Unemployment Insurance Eligibility and Wage Dispersion

Brennan C. Platt*

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Abstract

Unemployment insurance (UI) systems only distribute benefits to workers whose prior employment spell was sufficiently long. This feature alone can generate wage dispersion in the labor market among otherwise homogenous workers and firms. In our price-posting environment, changes to the UI system have surprising consequences. For instance, more generous benefits raise the wages received by *ineligible* workers, but lower them for the *eligible* workers. Increasing the minimum spell for eligibility has the same effect, assisting the very workers currently excluded.

JEL Classifications: D83, J31, J64, J65

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1 Introduction

All workers pay into unemployment insurance (UI) systems while employed, but not all of them are eligible for benefits once unemployed. Most system rules exclude those who are dismissed for cause or quit of their own accord. In addition, the worker's previous employment spell cannot be too short, ranging from a minimum of 4 months in France to a minimum of 15 months in Portugal (Ortega and Rioux, 2010). Rules vary across the United States, with most based on a required dollar

*Department of Economics, Brigham Young University, 135 FOB, Provo, UT 84602, (801) 422-8904, brennan_platt@byu.edu. Many thanks to Scott Condie, Joey McMurray, Val Lambson, David Fuller, and participants in the Fall 2013 Midwest Macro Meetings for their valuable comments. Sebastian Brown provided valuable research assistance. Any remaining errors are my own.

earnings, but meeting these can require up to one year of fulltime employment. This time requirement is binding for as much as 30% of the US unemployed population.[1]

UI design has attracted a large volume of empirical and theoretical studies (surveyed in Holmlund, 1998; Rogerson, *et al*, 2005; Eckstein and van den Berg, 2007; Tatsiramos and van Ours, 2014). The primary focus of these studies has been how the level and potential duration of benefits affect unemployment duration and subsequent wages. The effect of eligibility requirements on outcomes for the unemployed has only been empirically studied in Levine (1993), and only recently has received theoretical attention (Ortega and Rioux, 2010; Regev, 2012; Zhang and Faig, 2012; Andersen, *et al*, 2018). Each of these models assumes that wages are determined through Nash bargaining, with firms able to observe the worker's UI eligibility. Yet this seemingly innocuous feature has non-trivial implications, not only for the individuals who are disqualified from benefits, but for the equilibrium wages of those who are covered.

In our equilibrium labor search model, unemployed workers receive a fixed UI benefit only if they worked long enough in their prior employment to become eligible. Their benefit status is private information, so firms cannot use it in making wage offers.[2] Rather, employers select a wage that weighs the likelihood of being accepted against the realized profit if it is accepted, as in the standard wage posting environment. In equilibrium, at most two wages can be offered, corresponding to the reservation wages of eligible and ineligible unemployed workers.

We show that three equilibria can emerge. Two of these are degenerate, meaning that all firms offer the same wage, targeting only one of the two unemployed types. In the other equilibrium, both reservation wages are offered, resulting in wage dispersion even though all firms and workers are ex ante identical. Eligible unemployed workers always demand a wage greater than their unemployment income. We refer to this excess compensation as an *entitlement premium*, which eligible workers require because in accepting a job they might relinquish their UI eligibility and risk being

[1]Using CPS data from 1989 through 2012, Auray, *et al* (2013) compute that 42% of unemployed workers are ineligible to receive UI benefits; of these, 71% are excluded due to insufficient work history, which constitutes 30% of all unemployed workers.

[2]Eligibility rules are sufficiently complicated that an employer may have a difficult time predicting eligibility solely from a resume. Obscuring factors include why the employee left the prior job, how much was earned, whether a severance package was offered, and whether there were gaps due to temporary shutdowns. If firms price discriminate based on UI status, all job candidates would want to depict themselves as eligible to secure a higher wage offer; meanwhile, privacy laws would preclude directly contacting the UI administrator. In contrast, wage posting probabilistically exploits some local monopsony power without needing any information about UI status.

fired before re-earning it. At the same time, ineligible workers are willing to accept much lower wages in order to obtain eligibility in the future — known in the literature as a *(re-)entitlement effect* (Mortensen, 1977; Albrecht and Vroman, 2005), though it is muted here since accepting a job does not immediately bestow UI eligibility.

Changes in the UI system produce unexpected outcomes in this dispersed equilibrium. For instance, intuition suggests that increasing the size of unemployment benefits would increase the reservation wage of eligible unemployed workers; indeed, this occurs in partial equilibrium search models as well as in our degenerate equilibria. Yet in our dispersed equilibrium, more generous benefits lead to *lower* wages for eligible workers, while ineligible workers receive *higher* wages than before. This occurs because firms target eligible workers more heavily, which makes search more valuable for the ineligible unemployed. This also shrinks the entitlement premium since those who lose UI eligibility anticipate better search outcomes. In a similar vein, one would suspect that imposing a longer requirement for eligibility would harm those who are ineligible; yet these workers actually demand higher wages, while eligible workers obtain a lower wage than before.

These surprising comparative statics also differ from prior theoretical literature on UI eligibility. Both Ortega and Rioux (2010) and Regev (2012) predict that increasing UI generosity will raise wages for the eligible workers and lower them for the ineligible, creating more wage dispersion.[3] We get precisely the opposite. Also, in Ortega and Rioux (2010), an increase in assistance to all unemployed workers (regardless of eligibility) will raise both wages, while we find that high-end wages fall. Both models agree with ours that more lax access to eligibility will decrease low-end wages. Like us, Andersen, *et al* (2018) find that lax eligibility rules lead to longer unemployment durations, but this is due to decreased search effort in their setting rather than a worse job offer distribution in ours.

Our pivotal modeling distinction from this prior work is the mechanism of wage determination.[4] One advantage of the wage posting approach is that some job offers are rejected in equilibrium, whereas every match with positive joint surplus leads to

[3] Zhang and Faig (2012) only report the effect on unemployment rates and duration, which mimics the results of Ortega and Rioux (2010). We find the opposite effect: the unemployment rate falls as benefits are more generous (as empirically found in Levine, 1993) and as eligibility rules are more strict.

[4] Our wage posting is in the spirit of Burdett and Mortensen (1998), although like Albrecht and Vroman (2005), we omit on-the-job search for simplicity and thus obtain at most two wages in equilibrium rather than a continuum.

employment under the Nash bargaining approach. Wage posting also leads to longer unemployment durations for eligible unemployed workers, consistent with the data to which we calibrate our model. Direct evidence suggests that substantial fractions of job listings provide posted wages that are not negotiated by new hires (Brenčič, 2012; Hall and Krueger, 2012; Faberman and Menzio, 2018). This is particularly true in less-skilled occupations, whose workers may rely more heavily on unemployment insurance.

More broadly, we contribute to the theoretical literature on equilibrium wage dispersion, which examines why workers with similar characteristics are paid differently.[5] Burdett and Mortensen (1998) show that wage dispersion can occur in equilibrium if workers search on the job, differ in their unobserved productivity, or differ in their value of leisure (also seen in Albrecht and Axell, 1984). Albrecht and Vroman (2005) and Akin and Platt (2012) demonstrate that the limited duration of UI benefits can also generate wage dispersion among homogeneous workers. In this article, we shut down these sources of wage dispersion so as to isolate the effect of eligibility rules. In the prior models on eligibility, workers could lose UI benefits during an unemployment spell; in addition, workers and firms have a random match-specific productivity in Regev (2012) and Zhang and Faig (2012).

We proceed by developing the model in Section 2 and characterizing its solution in Section 3. In Section 4 we consider several extensions to the model: endogenizing the arrival rate, making eligibility deterministic, allowing for voluntary quits, and imposing a balanced budget constraint on the UI system. Section 5 concludes, with all proofs in the Appendix.

2 Model

Consider a labor market with homogeneous, risk-neutral workers. Unemployed workers receive offers at Poisson rate ϕ, which are then drawn from an endogenous distribution of posted wages. The worker must then either accept the wage or reject it, with no opportunity to recall past offers. If accepted, the job continues to pay the agreed-upon wage until it is exogenously destroyed at rate δ.

All unemployed workers receive an instantaneous utility $x > 0$, which can be

[5] See Christensen, *et al* (2005) for references to numerous empirical studies documenting wage dispersion.

thought of as home production or utility from leisure, relative to the disutility from labor which is normalized to 0. In addition, eligible workers receive unemployment benefit $b > 0$. In the base model, workers gain eligibility during their previous employment spell at rate γ. On accepting a new job, eligible workers lose their UI eligibility[6] with probability λ. Future payoffs are discounted at rate ρ.

All workers have a marginal product of $p > x$. Employers cannot observe the eligibility of a given worker, and thus post take-it-or-leave-it wage offers. These offers are chosen so as to maximize expected profit, which is the probability that the offer is accepted times the realized profit if it is accepted. If more than one price yields the maximal profit, an employer may employ mixed strategies over them.

We now formalize the objectives of workers and employers, as well as conditions required for a steady state equilibrium.

2.1 Workers

The state of an unemployed worker consists of whether they are eligible (ℓ) or not (n). We formulate a worker's decisions recursively, letting U_ℓ and U_n denote the present expected utility of unemployed workers in each state. Employed workers are classified based on their current wage w and eligibility status; we denote their present expected utility as $V_\ell(w)$ if they have gained eligiblity and $V_n(w)$ if not.

In the base model, only unemployed workers receive offers. Since these exist in at most two states, firms will offer at most two prices in equilibrium, which we label w_ℓ and w_n, depending on which type of unemployed worker is targeted in the job offer. Let $a \in [0, 1]$ denote the endogenously-determined probability that a given employer posts wage w_ℓ.

