10] See Mortensen (2003) chapter 5.

In the B-M framework, unemployed workers will only accept a wage that is at least as great as their opportunity cost of employment. In the PV-R framework, however, there is also a foot-in-the-door effect. Unemployed workers are prepared to accept a wage below b to have a chance of getting a wage increase via offer matching. In this case they effectively pay for the job when hired from unemployment. In our case, workers do not get their wages bid up to p when they receive a second offer. They must slowly make their way up the wage ladder via job shopping. Hence, they are not prepared to accept as low a wage.

The following Proposition now compares the firm's total steady state profit flow with the ones in B-M and PV-R.

PROPOSITION 2: *Given the unique market equilibrium* $\left\{w_r^E, F_u^E, F_e^E\right\}$, $\overline{\Omega} = \Omega_{PV-R} > \Omega_{B-M}$.

Proof: See Appendix.

This is an important result. In our framework, a firm's information set is restricted to the workers' employment status. Contrary to PV-R, the firm does not observe its employees outside offers nor the wages they where previously earning. However, in both cases firms obtain the same profits. Why?

First note that in the offer matching case, Bertrand competition in the market of employed workers drives profits in that market to zero. When firms discriminate by employment status, competition in the employed workers' market is not as fierce and firms are able to make positive profits. However, in both cases all firms offer unemployed workers a wage that makes them indifferent from staying unemployed forever or becoming employed. This implies that with full information, firms extract all the match rents, $(p - b)/\delta$, in the market of unemployed workers.

With information only on employment status, firms can do as well by capturing those rents in two parts.

To illustrate this consider the least generous firm in the market of employed workers. Total steady state profits can be expressed as

$$\overline{\Omega} = \lambda\mu \left[\frac{p - w_r^E}{\delta + \lambda} + \left(\frac{\lambda}{\delta + \lambda} \right) \frac{p - w_r^E}{\delta + \lambda} \right]. \tag{12}$$

Effectively this firm is then obtaining the discounted sum of expected profit, $(p - w_r^E) / (\delta + \lambda)$, from each unemployed worker it hires, where the discount rate is given by $\lambda / (\delta + \lambda)$. Substituting out for w_r^E using (11), it is easy to show that (12) is equivalent to $\lambda\mu$, the number of workers hired from unemployment, times the total match rents, $(p - b)/\delta$. The firm extracts a fraction $[(\delta + \lambda)/(\delta + 2\lambda)]$ of these rents when it first hires the unemployed and then extracts the rest, $[\lambda/(\delta + 2\lambda)]$, in the employed workers' market.

Now lets compare the wage distributions. (9) implies the wage offer distribution faced by employed workers is first order stochastically dominated by the one in B-M. As mentioned in the introduction, the wage offer distribution in the PV-R homogenous agents case degenerates to a mixture of two mass points. One at the common reservation wage and the other at the worker's marginal productivity. Figure 1 compares the equilibrium wage offer densities derived in the three models for the case of $w_r^{PV-R} > 0$.

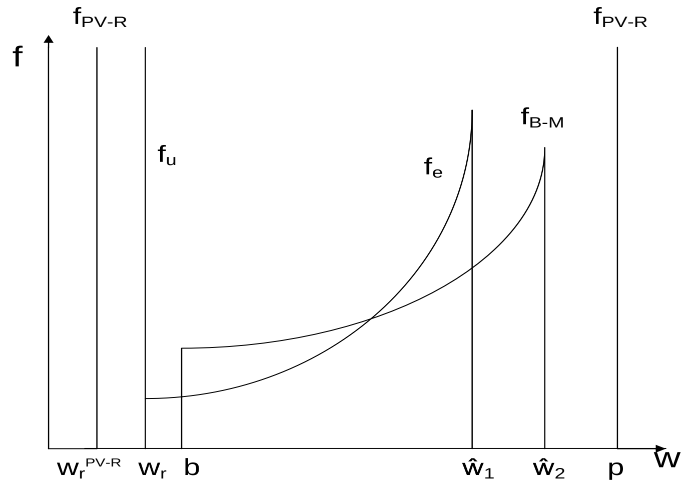

Figure 1: Wage offer density functions. A comparison with B-M and PV-R.

