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Unemployment Insurance and the Uninsured

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Abstract

Under federal-state law workers who quit a job are not entitled to receive unemployment insurance benefits. To show how the existence of the uninsured affects wages and employment, I extend an equilibrium search model to account for two types of unemployed workers: those who are currently receiving unemployment benefits and for whom an increase in unemployment benefits reduces the incentive to work, and those who are currently not insured. For these, work provides an added value in the form of future eligibility, and an increase in unemployment benefits increases their willingness to work. Incorporating both types into a search model permits me to solve analytically for the endogenous wage dispersion and insurance rate in the economy. I show that, in general equilibrium when firms adjust their job creation margin, the wage dispersion is reduced and the overall effect of benefits can be signed: higher unemployment benefits increase average wages and decrease the vacancy-to-unemployment ratio.

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1 Introduction

The empirical literature on unemployment insurance has stressed the disincentive to work that unemployment benefits provide. Meyer (1990) discusses the effect on prolonged unemployment spells, Cullen and Gruber (2000) show the reduction in spousal labor supply and Feldstein (1978) points to the increase in temporary layoffs.[1] The concern in these is that the increase in the value of unemployment will tilt the decision of the marginal worker to opt for the higher paid unemployment. Raising unemployment benefits reduces labor supply or, alternatively, increases the wages workers demand.

However, unemployment insurance (UI) also affects the unemployed who are not insured or ineligible. New entrants to the labor force, unemployed who have exhausted their benefits, unemployed who had unstable employment, and re-entrants to the labor force constitute more than half of the unemployed and are all nonrecipients of benefits.[2] For them, work has an added value in the form of future eligibility and unemployment benefits rents. Work by Green and Riddell (1993) and Levine (1993) suggest that this is not simply a theoretical curiosity. In the first case, disentitlement of the elderly from UI resulted in their withdrawal from the labor force.[3] In the second case, an increase in benefits was shown to reduce the unemployment duration of the uninsured.[4]

Given the two opposing incentive effects of UI on eligible and ineligible unemployed, and given that the ineligible constitute the larger share of the unemployed, what is the total effect of unemployment benefits on wages, layoffs, and unemployment? Mortensen (1977) pointed out these two opposite incentive effects of UI and analyzed the differential job search of the two types. His analysis considered only the labor supply decision and concluded that "the predicted

[1] See also Topel (1983) for the effects on layoffs and Krueger and Meyer (2002) for a survey of labor supply effects of unemployment insurance.

[2] Blank and Card (1991) estimate the fraction unemployed who are ineligible to be 0.57. See also Anderson and Meyer (1997).

[3] The authors focus on adverse selection issues, but in fact their evidence is very relevant here, as the removal of benefits reduced the value of employment, which resulted in the subsequent decline in labor supply.

[4] Levine attributes this to the substitution between the insured and the uninsured. Given the increased benefits, the search of the insured decreases and facilitates job finding by the uninsured. However, his hypothesis is observationally equivalent to the one posed here, that the uninsured search harder (and are more likely to work) because of the added value in employment.

sign of the effect of an increase in benefits on unemployment duration is ambiguous."[5] Recently Krueger and Meyer (2002) restated the ambiguity result and suggested general equilibrium could possibly magnify the adverse employment effects of UI.

Here I show that neither of these conjectures is robust to general equilibrium. By integrating the two effects into a general equilibrium search model á la Diamond-Mortensen-Pissarides (Diamond 1982, Mortensen and Pissarides 1994, Pissarides 2000) I trace the differential effects of UI on the two groups and show that while the differential effect still exists in general equilibrium, it is muted due to a form of cross-subsidization. I also find that the total effect is not ambiguous and is the one found by the empirical literature: increasing generosity of UI increases wages and unemployment. An additional outcome of the analysis is the derived rate of insurance in the economy. Since workers who are eligible for UI tend to have longer unemployment durations, they are disproportionately represented among the unemployed.

The driving force creating wage dispersion is that benefit eligibility determines the Nash wage outcome. Given complete contracts, negotiators' bargaining positions are determined by their initial conditions.[6] Eligible negotiators are entitled to benefits and can bargain to a higher wage. This is the "pure entitlement" effect, which ineligible negotiators lack. When bargaining takes place over future flows, an additional "*future* entitlement" effect comes into play. Ineligible negotiators experience an additional gain from work in the form of future UI entitlement and are therefore willing to accept even lower wages.[7]

When the two unemployed types coexist, the differential effects are reduced. A searching firm expects to meet an average type of worker. If a worker who demands lower wages is actually matched, the firm experiences a gain relative to its expectations. Sharing these gains with the low wage worker increases his wage somewhat but leaves the overall effect of benefits on his wages negative.