We then express the expected utility of employed workers in the following Bellman equations:

$$\rho V_\ell(w) = w + \delta\left(U_\ell - V_\ell(w)\right) \tag{1}$$

$$\rho V_n(w) = w + \delta\left(U_n - V_n(w)\right) + \gamma\left(V_\ell(w) - V_n(w)\right). \tag{2}$$

[6] For UI systems in the US, eligibility depends on sufficient work history over the prior year. Thus, a worker with over a year of full-time employment followed by a short unemployment spell could retain eligibility. However, those with unstable prior employment (such as furloughs or declining hours prior to firing) or with longer unemployment spells (over half a year) would need to re-earn eligibility. We approximate these rules with random eligibility retention to simplify the state space of workers.

In the first equation, eligible employed worker receive their wage each instant, and face the possibility of job loss at rate δ, in which case they move to unemployment with UI eligibility.[7] Ineligible employed workers also receive their wage and face the same rate of job loss, but become unemployed and ineligible in the latter event. Furthermore, the worker gains UI eligibility at rate γ, retaining his prior wage.

Next we turn to those who are unemployed. These are the only agents who must make choices of whether to accept a given wage or continue their search; yet these decisions are straightforward. Due to UI benefits received by the eligible, $U_\ell > U_n$; therefore, $w_\ell > w_n$. As a consequence, eligible unemployed workers will strictly prefer continued search over accepting w_n, and ineligible workers will strictly prefer accepting w_ℓ over continued search. Each is indifferent when offered the wage targeted to their type (*i.e.* $V_n(w_n) = U_n$ and $(1-\lambda)V_\ell(w_\ell) + \lambda V_n(w_\ell) = U_\ell$), but equilibrium will direct them to accept.[8]

Thus, we can formulate their Bellman equations as follows:

$$\rho U_\ell = x + b + \phi a \left((1-\lambda)V_\ell(w_\ell) + \lambda V_n(w_\ell) - U_\ell\right) \tag{3}$$

$$\rho U_n = x + \phi \left(a V_n(w_\ell) + (1-a)V_n(w_n) - U_n\right). \tag{4}$$

Both worker types receive x each instant, and receive a job offer at rate ϕ. Eligible workers also receive their UI benefit b, and will only accept w_ℓ, which is offered with probability a, and lose their eligibility status at the new job with probability λ. Ineligible unemployed workers accept either job offer.

2.2 Steady State Conditions

We next consider the distribution of workers in steady state, meaning the population of workers in each state remains stable over time. Let f_ℓ denote the population of unemployed workers who are eligible for UI benefits, while f_n represents those who

[7] As modeled, all job separations are outside the worker's control. We can also assume that an exogenous fraction q of these are firings for cause or other situations that would disqualify an otherwise eligible worker. This increases the population of ineligible workers, but has little effect on the equilibrium behavior or comparative statics. In Section 4.3, we examine voluntary quits.

[8] If a proposed equilibrium directed a strictly positive fraction of workers to reject a wage for which they were indifferent, employers would profit by increasing the posted wage by ϵ. This would break the indifference, hiring strictly more employees (those who would have rejected under indifference); but since ϵ can be arbitrarily small, it sacrifices no profit per employee. Thus, no such equilibrium can exist.

are unemployed and ineligible. For employed workers, the subscripts refer to the wage of the employee; thus, g_ℓ denotes the population of workers employed at w_ℓ but who are not yet eligible for future UI benefits, while g_n is the same for workers employed at wage w_n. Likewise, h_ℓ and h_n denote the population of workers employed at w_ℓ and w_n, respectively, who have obtained UI eligibility.

We normalize the population of workers to one, which allows us to interpret each variable as a fraction of all workers in the economy:

$$f_\ell + f_n + g_\ell + g_n + h_\ell + h_n = 1. \tag{5}$$

To maintain a stable population, flows into and out of each state must equate. We begin with ineligible unemployed workers. Workers enter this state only if they were ineligible and employed (at either wage, so measure $g_\ell + g_n$) and lost their job (at rate δ). Those who exit this state must have been unemployed and ineligible (f_n) and received any job offer (at rate ϕ). In steady state, these inflows and outflows must equate:

$$(g_\ell + g_n)\delta = \phi f_n. \tag{6}$$

Moving to eligible unemployed workers, workers enter this state only if they were eligible and employed at either wage ($h_\ell + h_n$) and then lost the job. To exit this state, the eligible unemployed workers (f_ℓ) must receive a job offer at wage w_ℓ (occurring at rate ϕa).

$$(h_\ell + h_n)\delta = \phi a f_\ell. \tag{7}$$

Now, consider the flow of ineligible workers employed at wage w_n. Workers only enter this state from ineligible unemployed workers (measure f_ℓ) who received an offer of that wage (at rate $\phi(1-a)$). They only exit this state when the job is dissolved (δ) or the worker gains eligibility (γ).

$$\phi(1-a)f_n = (\delta + \gamma)g_n. \tag{8}$$

Flows of ineligible workers employed at w_ℓ are similar, except they can also enter this state when eligible unemployed workers accept a w_ℓ job but lose their eligibility with probability λ:

$$\phi a(f_n + \lambda f_\ell) = (\delta + \gamma)g_\ell. \tag{9}$$

The final equation measures the flow of workers through eligible employment. Ineligible workers at either wage w_i where $i \in \{n, \ell\}$ will gain eligibility at rate γ, but eligible workers lose their job at rate δ.

$$\gamma g_i = \delta h_i. \tag{10}$$

2.3 Employers

A firm's profit is the number of workers it employs times its profit per worker, $p - w$. The former can be computed in steady state by dividing the measure of workers employed at that wage by the measure of firms offering that wage. Thus, firms posting the wage w_ℓ will earn:

$$\Pi_\ell = \frac{g_\ell + h_\ell}{a}(p - w_\ell), \tag{11}$$

while firms that post w_n will earn:

$$\Pi_n = \frac{g_n + h_n}{1 - a}(p - w_n). \tag{12}$$

The individual firm's choice has negligible effect on the distribution of wages a, but will strictly prefer to offer w_ℓ if $\Pi_\ell > \Pi_n$, or w_n if the inequality is reversed. If both options generate the same expected profit, firms may randomize across the two wages.

2.4 Equilibrium Conditions

The preceding problems constitute a game whose steady-state equilibrium is defined as reservation wages w_ℓ^* and w_n^*, firm profits Π_ℓ^* and Π_n^*, a distribution of workers f_ℓ^*, f_n^*, g_ℓ^*, g_n^*, h_ℓ^*, and h_n^*, and a distribution of wage offers a^*, such that:

1. The reservation wages w_ℓ^* and w_n^* satisfy $(1 - \lambda)V_\ell(w_\ell^*) + \lambda V_n(w_\ell^*) = U_\ell$ and $V_n(w_n^*) = U_n$, respectively, which are defined in the Bellman Eqs. 1 through 4, taking a^* as given.

2. The distribution of workers satisfy the Steady State Eqs. 5 through 10.

3. Either $\Pi_\ell^* > \Pi_n^*$ and $a^* = 1$, or $\Pi_\ell^* < \Pi_n^*$ and $a^* = 0$, or $\Pi_\ell^* = \Pi_n^*$ and $a^* \in [0, 1]$, with profits defined in Eqs. 11 and 12 and where w_ℓ^*, w_n^*, f_ℓ^*, and f_n^* are taken

as given.

The first requirement indicates that workers use an optimal reservation wage, while the second requires employers to correctly anticipate the distribution of workers. The third stipulates that firms are profit maximizing. We will show that profits are finite even in the extremes where $a = 0$ or $a = 1$ because the distribution of workers are functions of the distribution of wage offers.[9]

3 Equilibrium Characterization

3.1 Solution

Despite the endogenous wages and distribution of worker types, this model yields a closed form solution, reported this in terms of the employer strategy a^*. First, equilibrium wages will be:

$$w_\ell^* = x + b + \frac{b\delta\lambda(\delta+\rho)}{(\gamma+\delta\lambda+\rho)\phi a^* + \rho(\gamma+\delta+\rho)} \tag{13}$$

$$w_n^* = x + b - \frac{b(\gamma+\rho)(\delta+\rho)}{(\gamma+\delta\lambda+\rho)\phi a^* + \rho(\gamma+\delta+\rho)} \tag{14}$$

Note that $w_\ell^* > w_n^*$ for any $a^* \in [0,1]$. In fact, a firm trying to attract eligible workers must offer them more than their unemployment benefits $x+b$. We refer to the extra compensation above the unemployment income as an *entitlement premium*, which is needed to coax eligible unemployed workers to risk losing eligibility before their next unemployment spell.

On the other hand, $w_n^* < x + b$. In fact, it is even possible for $w_n^* < x$, which occurs if $\phi a^* < \frac{\gamma\delta}{\gamma+\delta\lambda\rho}$. That is, if high wage offers are infrequent but eligibility is quickly earned, then ineligible workers may accept low wages so as to get a job and work towards eligibility.