Not surprisingly, the expected lifetime earnings of unemployed and employed workers are strictly lower in our case than when firms do not use information on worker's employment status. However, the expected lifetime earnings of unemployed and employed workers that were previously unemployed are the same as in PV-R; i.e. in both cases $V_u = U = b/\delta$. Employed workers who have accepted at least two job offers are clearly worse off in our case.

Given $G_u(w_u) = 1$, (5) implies that the equilibrium steady state earnings distribution for employed workers hired from employment is

$$G_e(w_e) = \frac{\delta}{\lambda}\left[\left(\frac{p - w_r^E}{p - w_e}\right)^{1/2} - 1\right], \tag{13}$$

where $N_u = \lambda\delta/(\delta+\lambda)^2$ and $N_e = \lambda^2/(\delta+\lambda)^2$. As with the offer distribution function, this earnings distribution is first order stochastically dominated by the one in B-M. The average wage earned by an employed worker is a weighted average of the expected earnings in each market, where the weights are given by $N_i/(1-\mu)$,

$$E(w) = \frac{1}{(\delta+\lambda)}\left[\delta w_r^E + \lambda\int_{w_r^E}^{\overline{w}_e}[1 - G_e(w_e)]dw_e\right],$$

which is smaller than the one found in the B-M framework. The expected wage is also smaller than the one obtained in a simple version of the PV-R framework. This is because workers are paid their marginal product when they receive their second offer; while in our framework they climb the wage ladder more slowly through on-the-job search. As an example, let $p = 5$, $b = 4.5$, $\delta = 0.01$ and $\lambda = 0.1$. In this case, $w_r^E = 2.12$ and $E(w) = 2.57$, where in B-M $w_r^{B-M} = 4.5$ and $E(w)_{B-M} = 4.95$ and in PV-R $w_r^{PV-R} = -0.5$ and $E(w)_{PV-R} = 4.5$.[11]

Note that the increased monopsony power enjoyed by firms in this context can be partially counterbalanced by imposing a legal minimum wage, $w_{\min}$, or by increasing workers' UI payments and hence increasing b.[12] In particular, by imposing a $w_{\min} > w_r^E$, Figure 1 implies both f_u and f_e will shift upwards exhibiting a spike at the minimum wage. Note that if $w_{\min} = b$ the wage offer density function faced by employed workers would be the same as in the B-M framework. As in the standard B-M, under both policies worker's future earnings increase as firms adjust upwards their posted wage offers.

Finally, note that as frictions increase $(\lambda \to 0)$ Claim 4 and (11) imply both offer distributions converge to a single mass point at b. That is, the labour market converges to the pure monopsony case. As frictions disappear $(\lambda \to \infty)$, $\mu \to 0$ and (4) implies $N_u(.) \to 0$ for any w_u. (5) also implies $N_e(.) \to 0$ for all $w_e < \overline{w}_e$ and $N_e(.) \to 1$ when $w_e = \overline{w}_e$. Since $\overline{w}_e \to p$ when $\lambda \to \infty$ all workers are then paid their marginal product. The labour market converges to the perfectly competitive case.

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[11] Where $E(w)_{B-M} = p(\lambda/(\delta + \lambda)) + b(\delta/(\delta + \lambda))$ and $E(w)_{PV-R} = p(\lambda/(\delta + \lambda)) + w_r^{PV-R}(\delta/(\delta + \lambda))$.

[12] The opportunity cost of employment, b, is assumed to be the sum of the worker's value of leisure and any benefits he receives while unemployed.