The *total* (or average or expected) effects of benefits on wages and employment, turn out to

[5] Mortensen (1977) pg. 506.

[6] These are the only relevant payoffs in case of disagreement.

[7] While the analysis takes up the Nash solution to wages, it is not crucial for the results. Directed search would give the same dependency of wages on unemployment values. The main difference is that the cross-subsidization result below disappears.

be the standard ones.[8] The effect of increasing benefits sums up to the pure entitlement effect on the insured group. In a steady-state equilibrium, the wage differences across the two types are achieved through cross-subsidization between the groups. The only "real" effect of benefit increase is that expected wages increase in proportion to the expected benefit collection, which depends on the size of the insured group.

This increase in expected wages is accompanied by a decline in market tightness. Taking into account this general equilibrium effect of deteriorating market tightness tends to reduce the wages of both types, reducing the wages of the uninsured even further and mitigating the wage increase of the insured.

U.S. unemployment policy provides a strong case for the analysis. Under the federal-state UI program, unemployment benefits are provided to qualified workers who are unemployed *through no fault of their own*. An unemployed worker is eligible for benefits if he was laid off, but not if he quit or was fired. Insurance is conditional on it being the firm's decision to separate. The model uses this conditional feature of U.S. policy to distinguish between those who are eligible (unemployed who were laid off) and those who are ineligible (unemployed who quit their job).[9]

I first present the extension of the basic search model to two types of unemployed workers and explore the sources of the differential effects of unemployment benefits on wages, the total (average or expected) effects and the general equilibrium effects. To see the actual incentive effect, Section 3 introduces heterogeneous productivity and accordingly allows workers to decide on an entry productivity. The lower wage of uninsured workers translates to their willingness to work for lower productivities, leaving the pool of unemployed with a higher insurance rate. In section 4 I calibrate the model and find that the wage gap between the insured and the uninsured is around 3%, and that market tightness is responsive to an increase in benefits, while wages are not. Section 5 concludes.

[8] These are the average wages of workers in the economy, which are the wages a firm opening a vacancy expects to pay.

[9] Albrecht and Vroman (2005) use the limited duration of unemployment benefits to justify equilibrium wage dispersion similarly.

2 Simple Two-Type Model

2.1 Model

I extend a standard search model (Pissarides 2000) to allow for two types of unemployed: those currently receiving unemployment benefits and those who are not currently covered. The unemployment eligibility status depends on how job separation and the fall into unemployment occurred. If separation occurred because the worker quit, he is subsequently not eligible for UI. If the fall into unemployment was caused by the firm's decision to lay off the worker, then the unemployed is eligible. The contract is completely specified at the time of engagement. This pins down the original disagreement point as the only one relevant to surplus sharing. Search frictions create quasi rents that can be split with both types, allowing for two wages to coexist. Initially I consider a model where job take up is exogenous.

Time is continuous. There is a measure one of workers and a larger measure of firms, both risk neutral. Let $u_0 + u_1$ be the measure of unemployed workers, where u_0 is the measure of the unemployed who are not receiving benefits, and u_1 is the measure of UI recipients. Denote by $\widehat{u}_0 = \frac{u_0}{u_0+u_1}$ the fraction of nonrecipients among the unemployed. The measure of vacant firms is denoted by v , and the market tightness is defined as $\theta = \frac{v}{u_0+u_1}$. Assume workers and firms meet via a constant returns-to-scale matching technology, where the rate of job matches per unit of time is given by $m(u_0 + u_1, v)$. The rate at which vacant firms meet workers is then $q(\theta) \equiv m(u_0 + u_1, v)/v$, and the rate at which workers find jobs is $\theta q(\theta)$. Note that, in this specification, search is not directed. When a firm decides to open a vacancy, it incurs a flow search cost γ_0 while looking for a worker.

When a worker and a firm meet, they can jointly produce y. Upon being matched, the uninsured negotiate a wage contract w_0, and the insured negotiate a wage contract w_1. These wages are the Nash solutions to the bargaining problems over the present discounted value of future flows where the bargaining power of workers is given by $0 < \beta < 1$. Since it will turn out that $w_1 > w_0$, I will also use the terms "high wage" and "low wage."