For notational ease, let $q^* = \gamma(\delta+\phi a^*) + (\delta+\phi)\delta\lambda a^*$. The population distribution

[9]From the employer's perspective, a^* can be interpreted in one of two ways. One could think of this as a symmetric equilibrium, in which each firm randomizes over the two wages with the same mixed strategy a^*. Alternatively, one could think of this as fraction a^* of employers offering w_ℓ^* all the time, with the remainder posting w_n^* all the time. The equilibrium solution is unaffected by either interpretation.

then solves as:

$$
\begin{aligned}
f_\ell^* &= \frac{\gamma\delta}{q^*} && (15)\\
f_n^* &= \frac{\delta^2\lambda a^*}{q^*} && (16)\\
g_\ell^* &= \frac{\delta(\gamma+\delta a^*)\lambda\phi a^*}{(\gamma+\delta)q^*} && (17)\\
g_n^* &= \frac{\delta^2\lambda\phi(1-a^*)a^*}{(\gamma+\delta)q^*} && (18)\\
h_\ell^* &= \frac{\delta(\gamma+\delta(1-(1-a^*)\lambda))\gamma\phi a^*}{(\gamma+\delta)q^*} && (19)\\
h_n^* &= \frac{\gamma\delta\lambda\phi(1-a^*)a^*}{(\gamma+\delta)q^*} && (20)
\end{aligned}
$$

Finally, equilibrium profits per firm are:

$$
\begin{aligned}
\Pi_\ell^* &= \left(p-x-b-\frac{b\delta\lambda(\delta+\rho)}{(\gamma+\delta\lambda+\rho)\phi a^*+\rho(\gamma+\delta+\rho)}\right)\cdot\frac{(\gamma+\delta\lambda a^*)\phi}{q^*} && (21)\\
\Pi_n^* &= \left(p-x-b+\frac{b(\gamma+\rho)(\delta+\rho)}{(\gamma+\delta\lambda+\rho)\phi a^*+\rho(\gamma+\delta+\rho)}\right)\cdot\frac{\delta\lambda\phi a^*}{q^*} && (22)
\end{aligned}
$$

The following proposition, proven in the appendix, establishes that an equilibrium must necessarily satisfy these equations.

Proposition 1. *Any equilibrium will take the form expressed in Eqs. 13 through 22.*

The equilibrium a^* depends on parameter values. In order for all firms to exclusively offer w_ℓ^* (that is, for $a^*=1$), it must not be profitable for one firm to deviate, offering w_n^* while all other firms are offering w_ℓ^*. This holds if and only if:

$$
p-x \geq b\left(1+\frac{\delta\lambda}{\gamma}\cdot\frac{(\delta+\rho)(2\gamma+\delta\lambda+\rho)}{\phi(\gamma+\delta\lambda+\rho)+\rho(\gamma+\delta+\rho)}\right). \qquad (23)
$$

On the other hand, for all firms to exclusively offer w_n^* (that is, for $a^*=0$), it must not be profitable for one firm to deviate, offering w_ℓ^* while all other firms are offering w_n^*. This holds if and only if:

$$
p-x \leq b\left(1+\frac{\delta\lambda(\delta+\rho)}{\rho(\gamma+\delta+\rho)}\right). \qquad (24)
$$

We refer to either of the preceding solutions as a *degenerate equilibrium*, since only one price is offered. An unpleasant consequence of a w_n^* degenerate equilibrium is that eligible unemployment becomes an absorbing state, since workers are never offered a wage that entices them to abandon their UI benefits.

A *dispersed equilibrium* only can occur if employers employ a mixed strategy $a^* \in (0,1)$; either wage offer must be equally profitable in expectations. Setting these profits equal provides a linear equation in a^* which yields the unique solution:

$$a^* = \frac{1}{(\gamma + \delta\lambda + \rho)\phi} \cdot \left(\frac{b\delta\lambda(\delta+\rho)\left(\gamma\phi - \rho(\gamma+\delta+\rho)\right)}{\gamma\phi(p-x-b) - b\delta\lambda(\delta+\rho)} - \rho(\gamma+\delta+\rho) \right). \tag{25}$$

However, after calculating this a^*, one must verify that it lies between 0 and 1; otherwise, the dispersed equilibrium does not exist.

In light of these three possibilities, we next consider existence and uniqueness of equilibria among them. The outcome hinges on how quickly ineligible unemployed workers can find jobs and become entitled to unemployment benefits.

Proposition 2. *1. If $\gamma\phi < \rho(\gamma+\delta+\rho)$ then a unique equilibrium exists, whether degenerate or dispersed.*

2. If $\gamma\phi \geq \rho(\gamma+\delta+\rho)$ then at least one degenerate equilibrium exists. Moreover, the dispersed equilibrium exists if and only if both degenerate equilibria exist.

3. If $\gamma\phi = \rho(\gamma+\delta+\rho)$ and $p - x = b\left(1 + \frac{\delta\lambda(\delta+\rho)}{\rho(\gamma+\delta+\rho)}\right)$ then an equilibrium occurs using any $a^* \in [0,1]$.

These three possibilities are illustrated in the top row of Figure 1, for various levels of eligibility rates (γ) and UI benefit levels (b). Other parameters are calibrated as described below. When the first condition of Proposition 2 is satisfied (which requires very stringent eligibility rules, as in the left column of Figure 1), only one equilibrium can occur at each b. For low unemployment benefits, Equation 23 will be satisfied and the w_ℓ degenerate equilibrium occurs ($a^* = 1$). As benefits increase, this transitions to the dispersed equilibrium. As b increases further, Equation 24 eventually holds and the w_n degenerate equilibrium takes over ($a^* = 0$).

When the second condition of Proposition 2 is satisfied (with generous eligibility rules, as in the right column of Figure 1), it is still true that only the w_ℓ degenerate

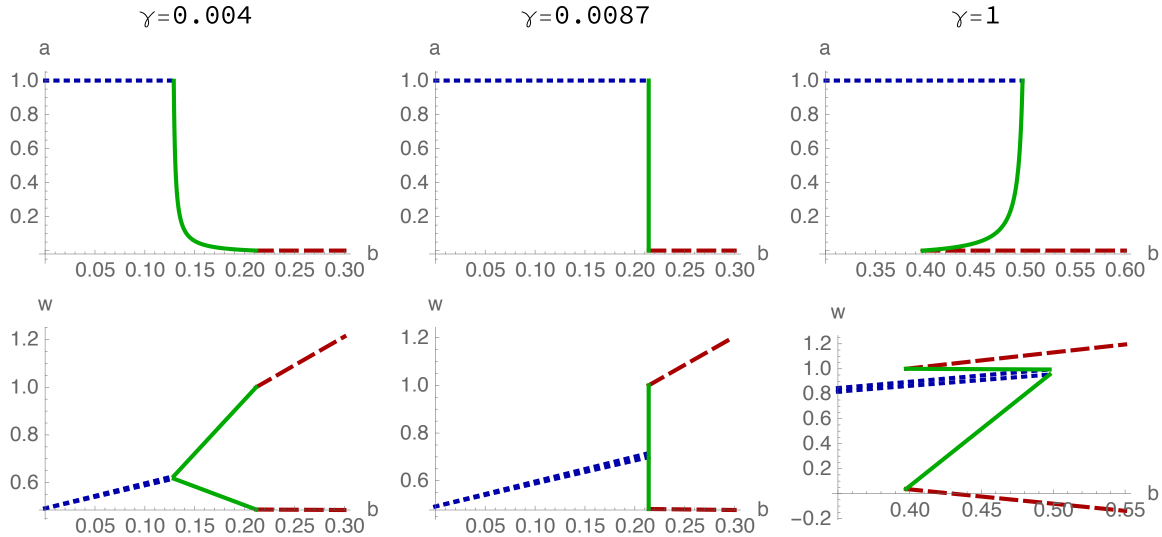

Figure 1: **Equilibrium Wage Offers**. Graphs in the top row depict the fraction a^* of firms that offer the high wage w_ℓ in equilibrium, depending on the rate at which eligibility is gained γ (columns) and the benefit level b (x axis). Graphs on the bottom row indicate the equilibrium wages (with w_ℓ as the higher wage, w_n as the lower wage). Points on a solid line depict a dispersed equilibrium, while points on the dashed and dotted line denote a degenerate equilibrium where firms only offer w_ℓ or w_n, respectively.

equilibrium occurs for low benefit levels, and only the w_n degenerate equilibrium holds for high benefit levels. However, for moderate benefit levels ($b \in (0.4, 0.5)$ in the example), both of these equilibria exist as well as the dispersed equilibrium. This moderate range becomes larger as λ increases.

The third condition of Proposition 2, of course, is not generic; but when it holds (as in the center column of Figure 1 at $b = 0.21$), it generates a continuum of equilibria, one for each $a^* \in [0, 1]$.

For this illustration of equilibrium behavior, parameters are calibrated to match the following stylized facts from the US economy (from the CPS 2014-2017). The average unemployment duration is 18 weeks for workers not receiving UI benefits and 21.5 weeks for those who did, which is consistent with $\phi = 2.88$ (setting a year as one unit of time) and $a^* = 0.84$. UI eligibility rules are set by each state, but typically require one year of steady earnings ($\gamma = 1$). To match the average unemployment rate of 5.45%, we set $\delta = 0.14$. We normalize $p = 1$, then set $b = 0.497$ so as to match the 50% ratio of benefits to average wages, and $x = 0.492$ so that the equilibrium condition on a^* holds (Eq. 25). We take $\rho = 0.1$ and $\lambda = 1$, but the solution is not highly sensitive to either parameter.

These parameters imply an average job tenure of 7 years. The data report an average tenure of 5.3 years, but does not distinguish between causes of job transitions, some of which would not be UI eligible. The model also predicts 89% of unemployed workers are eligible, while data estimates place this close to 70%. We note that these parameters strongly satisfy case 2 of Proposition 2, and that a dispersed equilibrium is necessary to generate the difference in unemployment duration. The calibrated model generates a 5.0% premium in the post-unemployment wages of UI recipients over non-recipients.