7 Conclusions

The present study has analysed firms' recruitment strategies in a frictional labour market when they have information on workers' employment status. Under these circumstances a firm segments its labour market in two offering a low wage to unemployed workers and a high wage to employed workers. We show that this policy makes all workers worse off. The theory presented in this paper suggests an alternative explanation of why unemployed workers are subject to wage scarring even when their human capital has been unaffected. Imposing a minimum wage or increasing UI payments will reducing the increased monopsony power of firms by shifting the earning distribution upward making all workers better off. We also show that this recruitment strategy is payoff equivalent to the one followed when firms have complete information about workers' common reservation wage and outside offers. The latter implies wage dispersion can arise in less anonymous labour markets in which firms can verify more information about their potential new recruits, but ex-ante choose not to match outside offers.

Doeringer and Piore (1971) present evidence showing that in some manufacturing industries firms segment their labour market in two. In the upper tier firms offer high wages, employment stability and promotions. The lower tier is characterised by low wages and a high degree of turnover. This result is consistent with the recruitment strategy followed by firms in our framework. We argue that search frictions can give an alternative explanation of why a "dual" labour market might appear within a firm without relying on the existence of differences in monitoring costs between "good" and "bad" jobs as has been previously assumed. For example, see Albrecht and Vroman (1992) and Saint-Paul (1996).

Our model predicts that the offer distribution faced by unemployed workers is degenerate at their reservation wage, but disperse for the case of employed workers. As in the B-M model the earnings distribution for workers who have had more than one job will have an increasing density. B-M and Bontemps, Robin and Van den Berg (2000) have shown that by allowing for dispersion in firms' productivity one can obtain an earnings distribution that resemble the one observe empirically. This is also true in our case. A unique prediction of our model, however, is the existence of a mass point at the infimum of its support. This implies that if our theory was to be tested empirically we would expect to observe a bimodal earnings distribution in which the "humps" are located in the left tail of the distribution. Estimating the predictions of our model is an issue we leave open for future research.

Finally, in this paper we have assumed firms offer constant wage contracts. Stevens (2004) and Burdett and Coles (2003) have pointed out that this contract is not an optimal one in the presence of workers' on-the-job search. They show that the optimal contract has an increasing wage-tenure profile such that it reduces workers' quit probability. This is an important extension of the paper, however, we also leave it for future research.

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Appendix

Proof of Claim 1:

First note that if $w_r < p$ then a firm hiring unemployed workers can always make strictly positive profits by offering them a wage $w_u = w_r$. The constant profit condition (8) then implies in equilibrium all firms must also make positive profits in this market and hence $p > \overline{w}_u$. Now consider a firm hiring employed workers. By offering a wage $w_e = \overline{w}_u + \varepsilon < p$, where $\varepsilon > 0$ but arbitrarily small, this firm has a positive hiring rate and makes positive profits. (8) again implies in equilibrium all firms offering a wage in the support of F_e must make positive profits in this market. Hence $\underline{w}_e \geq \underline{w}_u$ in equilibrium; otherwise the firm offering the least generous wage to employed workers cannot hire any worker and makes zero steady state profits in that market. Finally assume $\overline{w}_u > \overline{w}_e$. (6) then implies offering $w_u = \overline{w}_u$ cannot be optimal unless $\overline{w}_u = w_r$. However, since $\overline{w}_e \geq \underline{w}_e \geq \underline{w}_u \geq w_r$ this implies the required contradiction.||

Proof of Claim 2:

Fix a $w_r < p$ and a F_u.

(a) No mass points: Suppose F_e has a mass point at $\widetilde{w}_e \in [\underline{w}_e, \overline{w}_e]$. (7) then implies

$$\begin{aligned}\Omega_e(\widetilde{w}_e) &= \left[\frac{\lambda^2 F_u(\widetilde{w}_e^-)\mu}{\delta + \lambda[1 - F_e(\widetilde{w}_e) + m_e(\widetilde{w}_e)]} + \frac{\lambda^2 \int_{\underline{w}_u}^{\widetilde{w}_e^-} [F_e(\widetilde{w}_e) - m_e(\widetilde{w}_e) - F_e(x)] dN_u(x)}{\delta + \lambda[1 - F_e(\widetilde{w}_e) + m_e(\widetilde{w}_e)]}\right] \\ &\quad \times \left[\frac{p - \widetilde{w}_e}{\delta + \lambda(1 - F_e(\widetilde{w}_e))}\right],\end{aligned}$$