Whenever multiple equilibria occur (under either the second or third condition), the equilibria are not payoff equivalent for most of the actors. Holding all parameters constant, the equilibrium with a larger a^* will always result in greater profit for firms as well as more utility for ineligible unemployed workers and workers employed at wage w_n. Eligible unemployed workers are unaffected by a^*, while workers employed at wage w_ℓ enjoy less utility as a^* rises.

Of course, multiple equilibria are not uncommon in search models. These occur because the aggregate level of search affects both the incentives of employers and the incentives of workers. For instance, if a large fraction of workers hold out for the high wage, it can be optimal for firms to only offer the high wage and thus optimal for workers to hold out for that wage; but if fewer workers insist on the high wage, firms might be willing to offer both wages. Under the right conditions (noted above), these forces can precisely cancel out.

We close this section by computing aggregate statistics from the model solution. These will be particularly useful in judging how the model responds to parameter changes, examined in Section 3.2.

First, the unemployment rate consists of $f_\ell + f_n$, which is:

$$\bar{u}^* \equiv \frac{\delta(\gamma + \delta\lambda a^*)}{\gamma(\delta + \phi a^*) + \delta\lambda(\delta + \phi)a^*}. \tag{26}$$

The fraction of the unemployed who are eligible is $f_\ell/(f_\ell + f_n)$, or:

$$\bar{\ell}^* \equiv \frac{\gamma}{\gamma + \delta\lambda a^*}. \tag{27}$$

Table 1: **Comparative statics in dispersed equilibria**

		$\partial/\partial x$	$\partial/\partial b$	$\partial/\partial \lambda$	$\partial/\partial \phi$	$\partial/\partial \gamma$
% offering high wage:	a^*	$+$	$+$	$+$	$-$	$-$
High wage:	w_ℓ^*	$-$	$-$	$-$	$+$	$+$
Low wage:	w_n^*	$+^\dagger$	$+$	$+$	$-$	$-^\dagger$
Average offered wage:	$\bar{w}^*$	$+^\dagger$	$+$	$+$	$-$	$-^\dagger$
Unemployment rate:	$\bar{u}^*$	$-$	$-$	$-$	$+$	$+$
% unemp. who are eligible:	$\bar{\ell}^*$	$-$	$-$	$-$	$+$	$+^\dagger$

Notes: Table reports the signs of each comparative static assuming a dispersed equilibrium and $\gamma\phi > \rho(\gamma+\delta+\rho)$. The signs would switch if the condition were reversed, except for those marked with †, which require an even lower γ to switch the sign. The precise comparative statics are derived in the Appendix.

Workers who are eligible for UI accept new jobs at rate ϕa^*, while those who are ineligible do so at rate ϕ.

Finally, the expected wage offer is $a^* w_\ell^* + (1-a^*)w_n^*$, which simplifies to:

$$\bar{w}^* \equiv x + b + \frac{b(\delta+\rho)(\delta\lambda a^* - (1-a^*)(\gamma+\rho))}{(\gamma+\delta\lambda+\rho)\phi a^* + \rho(\gamma+\delta+\rho)}. \tag{28}$$

3.2 Comparative Statics

We next examine how equilibrium wages and employment reacts to changes in the underlying parameters, reported in Table 1. The direct effect of a parameter change can be seen by taking the derivative of the equilibrium solution while holding a^* constant. This partial-equilibrium intuition is correct in the degenerate equilibria (whose comparative statics are reported in Table 2 of the Appendix). However, in a dispersed equilibrium, firms respond by changing the wage offer distribution, often reversing the direct effect.

For instance, the direct effect of an increase in leisure (x) lifts both reservation wages (w_ℓ and w_n) by the same amount, as all workers have an improved outside option to employment. However, this means that the expected profit from offering the high wage, $p - w_\ell$, falls by more than the expected profit from offering the low wage, $(1-\bar{\ell})(p-w_n)$. Thus, firms must adjust their mixed strategy until profits are again equal across the two wage offers. One would expect firms to reduce a^*, targeting the relatively-more-profitable ineligible workers with greater intensity; yet exactly the opposite occurs!

To pinpoint the mechanism behind these counterintuitive results, look to the effect of a^* in Eqs. 13 and 14. The reservation wage of the ineligible (w_n) will increase as more firms offer the high wage. These workers are more likely to encounter the high wage and are hence more willing to continue their search; thus, firms must increase the low wage to convince ineligible unemployed workers to give up further search.

At the same time, the reservation wage of eligible workers (w_ℓ) will *decrease* as more firms offer the high wage. This is a consequence of the entitlement premium. Eligible workers demand wages above their unemployment utility ($x+b$) only because they fear accepting a job and then losing it before renewing their UI eligibility. But if more firms offer the high wage, a spell of non-insured unemployment is not as painful. Hence they accept a smaller entitlement premium — which more than offsets the direct effect of greater leisure. A third effect of a^* increasing is to reduce the fraction of unemployed workers who are eligible ($\bar{\ell}$), who now find acceptable offers more quickly.

Thus, to re-equate profits across the two wages, a^* must increase. This will cause w_n to rise and w_ℓ to fall. Ironically, this means firms are targeting eligible workers more heavily even as there are fewer of them. To give a sense of magnitude around the calibrated parameters, a 1% increase in x causes a 4.5% increase in w_n and a 0.02% decline in w_ℓ.

Similar logic applies after an increase in unemployment benefits (b). Higher UI benefits immediately help eligible unemployed workers, raising their reservation wage (w_ℓ). Ineligible unemployed workers also stand to gain, but only in the future if they become eligible; hence, w_n increases to a lesser degree. To restore indifference between the two wage strategies, a^* must rise, but doing so reduces the entitlement premium. Thus, even though eligible workers are the direct beneficiaries of a more generous UI system, they actually receive lower wages in equilibrium since they are less concerned about losing the new job without renewing UI eligibility.

This also means that higher benefits lead to less wage dispersion; in the lower right graph of Figure 1, the two wages marked with solid lines draw closer as b increases. This carries some irony since workers only differ because of these benefits, yet a larger wedge between types produces a smaller gap between outcomes. A 1% increase in b generates nearly identical response as a similar increase in x. The unemployment rate would also fall by 4.6% (rather than rising, as in Ortega and Rioux, 2010; Zhang and

Faig, 2012). Empirical estimates in Levine (1993) suggest that the unemployment rate does fall, but the point estimate is -0.37% and is only significant at the 10% level.

A decrease in the eligibility requirement (increasing γ) is a bit surprising even in its direct effect (holding a^* constant), as both wages are pushed lower. This reduces the entitlement premium since a newly hired worker is now more likely to renew eligibility before losing the job. Moreover, the main reason an ineligible worker accepts offer w_n is to gain future eligibility; this now requires less time, so the low wage offer is more attractive and can be lowered. However, after firms respond in equilibrium by lowering a^*, the entitlement premium more than rebounds. A 10% increase in γ results in a 0.06% net increase in w_ℓ, while w_n will decrease by 0.9%.

Note that the comparative static on a^* is interesting in its own right, as a^* is equal to the ratio of the job finding rates of eligible versus ineligible workers. Thus, if x, b or λ increases, or if ϕ or γ falls, the model predicts that the job finding rates will become more similar across the two types of unemployed workers. This is particularly surprising for b, γ, or λ, as one might expect eligible workers to be more reluctant to relinquish benefits that are more generous, or harder to obtain and/or retain. But the equilibrium response of firms more than compensates by targeting these eligible workers more heavily.

4 Extensions

4.1 Endogenous Arrival Rates

Here, we explicitly model the dynamic problem of employers. Firms incur an instantaneous cost k for as long as a posted job vacancy is unfilled, and are matched with a potential employee at endogenous rate α, at which point the wage offer and acceptance proceed as before.

Let K_ℓ denote the present expected value of a job posting by a firm that targets eligible workers, while K_n denotes the same for firms targeting ineligible workers. Similarly, let J_ℓ and J_n denote the present expected value to the firm of a worker employed at wage w_ℓ or w_n, respectively. Expressed recursively, the value of a vacancy is:

$$\rho K_\ell = -k + \alpha(J_\ell - K_\ell) \tag{29}$$

$$\rho K_n = -k + \alpha \frac{f_n}{f_n + f_\ell}(J_n - K_n). \tag{30}$$

As before, the two wage-posting strategies only differ in their likelihood of success, since w_n is only acceptable to fraction $\frac{f_n}{f_n+f_\ell}$ of unemployed workers.

The value of an employed worker is expressed recursively as:

$$\rho J_\ell = p - w_\ell + \delta(K_\ell - J_\ell) \tag{31}$$

$$\rho J_n = p - w_n + \delta(K_n - J_n), \tag{32}$$

which differ only in the wage paid each instant.

This system of four equations immediately solves as:

$$K_\ell = \frac{p - w_\ell}{\rho} - \frac{(\delta + \rho)(p - w_\ell + k)}{\rho(\alpha + \delta + \rho)} \tag{33}$$

$$K_n = \frac{p - w_n}{\rho} - \frac{(\delta + \rho)(f_\ell + f_n)(p - w_n + k)}{\rho(\alpha f_n + (\delta + \rho)(f_\ell + f_n))} \tag{34}$$

$$J_\ell = \frac{p - w_\ell}{\rho} - \frac{\delta(p - w_\ell + k)}{\rho(\alpha + \delta + \rho)} \tag{35}$$

$$J_n = \frac{p - w_n}{\rho} - \frac{\delta(f_\ell + f_n)(p - w_n + k)}{\rho(\alpha f_n + (\delta + \rho)(f_\ell + f_n))}. \tag{36}$$

We assume that firms can freely enter or exit the market, so the total number of vacancies must adjust until the value of posting a job is zero. This imposes that $K_\ell \leq 0$ and $K_n \leq 0$, with strict equality if a positive measure of firms post that wage. If both wages are offered in equilibrium, they must be equally profitable in expectation, so α must adjust such that $K_\ell = K_n = 0$, yielding:

$$p - w_\ell = \frac{f_n}{f_\ell + f_n}(p - w_n). \tag{37}$$

Note that this is equivalent to the equal profit condition in Section 2.3.

In this environment, arrival rates α and ϕ are endogenously determined based on the number of unemployed workers and vacancies, necessitating a choice of matching function. For simplicity, we assume that all participants on the short side of the market are matched at an exogenous rate, while the long side of the market is proportionally rationed. If $u = f_\ell + f_n$ denotes unemployed workers and v denotes vacancies, the total number of matches each instant are $M(u, v) = A \min\{u, v\}$, and thus $\alpha = M(u, v)/v$ and $\phi = M(u, v)/u$. If the cost of posting a vacancy is sufficiently low, unemployed workers will be more scarce than vacancies and the model proceeds as before; other matching functions are more complicated to solve but result in qualitatively similar behavior.

Proposition 3. *The base model dispersed solution still holds with endogenous arrival rate*

$$\phi = \begin{cases} A & \text{if } k(\delta+\rho) < A\left(\frac{b\delta\lambda(\delta+\rho)-\rho(p-b-x)(\gamma+\delta+\rho)}{A\gamma-\rho(\gamma+\delta+\rho)}\right) \\ \frac{A\left(b\delta\lambda - \frac{\rho(p-x-b)(\gamma+\delta+\rho)}{\delta+\rho}\right)}{\gamma k} + \frac{\rho(\gamma+\delta+\rho)}{A\gamma} & \text{otherwise} \end{cases}$$

For brevity, we only report the dispersed solution. Degenerate outcomes have a similar threshold for k dictating whether unemployed workers are more scarce than vacancies, though the precise threshold differs across the three equilibria. In each case, the threshold compares the posting cost relative to unemployment benefits b, and it seems plausible that the latter would be larger. If so, all three equilibria will result in $\phi = A$, leaving all of our previous results intact. If vacancy costs dramatically exceed unemployment benefits, up to three equilibria can occur (as in Proposition 2), but the arrival rate can differ across those equilibria.

4.2 Deterministic Eligibility

In our base model, employees gain UI eligibility at a random Poisson rate. In practice, most UI systems award eligibility after a set amount of earnings or time worked; so the date of eligibility can be predicted from the hiring date, should the worker remain employed. Here, we demonstrate that deterministic eligibility rules have minimal influence on the equilibrium behavior. In contrast, random versus deterministic loss of eligibility during an unemployment spell was shown to have important equilibrium search consequences in Akin and Platt (2012).

In this setting, an employee's tenure t must be recorded up through eligibility awarded at time T, after which tenure is no longer relevant. For an ineligible worker, this replaces Eq. 2 with:

$$\rho V_n(w,t) = w + \delta\left(U_n - V_n(w,t)\right) + \frac{\partial V_n(w,t)}{\partial t}. \tag{38}$$

As before, the worker receives his wage and has the risk of being fired, but the last term captures the steady passage of time, eventually reaching the terminal condition $V_n(w,T) = V_\ell(w)$. This differential equation readily solves to yield (at the time of hire):

$$V_n(w,0) = \frac{w + \delta U_\ell}{\delta + \rho} + \frac{\delta\left(1 - e^{-(\delta+\rho)T}\right)(U_n - U_\ell)}{\delta + \rho}. \tag{39}$$

If we define $\gamma = \frac{\delta+\rho}{e^{T(\delta+\rho)}-1}$, this is equivalent to the solution for $V_n(w)$ in the base model, while U_n, U_ℓ, and $V_\ell(w)$ are. unchanged.

Similarly, the flows of ineligible workers must track tenure. Since they lose their job at rate δ, only $e^{-\delta T}$ of new hires will survive to gain eligibility. Thus, we combine Eqs. 8 and 10 to get:

$$\phi(1-a)f_n e^{-\delta T} = \delta h_n \tag{40}$$

and Eqs. 9 and 10 to get:

$$\phi a(f_n + \lambda f_\ell)e^{-\delta T} = \delta h_\ell. \tag{41}$$

In each case, the flow of new hires is multiplied by $e^{-\delta T}$ to determine the flow of newly eligible workers T periods later.

When the steady state conditions are solved, the workers per firm would be identical to the base model if $\gamma = \frac{\delta\lambda}{e^{T\delta}-\lambda}$. Thus, with no automatic renewal of eligibility and highly patient workers ($\lambda = 1$ and $\rho \to 0$), the deterministic eligibility model literally coincides with the random eligibility model. More broadly, the equilibrium behavior is highly similar even in its magnitudes. For instance, calibrating to previous targets with $T = 1$, we obtain $\delta = 0.143$, $x = 0.491$ and $b = 0.496$, which are only 0.2% lower than the base model estimates. Comparative statics are also similar in sign and magnitude.

4.3 Voluntary Quits

In our model, the primary motivation for unemployed workers to accept the lower wage is to begin earning unemployment eligibility. Indeed, in equilibrium, $V_\ell(w_n^*) < U_\ell$; meaning that an eligible low-paid worker would prefer quitting so as to enjoy unemployment benefits and wait for the high-paying job. (On the other hand, $V_\ell(w_\ell^*) > U_\ell$, so one would never abandon the high-paying job.) Here, we adapt the model to allow these voluntary quits, and demonstrate that our previous results are not sensitive to this assumption.

At the outset, we note that under most UI systems, workers who left voluntarily are not eligible for benefits. Moreover, those fired due to bad behavior also face some restrictions. For the sake of demonstration, we assume that the cause of job separation either cannot be verified or does not affect benefits.

This affects the model in two ways. First, for a worker employed at w_n, Equation 2 is replaced with:

$$\rho V_n(w_n) = w_n + \delta \left(U_n - V_n(w)\right) + \gamma \left(U_\ell - V_n(w_n)\right). \tag{42}$$

That is, on obtaining eligibility, such a worker immediately abandons the job and enters unemployment. All other Bellman equations are unchanged.

Second, the steady state conditions are altered in two cases. The flow into eligible unemployed workers now includes the newly eligible low-wage workers who quit their job (γg_n). Thus, Equation 7 is replaced by:

$$\delta(h_n + h_\ell) + \gamma g_n = \phi a f_\ell \tag{43}$$

Moreover, Equation 10 is replaced with $h_n = 0$, as no workers remain employed at the low wage after obtaining eligibility. This solves easily via the same solution process as in the proof of Proposition 1, but the resulting equal profit condition is more cumbersome, and this prevents analytic characterizations of the solution in most aspects. However, in numeric examples, the qualitative behavior is virtually identical to the original problem. The ineligible wage is lower than in the original model (by 2% under the calibrated parameters), since ineligible unemployed workers can effectively upgrade if they survive a year on the job. This also entices more employers to offer this low wage. Numerically evaluated comparative statics are also consistent with Table 1.

A different approach would be to assume that workers can quit, but that firms preemptively increase their wages when they reach eligibility, offering sufficient compensation w_r to make them indifferent about remaining with the firm: $V_\ell(w_r) = U_\ell$. A firm would prefer to do this since it still earns positive profit and is better than seeking a new candidate, which takes time even when offering $w_\ell > w_r$. Threatened quits are never realized in equilibrium, so the original steady state equations again apply. This version of the model solves analytically and qualitatively is identical to the original model.

4.4 UI Funding

Our base model does not explicitly model the funding of UI benefits, which could adequately depict a system that draws on general tax revenue. However, UI systems frequently are required to run a balanced budget by collecting taxes from employed workers. Even when not, any policy reform may require budget-neutrality, where any increase in benefits or decrease in eligibility requirements must be funded through increased taxes. We formally develop a self-funded model here, and consider welfare implications under it.

Let τ denote a lump-sum tax taken each instant from each worker, while b is determined endogenously by splitting available revenue among all eligible unemployed workers. That is:

$$f_\ell b = \tau(g_\ell + g_n + h_\ell + h_n). \tag{44}$$

In practice, UI systems are typically funded through a proportional tax, but this is only applied to the initial earnings, with a typical cap of $7,000 per year. We assume lump sum taxes for the sake of simplicity; while we can solve the model with proportional taxes, the solution is more complicated and requires numerically solving a^* and b.

Steady state conditions are not affected by the addition of taxes, nor are the definitions of expected profit. In light of this, the balanced budget requirement in Equation 44 yields $b^* = (a^* \tau \phi(\gamma + \delta\lambda))/(\gamma\delta)$. The only alteration needed in the Bellman equations is to replace w with $w - \tau$ in all instances. This has the effect of increasing the solutions for w_ℓ^* and w_n^* in Equations 13 and 14 by τ.