where $m_e(\widetilde{w}_e)$ is the mass of firms offering exactly $\widetilde{w}_e$. Note that the hiring rate is continuously increasing in w_e and jumps discontinuously at $\widetilde{w}_e$. As the profit per worker is continuous in w_e, this firm can strictly increase profits by offering a wage $w_e' = \widetilde{w}_e + \varepsilon$, for $\varepsilon > 0$ arbitrarily small. The increase in the hiring rate more than offsets the loss in profits per worker. Hence, (8) implies the existence of a mass point contradicts the definition of a market equilibrium.

(b) Connected support: Consider the following two cases.

1. $\underline{w}_e \geq \overline{w}_u$: For any F_u assume the support of F_e is not connected in the region $[w_{e1}, w_{e2}]$, where $\underline{w}_e \leq w_{e1} < w_{e2} \leq \overline{w}_e$. Consider a firm offering w_{e2}. As F_e does not have a mass point at w_{e2} and $\underline{w}_e \geq \overline{w}_u$, (7) implies

$$\Omega_e(w_{e2}) = \left[\mu + \int_{\underline{w}_u}^{\overline{w}_u} [F_e(w_{e2}) - F_e(x)]\, dN_u(x)\right] \left[\frac{\lambda^2(p - w_{e2})}{[\delta + \lambda(1 - F_e(w_{e2}))]^2}\right].$$

This firm can offer a strictly lower wage $w_e' = w_{e2} - \varepsilon > w_{e1}$, for any $\varepsilon > 0$, and increase its profits per worker while keeping a constant hiring rate. Hence by deviating to w_e' the firm strictly increases steady state flow profits. This contradicts the definition of a market equilibrium.

2. $\overline{w}_u > \underline{w}_e$: First consider the non overlapping interval $[\overline{w}_u, \overline{w}_e]$. It is easy to see that for any F_u the same arguments used in part (1) imply the support of F_e must be connected over this interval. Now consider the overlapping interval $[\underline{w}_e, \overline{w}_u]$. Suppose F_u has connected support and that the support of F_e is not connected in the region $[w_{e1}, w_{e2}]$, where $\underline{w}_e < w_{e1} < w_{e2} \leq \overline{w}_u$. Continuity of F_e and (6) imply

$$\Omega_u(w_{e2}) = \left[\frac{\lambda\delta}{(\lambda + \delta)}\right] \left[\frac{(p - w_{e2})}{\delta + \lambda(1 - F_e(w_{e2}))}\right].$$

This firm can strictly increase profits by offering $w_u' = w_{e2} - \varepsilon > w_{e1}$, for any $\varepsilon > 0$, since by doing so it increases profits per worker while keeping a constant quit rate. Hence the assumed F_e cannot be an equilibrium distribution function. Next suppose each F_i do not have connected supports over the interval $[\underline{w}_e, \overline{w}_u]$ and that the support of F_i is not connected in the region $[w_{i1}, w_{i2}]$. Two further significant cases arise. First let $\underline{w}_e < w_{e1} \leq w_{u1} < w_{u2} < w_{e2} \leq \overline{w}_u$. In this case the arguments used above to show the support of F_e is connected in the interval $[\underline{w}_e, \overline{w}_u]$ when F_u is connected again apply. Now let $\underline{w}_e \leq w_{u1} < w_{e1} < w_{e2} \leq w_{u2} < \overline{w}_u$. In this case (7) implies

$$\Omega_e(w_{e2}) = \left[F_u(w_{u1}^-)\mu + \int_{\underline{w}_u}^{w_{e1}^-}[F_e(w_{e1}) - F_e(x)]dN_u(x)\right]\left[\frac{\lambda^2(p - w_{e2})}{[\delta + \lambda(1 - F_e(w_{e1}))]^2}\right],$$

This firm can increase profits by offering a wage $w_e' = w_{e2} - \varepsilon > w_{e1}$, for any $\varepsilon > 0$, as by doing so it keeps its hiring and quit rate constant and increases profits per worker. It then follows that for any F_u if $\overline{w}_u > \underline{w}_e$, any F_e must have connected support in any market equilibrium. Combining the results of (1) and (2) then for any F_u a market equilibrium implies F_e must have connected support.||

Proof of Proposition 1:

Fix a $w_r < p$ and recall Claim 1 showed that in equilibrium $p > \overline{w}_e \geq \overline{w}_u$ and $\underline{w}_e \geq \underline{w}_u \geq w_r$. Now suppose $\overline{w}_e \geq \overline{w}_u > \underline{w}_e \geq \underline{w}_u \geq w_r$. Note that since F_e has connected support (see Claim 2), $\overline{w}_u$ lies on its support. The objective is to show that under this condition a firm offering $w_e = \overline{w}_u$ makes strictly higher steady state profits than a firm offering $w_e = \underline{w}_e$. Since this contradicts the constant profit condition (8) in the market for employed workers, it follows that the definition of equilibrium implies the supports of F_i are such that $\overline{w}_e > \underline{w}_e \geq \overline{w}_u \geq \underline{w}_u$.

Step 1: Consider the market for unemployed workers. Note that in any equilibrium the constant profit condition requires $\Omega_u(w_u) = \Omega_u(\underline{w}_u) = \overline{\Omega}_u$ for any w_u in the support of F_u. (6) and Claim 2 then imply a unique and continuous offer distribution

$$F_e(w_u) = \left(\frac{\delta + \lambda}{\lambda}\right)\left[1 - \left(\frac{p - w_u}{p - \underline{w}_u}\right)\right], \tag{14}$$

for all w_u in the support of F_u.

Step 2: Now consider a firm offering the least generous wage to an employed worker, $w_e = \underline{w}_e$. Note that for any equilibrium F_e, Claim 2 implies $F_e(\underline{w}_e) = 0$ and hence (7) implies

$$\Omega_e(\underline{w}_e) = F_u(\underline{w}_e^-)\mu \left[\frac{\lambda^2}{(\delta+\lambda)^2}(p - \underline{w}_e) \right]. \tag{15}$$

Next consider a firm offering $w_e = \overline{w}_u$ to an employed worker. (7) then implies

$$\begin{aligned} \Omega_e(\overline{w}_u) &= \left[\lambda F_u(\overline{w}_u^-)\mu + \lambda \int_{\underline{w}_u}^{\overline{w}_u^-} [F_e(\overline{w}_u) - F_e(x)]\, dN_u(x) \right] \left[\frac{\lambda(p - \overline{w}_u)}{[\delta + \lambda(1 - F_e(\overline{w}_u))]^2} \right] \\ &= \left[F_u(\overline{w}_u^-)\mu + \int_{\underline{w}_u}^{\overline{w}_u^-} [F_e(\overline{w}_u) - F_e(x)]\, dN_u(x) \right] \left[\frac{\lambda^2}{(\delta+\lambda)^2} \frac{(p - \underline{w}_u)}{(p - \overline{w}_u)}(p - \underline{w}_u) \right], \end{aligned} \tag{16}$$

where the last expression is obtained by substituting out F_e using (14). Inspection establishes that $\Omega_e(w_e = \overline{w}_u) > \Omega_e(w_e = \underline{w}_e)$. We then have the required contradiction and hence any market equilibrium implies $\underline{w}_e \geq \overline{w}_u$.$\|$

<u>Proof of Claim 3</u>:

Claim 2 and Proposition 1 imply a firm offering $\overline{w}_u$ to an unemployed worker will have a steady state profit flow given by

$$\Omega_u(\overline{w}_u) = \frac{\lambda\delta(p - \overline{w}_u)}{(\delta+\lambda)^2}.$$