The only additional step needed is to substitute for w_ℓ^*, w_n^*, and b^* in each profit computation. The comparison of profits determines which equilibrium holds. For the case of a dispersed equilibrium, a^* must solve:

$$
\begin{aligned}
a^2\tau\phi(\gamma+\delta\lambda)(\gamma+\delta\lambda+\rho)(\gamma\phi+\delta\lambda(\delta+\rho))+ & \\
a\gamma\phi\left(\tau(\gamma+\delta\lambda)(\gamma\rho+(\delta+\rho)(\delta\lambda+\rho))-\gamma\delta(p-x-\tau)(\gamma+\delta\lambda+\rho)\right)- & \\
\gamma^2\delta\rho(\gamma+\delta+\rho)(p-\tau-x) & = 0.
\end{aligned}
$$

This quadratic equation yields two solutions, but one is always negative so only the other constitutes a dispersed equilibrium. In fact, this self-funded setting also ensures a unique equilibrium under any parameter values, rather than allowing the coexistence of dispersed and degenerate equilibria. If we calibrate this self-funded model to our previous targets, the only affected parameters are $x = 0.466$ and $\tau = 2.56\%$ (which preserves the same benefit $b = 0.497$).[10]

Comparative statics in this environment often have ambiguous signs. This is because a worse wage offer distribution (lower a^*) will increase the unemployment rate and the fraction of unemployed who are eligible for benefits; this necessitates lower benefits (or higher tax rates) to balance the budget, creating a feedback loop that can counteract the effects described in Table 1.

The most interesting comparative static is with respect to the UI tax itself, illustrated in Figure 2. The direct effect of a tax increase is that either type of unemployed worker demands a higher wage, which reduces profits more for w_ℓ- than w_n-employers. As a consequence a^* falls, causing the eligible unemployed to reject more offers and thus increases the number of UI recipients. Even with a higher tax per worker, the benefit per worker must be reduced. Surprisingly, an increase in τ mirrors a *decrease* in b reported in Table 1. For very high tax rates, however, the feedback loop through a^* is dampened, allowing wages to rise with taxes while benefits remain steady.

In contrast, relaxing eligibility requirements (increasing γ) in this setting will consistently lift the benefits available to eligible workers. The net effect of higher b and higher γ lead to an increase in a^*, thereby reducing the number of UI recipients and allowing the larger benefit per worker. In effect, the direct effect of relaxed eligibility is overpowered by the indirect effect of generous benefits. Not surprisingly, this net effect is small: cutting the required employment span in half would lift w_ℓ by

[10] The US unemployment insurance tax rate is nominally 6%, but can be lower for firms with few firings and is only applied up to a cap on earnings that ranges from $7,000 to 33,000 across the states.

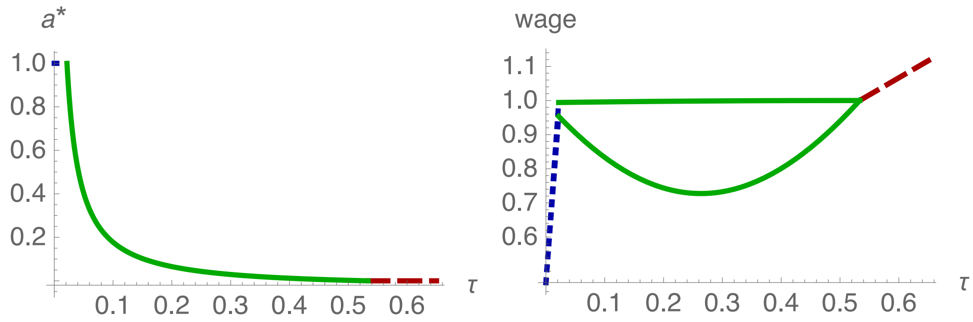

Figure 2: **Self-funding Equilibrium**. The left graph depicts the fraction a^* of firms that offer the high wage w_ℓ in equilibrium, depending on the tax τ used to fund benefits. The right graph indicates the equilibrium wages (with w_ℓ as the higher wage, w_n as the lower wage). Points on a solid line depict a dispersed equilibrium, while points on the dashed and dotted line denote a degenerate equilibrium where firms only offer w_ℓ or w_n, respectively.

only 0.3% and w_n by 0.6%.

This setting is also conducive for considering welfare implications of UI benefits and eligibility.[11] Welfare is measured as the weighted sum of worker utility ($\sum_{i=\ell,n} f_i U_i + g_i V_n(w_i) + h_i V_\ell(w_i)$), and is maximized by providing the largest benefits b possible. In a w_ℓ degenerate equilibrium, benefits rise with the tax rate, but the reverse holds true once a dispersed equilibrium emerges. Thus, the optimal tax is exactly when a dispersed equilibrium is about to emerge with $a^* = 1$, which is $\tau = 2.17\%$ under the calibrated parameters. In practice, the estimated $\tau = 2.56\%$ with its dispersed equilibrium reduces total welfare by only 0.49%. Shorter eligibility rules are also welfare improving, though the gains are exceptionally small for typical levels of γ. For instance, cutting the work requirement from 1 year to 1 month would only increase the maximum welfare by 0.52%.

5 Conclusion

The influence of unemployment insurance extends well beyond its distortions to individual search effort or duration. These well-understood worker responses in partial

[11] A self-sustaining UI system takes on the appearance of insurance, yet with risk neutral workers, the consumption smoothing provided by the UI system makes no contribution to utility. Rather, workers only care for the direct value of the benefits and the indirect effect on the wage distribution. Numerical solutions with risk averse workers produce qualitatively similar results.

equilibrium have a subtle yet powerful impact in general equilibrium. This paper identifies eligibility requirements as another innocuous feature of UI that creates distinction among otherwise identical workers. Firms anticipate the effect on reservation wages and use a wage posting strategy that targets either ineligible workers with a low wage or eligible workers with a higher wage. The search friction provides firms with local monopsony power, allowing them to obtain labor for less than its marginal product; at the same time, it creates wage dispersion among workers of identical productivity.

Our model is distinguished from prior literature in that wages are determined by posting rather than through Nash bargaining. This environment reverses the comparative statics with some rather surprising consequences. In particular, more generous benefits or more stringent eligibility requirements raise the wages received by ineligible workers, but lower them for the eligible workers. Our model also explains why more generous benefits can actually lower the unemployment rate, as empirically observed by Levine (1993).

These counterintuitive responses arise due to firms adjusting their price posting strategies: benefit size and time required for eligibility have a differential effect on eligible versus ineligible workers, with a stronger effect on the reservation wages of the former. To reach equilibrium, employers target eligible workers more heavily, a move that disproportionately assists the ineligible workers, who now have a greater chance of serendipitously being offered a job paying well above their reservation wage.

Ultimately, this invites careful empirical work on the response of market wages to changes in the eligibility requirements. The difficultly lies in finding a suitable natural experiment where the policy change is not motivated by changing macroeconomic conditions, and where program changes are economy-wide rather than targeted to subsets of the population. The nature of our predictions require a setting that captures the full equilibrium response, rather than focusing on the partial equilibrium adjustments of a subset of workers.

A Proofs

Algebraic manipulations can be verified in the online technical appendix, a Mathematica file found at `https://economics.byu.edu/Documents/Faculty/Brennan%20Platt/UIEligibilityTA.nb`.

Proof of Proposition 1. We begin with the steady state conditions. Eqs. 5 through 10 are simply a linear system of equations, one of which is co-linear with the others. Their unique solution yields Eqs. 15 through 20.

We next turn to the simplification of the Bellman Equations. First, Eq. 1 rearranges to $V_\ell(w) = \frac{w+\delta U_\ell}{\delta+\rho}$. This can then be substituted into Eq. 2, which then yields $V_n(w) = \frac{w+\delta U_\ell}{\delta+\rho} - \frac{\delta(U_\ell - U_n)}{\gamma+\delta+\rho}$.

Next, after substituting for the indifference condition $(1-\lambda)V_\ell(w_\ell)+\lambda V_n(w_\ell) = U_\ell$, Eq. 3 simplifies to $\rho U_\ell = b + x$. Likewise, $V_n(w_n) = U_n$ simplifies Eq. 4 to becomes $\rho U_n = x + \phi a(V_n(w_\ell) - U_n)$. Together with the solution for $V_n(w_\ell)$ above, these yield: $U_\ell = \frac{b+x}{\rho}$ and $U_n = \frac{b+x}{\rho} - \frac{(\gamma+\delta+\rho)(a\phi(b+x-w_\ell)+b(\delta+\rho))}{(\delta+\rho)(a\phi(\gamma+\rho)+\rho(\gamma+\delta+\rho))}$.

Returning to the indifference conditions, we can replace U_ℓ, U_n, $V_\ell(w)$, and $V_n(w)$ with the preceeding solutions. From $(1-\lambda)V_\ell(w_\ell) + \lambda V_n(w_\ell) = U_\ell$ we obtain w_ℓ in Eq. 13, and from $V_n(w_n) = U_n$ we obtain w_n in Eq. 14.

Finally, equilibrium profits simplify to those listed in Eqs. 21 and 22 once we substitute the solutions for w_ℓ, w_n, g_ℓ, g_n, h_ℓ, and h_n. The comparison of profits is a mere simplification of the three possibilities stated in the third equilibrium requirement. In the case of indifference, we solve for the a^* that equates profits.

Since these solutions are simply an equivalent expression of each equilibrium requirement, any equilibrium must take this form. □

Proof of Proposition 2. Define the difference in expected profits between offering w_ℓ and w_n as:

$$\Delta(a^*) \equiv \frac{\phi}{q^*} \cdot \left(\frac{b\delta\lambda(\delta+\rho)(\gamma+(\gamma+\delta\lambda+\rho)a^*)}{(\gamma+\delta\lambda+\rho)\phi a^* + \rho(\gamma+\delta+\rho)} - \gamma(p-b-x) \right), \tag{45}$$

which is merely $\Pi_\ell - \Pi_n$ after substituting for w_ℓ, w_n, f_ℓ, and f_n as functions of a. Note that $\Delta(a^*) = 0$ has a unique solution because, when placed over a common denominator, the numerator is linear in a^*. The w_ℓ degenerate equilibrium exists iff $\Delta(1) \geq 0$, and the w_n degenerate equilibrium exists iff $\Delta(0) \leq 0$.

Now suppose parameters are such that $\Delta(1) < 0 < \Delta(0)$; thus, neither degenerate equilibrium can occur. Since $\Delta(a)$ is a continuous function, by the intermediate value theorem, there exists an $a^* \in (0,1)$ such that $\Delta(a^*) = 0$. Note that $\Delta(1) < 0$ and $0 < \Delta(0)$ can rearrange as $p - x < b\left(1 + \frac{\delta\lambda}{\gamma} \cdot \frac{(\delta+\rho)(2\gamma+\delta\lambda+\rho)}{\phi(\gamma+\delta\lambda+\rho)+\rho(\gamma+\delta+\rho)}\right)$ and $p - x > b\left(1 + \frac{\delta\lambda(\delta+\rho)}{\rho(\gamma+\delta+\rho)}\right)$, respectively. Combining these, this case can only occur if:

$$b\left(1 + \frac{\delta\lambda}{\gamma} \cdot \frac{(\delta+\rho)(2\gamma+\delta\lambda+\rho)}{\phi(\gamma+\delta\lambda+\rho)+\rho(\gamma+\delta+\rho)}\right) > b\left(1 + \frac{\delta\lambda(\delta+\rho)}{\rho(\gamma+\delta+\rho)}\right),$$

which is equivalent to the condition in the proposition, $\gamma\phi < \rho(\gamma+\delta+\rho)$.

If $\Delta(1) > 0 > \Delta(0)$, both degenerate equilibria exist, and the intermediate value theorem ensures that $\Delta(a^*) = 0$ for some $a^* \in (0,1)$. Thus, all three equilibria exist.

Next, consider if $\Delta(1) = 0 > \Delta(0)$. In this case, $a^* = 1$ is the unique solution to $\Delta(a^*) = 0$, so the "dispersed equilibrium" coincides with the w_ℓ degenerate solution. Similarly, if $\Delta(1) > 0 = \Delta(0)$, the "dispersed equilibrium" coincides with the w_n degenerate solution. Thus in both cases, the dispersed equilibrium does not occur, but both degenerate equilibria do.

Note that $\Delta(1) \geq 0 \geq \Delta(0)$ can only occur if $\gamma\phi \geq \rho(\gamma+\delta+\rho)$. This is found simply by reversing the inequalities used above.

If $\Delta(1) = 0$ and $\Delta(0) = 0$, then we obtain $\gamma\phi = \rho(\gamma+\delta+\rho)$ from $\Delta(1) = \Delta(0)$. Furthermore, by substituting for λ, we find that $\Delta(a^*) = 0$ for all $a^* \in [0,1]$ so long as $p - x = b\left(1 + \frac{\delta\lambda(\delta+\rho)}{\rho(\gamma+\delta+\rho)}\right)$.

Suppose $\Delta(1) < 0$ and $\Delta(0) \leq 0$. Thus, the w_n degenerate equilibrium exists, while the w_ℓ degenerate equilibrium does not. We will also show that the dispersed equilibrium cannot. If $\gamma\phi < \rho(\gamma+\delta+\rho)$, then the numerator of Eq. 25 is positive.

Suppose there also exists an $a^* \in (0,1)$ such that $\Delta(a^*) = 0$. Because $\Delta(a)$ is continuous, this can occur in one of two ways. First, there could be two such solutions, one where $\Delta'(a) > 0$ and another where $\Delta'(a) < 0$. (One of these could be at $a = 0$ in the case where $\Delta(0) = 0$.) But above we say that the sign of $\Delta'(a)$ does not depend on a, so this cannot occur. Alternatively, it could be that there is only one such a^* and $\Delta'(a^*) = 0$. However, then $\Delta'(a) = 0$ for all a, including $a = 0$ and $a = 1$. This would require that $\Delta(1) = \Delta(0)$. So no dispersed equilibrium exists, nor does the w_ℓ degenerate equilibrium. Only the w_n degenerate equilibrium exists.

The same reasoning applies when $\Delta(1) \geq 0$ and $\Delta(0) > 0$. Again, no dispersed equilibrium exists, nor does the w_n degenerate equilibrium. Only the w_ℓ degenerate equilibrium exists.

$\square$

Proof of Comparative Statics. In a dispersed equilibrium, Equation 25 holds, which can be rearranged as:

$$p = x + b + \frac{b\delta\lambda(\delta+\rho)}{\rho} \cdot \frac{\gamma + a(\gamma+\delta\lambda+\rho)}{(\gamma+\delta\lambda+\rho)\phi a + \rho(\gamma+\delta+\rho)}. \tag{46}$$

Consider the derivative of a with respect to each parameter. If one only takes the derivative of the original Equation 25, its sign is not obvious because it requires a weighted comparison of p, x, and b. However, because this derivative was taken at the equilibrium value for a, we can then substitute for p using Equation 46. In each case, this eliminates p and x, allowing unambiguous signing of the comparative static.

Recall that $q^* = \gamma(\delta+\phi a^*)+(\delta+\phi)\delta\lambda a^*$, and let $m^* = (\gamma+\delta\lambda+\rho)\phi a^*+\rho(\gamma+\delta+\rho)$.

$$\begin{aligned}
\frac{\partial a^*}{\partial x} &= \frac{\gamma m^{*2}}{b\delta\lambda(\delta+\rho)(\gamma+\delta\lambda+\rho)(\gamma\phi-\rho(\gamma+\delta+\rho))} > 0 \\
\frac{\partial a^*}{\partial b} &= \frac{m^*}{b\delta\lambda(\gamma\phi-\rho(\gamma+\delta+\rho))(\gamma+\delta\lambda+\rho)} \cdot \left(\frac{\gamma m^*}{\delta+\rho} + \delta\lambda(a^*(\gamma+\delta\lambda+\rho)+\gamma)\right) > 0 \\
\frac{\partial a^*}{\partial \lambda} &= \frac{(\gamma+(\gamma+2\delta\lambda+\rho)a^*)(\gamma\phi a^*+\rho(\gamma+\delta+\rho)) + \left((1+a^*)\gamma\rho + a^*(\delta\lambda+\rho)^2\right)\phi a^*}{\lambda(\gamma+\delta\lambda+\rho)(\gamma\phi-\rho(\gamma+\delta+\rho))} < 0 \\
\frac{\partial a^*}{\partial \phi} &= -\frac{(\gamma+(\gamma+\delta\lambda+\rho)a^*)a^*}{\gamma\phi-\rho(\gamma+\delta+\rho)} < 0 \\
\frac{\partial a^*}{\partial \gamma} &= -\frac{\gamma(\phi a^*+\rho)(a^*(\gamma+\delta\lambda+\rho)+\gamma)+(\delta\lambda+\rho)a^* m^*}{\gamma(\gamma+\delta\lambda+\rho)(\gamma\phi-\rho(\gamma+\delta+\rho))} < 0.
\end{aligned}$$

Recall that multiple equilibria can occur iff $\gamma\phi > \rho(\gamma+\delta+\rho)$.

The remaining comparative statics employ the similar technique, yielding with respect to x:

$$
\begin{aligned}
\frac{\partial w_\ell^*}{\partial x} &= -\frac{\rho(\gamma+\delta+\rho)}{\gamma\phi-\rho(\gamma+\delta+\rho)} < 0 \\
\frac{\partial w_n^*}{\partial x} &= \frac{\gamma\phi(\gamma+\rho)}{\delta\lambda(\gamma\phi-\rho(\gamma+\delta+\rho))} + 1 > 0 \\
\frac{\partial \bar{w}^*}{\partial x} &= \frac{\gamma((\phi+\rho)(\gamma+\rho)+\rho\delta)}{\delta\lambda(\gamma\phi-\rho(\gamma+\delta+\rho))} + 1 > 0 \\
\frac{\partial \bar{u}^*}{\partial x} &= -\frac{\phi(\gamma+\delta\lambda)m^{*2}}{b\lambda(\delta+\rho)(\gamma+\delta\lambda+\rho)(\gamma\phi-\rho(\gamma+\delta+\rho))q^{*2}} < 0 \\
\frac{\partial \bar{\ell}^*}{\partial x} &= -\frac{m^{*2}}{b(\delta+\rho)(\gamma+\delta\lambda a^*)^2(\gamma+\delta\lambda+\rho)(\gamma\phi-\rho(\gamma+\delta+\rho))} < 0.
\end{aligned}
$$