Hence, maximising Ω_u requires offering an unemployed worker his reservation wage; i.e. $\overline{w}_u = w_r$. It then follows from the constant profit condition that any $w_u = w_r$ in the support of F_u.$\|$

<u>Proof of Claim 4</u>:

First note that Claim 2 and (7) imply the expected steady state profit in the market for employed workers of a firm offering $\underline{w}_e$ is given by

$$\Omega_e(\underline{w}_e) = \left[\frac{\lambda^2 F_u(\underline{w}_e^-)\mu}{\delta+\lambda} \right] \left[\frac{p - \underline{w}_e}{\delta+\lambda} \right].$$

Since for any $w_r < p$, equilibrium implies $\underline{w}_e \geq \overline{w}_u = w_r$, this firm will maximise steady state profits in that market by offering the lowest possible wage an employed worker, hired from unemployment, will accept. That is, $\underline{w}_e = w_r + \varepsilon$ where $\varepsilon > 0$ is arbitrarily small. Hence, w_r describes the infimum of the support of F_e. It then follows from the constant profit condition that in the market for employed workers all firms make steady state profit

$$\overline{\Omega}_e = \frac{\lambda^2 \mu}{(\delta+\lambda)^2}(p - w_r) = \lambda N_u \frac{(p-w_r)}{(\delta+\lambda)},$$

where the last equality follows from using (4). Next note that (7), Claim 2 and Proposition 1 imply

$$\begin{aligned}
\Omega_e(w_e) &= \left[\frac{\lambda^2 \mu}{\delta+\lambda(1-F_e(w_e))} + \frac{\lambda^2 F_e(w_e) N_u}{\delta+\lambda(1-F_e(w_e))}\right]\left[\frac{p-w_e}{\delta+\lambda(1-F_e(w_e))}\right] \\
&= \left[\frac{\lambda N_u(\delta+\lambda)}{\delta+\lambda(1-F_e(w_e))}\right]\left[\frac{p-w_e}{\delta+\lambda(1-F_e(w_e))}\right]
\end{aligned}$$

describes the steady state profit flow in the market for employed workers of a firm offering w_e. The last equality again follows from using (4). The constant profit condition then requires that $\Omega_e(w_e) = \overline{\Omega}_e$ for any $w_e \in [\underline{w}_e, \overline{w}_e]$. Hence, using the above expressions and some manipulations establish the expression for F_e. Finally, using $\Omega_e(\overline{w}_e) = \overline{\Omega}_e$ establish the expression for $\overline{w}_e$.‖

Proof of Proposition 2:

Using (6), (7) and applying the constant profit condition the total expected steady state profit flow is given by

$$\begin{aligned}
\overline{\Omega} &= \overline{\Omega}_u + \overline{\Omega}_e = \frac{\lambda\delta}{\delta+\lambda}\left[\frac{p-w_r^E}{\delta+\lambda}\right] + \frac{\lambda^2\delta}{(\delta+\lambda)^2}\left[\frac{p-w_r^E}{\delta+\lambda}\right] \\
&= \frac{\lambda\delta}{(\delta+\lambda)}\left[\frac{p-w_r^E}{\delta+\lambda}\right]\left[1+\frac{\lambda}{\delta+\lambda}\right].
\end{aligned}$$

In the B-M case, where firms offer the same wage to all workers, the constant profit condition implies that a firm's steady state profit flow is given by

$$\Omega_{B-M} = \frac{\lambda\delta}{(\delta+\lambda)}\left[\frac{p-b}{\delta+\lambda}\right].$$

where the first term is the hiring rate, $\lambda\mu$, and the second the expected profit per new hire. By the same token, in the PV-R framework once a worker just hired from unemployment receives a job offer, his wage is bid up to p and the firm makes zero profit. Hence,

$$\Omega_{PV-R} = \frac{\lambda\delta}{(\delta+\lambda)}\left[\frac{p-w_r^{PV-R}}{\delta+\lambda}\right].$$

Using the expressions for the respective reservation wages we obtain that $\overline{\Omega} = \Omega_{PV-R} > \Omega_{B-M}.\|$