With respect to b, the comparative statics are:

$$
\begin{aligned}
\frac{\partial w_\ell^*}{\partial b} &= -\frac{\gamma\rho+(\delta+\rho)(\delta\lambda+\rho)}{\gamma\phi-\rho(\gamma+\delta+\rho)} < 0 \\
\frac{\partial w_n^*}{\partial b} &= \frac{\gamma\left(\phi(\gamma+\delta\lambda+\rho)+\delta^2\lambda\right)}{\delta\lambda(\gamma\phi-\rho(\gamma+\delta+\rho))} > 0 \\
\frac{\partial \bar{w}^*}{\partial b} &= \frac{\gamma\left((\gamma+\rho)(\rho+\phi)+2\lambda\delta^2+\delta(\lambda\rho+\lambda\phi+\rho)\right)}{\delta\lambda(\gamma\phi-\rho(\gamma+\delta+\rho))} > 0 \\
\frac{\partial \bar{u}^*}{\partial b} &= -\frac{\delta\lambda(\delta+\rho)(a^*(\gamma+\delta\lambda+\rho)+\gamma)+\gamma m^*}{b\lambda(\delta+\rho)(\gamma+\delta\lambda+\rho)q^{*2}} \cdot \frac{\gamma\phi(\gamma+\delta\lambda)m^*}{\gamma\phi-\rho(\gamma+\delta+\rho)} < 0 \\
\frac{\partial \bar{\ell}^*}{\partial b} &= -\frac{\delta\lambda(\delta+\rho)(a^*(\gamma+\delta\lambda+\rho)+\gamma)+\gamma m^*}{b(\delta+\rho)(\delta\lambda a^*+\gamma)^2(\gamma+\delta\lambda+\rho)} \cdot \frac{\gamma m^*}{\gamma\phi-\rho(\gamma+\delta+\rho)} < 0.
\end{aligned}
$$

With respect to λ, the comparative statics are:

$$
\begin{aligned}
\frac{\partial w_\ell^*}{\partial \lambda} &= -\frac{b\delta(\delta+\rho)}{\gamma\phi-\rho(\gamma+\delta+\rho)} < 0 \\
\frac{\partial w_n^*}{\partial \lambda} &= \frac{b\phi(\gamma+\rho)(\delta+\rho)(\gamma+(\gamma+\delta\lambda+\rho)a^*)}{\lambda(\gamma\phi-\rho(\gamma+\delta+\rho))m^*} > 0 \\
\frac{\partial \bar{w}^*}{\partial \lambda} &= \frac{b(\delta+\rho)((\gamma+\rho)(\rho+\phi)+\rho\delta)(\gamma+(\gamma+\delta\lambda+\rho)a^*)}{\lambda(\gamma\phi-\rho(\gamma+\delta+\rho))m^*} > 0 \\
\frac{\partial \bar{u}^*}{\partial \lambda} &= -\frac{\gamma\delta\phi}{\lambda(\gamma+\delta\lambda+\rho)(\gamma\phi-\rho(\gamma+\delta+\rho))q^{*2}} \cdot \Big(a^*\delta\lambda(\phi(a^*(\delta\lambda+\rho)(\gamma+\delta\lambda+\rho)+\gamma\rho)) + \\
&\qquad ((a^*+1)(\gamma+\delta\lambda)+\rho a^*)(\gamma m^*+a^*\delta\lambda\rho(\gamma+\delta+\rho))\Big) < 0 \\
\frac{\partial \bar{\ell}^*}{\partial \lambda} &= -\frac{\gamma\delta\left((\gamma+\rho)(a^*(\gamma+\delta\lambda+\rho)+\gamma)\phi a^*+(\delta\lambda a^*+\gamma)m^*\right)}{(\delta\lambda a^*+\gamma)^2(\gamma+\delta\lambda+\rho)(\gamma\phi-\rho(\gamma+\delta+\rho))} < 0.
\end{aligned}
$$

With respect to ϕ, the comparative statics are:

$$\begin{aligned}
\frac{\partial w_\ell^*}{\partial \phi} &= \frac{b\delta\lambda(\delta+\rho)(\gamma+\delta\lambda+\rho)a^*}{(\gamma\phi-\rho(\gamma+\delta+\rho))m^*} > 0 \\
\frac{\partial w_n^*}{\partial \phi} &= -\frac{b(\gamma+\rho)(\delta+\rho)(\gamma+\delta\lambda+\rho)a^*}{(\gamma\phi-\rho(\gamma+\delta+\rho))m^*} < 0 \\
\frac{\partial \bar{w}^*}{\partial \phi} &= -\frac{b(2\gamma+\rho)(\delta+\rho)(\gamma+\delta\lambda+\rho)a^*}{(\gamma\phi-\rho(\gamma+\delta+\rho))m^*} < 0 \\
\frac{\partial \bar{u}^*}{\partial \phi} &= \frac{\delta(\gamma+\delta\lambda)(\rho(\gamma+\delta+\rho)(\gamma+\delta\lambda a^*)+\gamma(\gamma+\rho)\phi a^*)a^*}{(\gamma\phi-\rho(\gamma+\delta+\rho))q^{*2}} > 0 \\
\frac{\partial \bar{\ell}^*}{\partial \phi} &= \frac{\gamma\delta\lambda(\gamma+(\gamma+\delta\lambda+\rho)a^*)a^*}{(\delta\lambda a^*+\gamma)^2(\gamma\phi-\rho(\gamma+\delta+\rho))} > 0.
\end{aligned}$$

Finally, with respect to γ, the comparative statics are:

$$\begin{aligned}
\frac{\partial w_\ell^*}{\partial \gamma} &= \frac{b\delta\lambda(\delta+\rho)((\gamma+\delta\lambda+\rho)\phi a^*+\gamma\rho)}{\gamma(\gamma\phi-\rho(\gamma+\delta+\rho))m^*} > 0 \\
\frac{\partial w_n^*}{\partial \gamma} &= -\frac{b(\delta+\rho)(\gamma+\rho)}{\gamma m^*}\left(\frac{(\gamma+\delta\lambda+\rho)\phi a^*+\gamma\rho}{\gamma\phi-\rho(\gamma+\delta+\rho)}+\frac{\gamma}{\gamma+\rho}\right) < 0 \\
\frac{\partial \bar{w}^*}{\partial \gamma} &= -\frac{(b(\delta+\rho))\left(\frac{a^*(\gamma+\delta\lambda+\rho)(\gamma(\rho+\phi)+\rho(\delta+\rho+\phi))+\gamma\rho(2\gamma+\rho)}{\gamma\phi-\rho(\gamma+\delta+\rho)}+\gamma\right)}{\gamma m^*} < 0 \\
\frac{\partial \bar{u}^*}{\partial \gamma} &= \frac{1}{(\gamma+\delta\lambda+\rho)(\gamma\phi-\rho(\gamma+\delta+\rho))q^{*2}} \cdot \\
&\quad \Big(a^{*2}\delta\phi(\gamma+\delta\lambda+\rho)\left(\phi\left(\gamma^2+(\gamma+\delta\lambda)(\delta\lambda+\rho)\right)+\delta\lambda\rho(\gamma+\delta+\rho)\right)+ \\
&\quad a^*\gamma\delta\phi\left((\rho+\phi)\left((\gamma+\delta\lambda)^2+\delta\lambda\rho\right)+\rho^2(2\gamma+\delta+\rho)\right)+\gamma^2\delta\rho\phi(\gamma+\delta\lambda)\Big) > 0 \\
\frac{\partial \bar{\ell}^*}{\partial \gamma} &= \frac{\delta\lambda\left(\frac{(\gamma+(\gamma+\delta\lambda+\rho)a^*)((\gamma+\delta\lambda+\rho)\phi a^*+\gamma\rho)}{\gamma\phi-\rho(\gamma+\delta+\rho)}+\gamma a^*\right)}{(\delta\lambda a^*+\gamma)^2(\gamma+\delta\lambda+\rho)} > 0.
\end{aligned}$$

□

Proof of Proposition 3. In a dispersed equilibrium, $K_\ell = 0$ and therefore $\alpha = \frac{(\delta+\rho)k}{p-w_\ell}$.

Suppose that $u < v$. Therefore $\phi = A$ and $\alpha = A \cdot \frac{u}{v}$, or substituting for α, $v = uA \cdot \frac{p-w_\ell}{(\delta+\rho)k}$. After substituting for the dispersed equilibrium w_ℓ, this becomes $v = u \cdot \frac{\rho(p-x-b)(\gamma+\delta+\rho)-b(\delta+\rho)\delta\lambda}{(\delta+\rho)k(\rho(\gamma+\delta+\rho)-\gamma\phi)}$. Note that $u < v$ precisely when the inequality holds from the proposition.

Suppose instead that $u \geq v$. Therefore $\alpha = A$. Substituting for α and w_ℓ,

Table 2: **Comparative statics in Degenerate Equilibria**

		$\partial/\partial x$	$\partial/\partial b$	$\partial/\partial\lambda$	$\partial/\partial\phi$	$\partial/\partial\gamma$
High wage:	w_ℓ^*	$+$	$+$	$-$	$-$	$-$
Low wage:	w_n^*	$+$	$+^*$	$+$	$+$	$-$
Average offered wage:	$\bar{w}^*$	$+$	$+^*$	$-$	$-$	$-$
Unemployment rate:	$\bar{u}^*$	0	0	0	$-$	0
% unemp. who are eligible:	$\bar{\ell}^*$	0	0	$-$	0	$+$

Notes: Table reports the signs of each comparative static assuming a w_ℓ degenerate equilibrium. The w_n degenerate equilibrium produces the same signs except those marked with $*$. The comparative static of $\frac{\partial w_n^*}{\partial b}$ assumes $(\gamma + \delta\lambda + \rho)\phi > \gamma\delta$, and would reverse otherwise.

this becomes $\frac{(\delta+\rho)k(\rho(\gamma+\delta+\rho)-\gamma\phi)}{\rho(p-x-b)(\gamma+\delta+\rho)-b(\delta+\rho)\delta\lambda} = A$. We then insert $\phi = A \cdot \frac{v}{u}$, obtaining $v = u \cdot \frac{\rho(p-x-b)(\gamma+\delta+\rho)-b(\delta+\rho)\delta\lambda}{(\delta+\rho)k(\rho(\gamma+\delta+\rho)-\gamma\phi)}$. Again, $v \geq u$ holds precisely when the inequality from the proposition does not. $\square$

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