Productivity is subject to bad shocks which arrive at a Poisson rate of λ and are followed by layoffs, after which the discharged worker is eligible for a flow unemployment benefit of z.

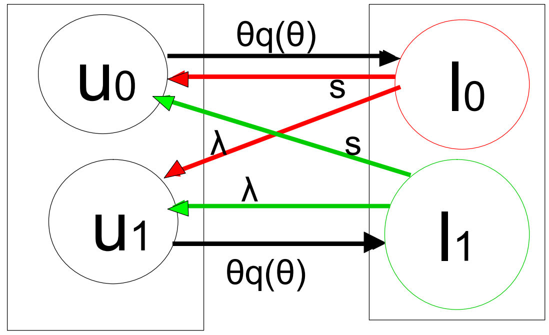

Figure 1: Flows

For now, assume that $y > z$ so that it is always jointly efficient to produce. There is also an exogenous probability of workers quitting at a Poisson rate of s, after which the ex-worker is not covered by UI since the separation was his fault. Figure 1 illustrates the flow of workers in and out of the four different states, where l_0 denotes the fraction of the labor force who are employed at low wages and l_1 denotes the fraction who are employed at high wages.

Denote by J^{ji} the present discounted value of being in state ji, where $j \in \{U, E, V, F\} \equiv \{Unemployed, Employed, Vacant, Filled\}$ and $i \in \{0, 1\} \equiv \{Uninsured, Insured\}$, indicates the eligibility status. When joint production occurs, these values depend on the realized level of production, y. Firms' values possibly differ depending on whether they match with an uninsured or an insured worker ($J^{E0}(y)$ or $J^{E1}(y)$), since the bargaining position of an insured worker is more powerful than the bargaining position of an uninsured worker. The value of a vacant firm, however, is simply J^V. The values for a worker are similarly J^{U0}, J^{U1} , $J^{E0}(y)$, and $J^{E1}(y)$.

The economy can be described by a series of Bellman equations.A vacant firm incurs the flow cost of opening a vacancy $-\gamma_0$, and finds a match at the rate $q(\theta)$. Since search is not directed, with probability $\widehat{u}_0$ the worker is not receiving insurance, and hence the firm transitions to have a value of $J^{F0}(y)$; alternatively, the firm meets an insured unemployed worker and transitions to have a value of $J^{F1}(y)$,

$$rJ^V = -\gamma_0 + q(\theta)[\widehat{u}_0(J^{F0}(y) - J^V) + (1 - \widehat{u}_0)(J^{F1}(y) - J^V)]. \tag{1}$$

A filled firm that employs a previously uninsured worker gets a flow of $y - w_0$, and is either hit by a productivity shock λ or by a taste/relocation shock s for the worker. In both cases, the relationship is destroyed and the firm returns to its vacant state. If the firm employs a previously insured worker, I simply adjust the wages contracted to be w_1 and the firm value which reflects this change is J^{F1}. Therefore, the values of a firm with a filled position are, for $i = 0, 1$:

$$rJ^{Fi}(y) = y - w_i + \lambda[J^V - J^{Fi}(y)] + s[J^V - J^{Fi}(y)]. \tag{2}$$

I can similarly describe the worker's value in each state. When a worker is unemployed and not eligible for UI, his flow value is simply the expected gain from future matches. He will meet a firm at a rate of $\theta q(\theta)$, at which point he'll switch to have value $J^{E0}(y)$. An insured worker in addition receives a flow z while unemployed. For $i = 0, 1$ the unemployed values are given by

$$rJ^{Ui} = zi + \theta q(\theta)(J^{Ei}(y) - J^{Ui}). \tag{3}$$

Once a worker of previous status i is matched with a firm, he earns the flow negotiated wage w_i and can separate from a firm for two reasons. Either a shock hits the firm (λ), or he quits through his own fault (s),

$$rJ^{Ei}(y) = w_i + \lambda[J^{U1} - J^{Ei}(y)] + s[J^{U0} - J^{Ei}(y)]. \tag{4}$$

Note in equation (4) that whether a worker was eligible or not for benefits, he might be subject to a shock λ in which case he'll be laid off and consequently receive unemployment benefits, transitioning to state J^{U1}; or hemight become ineligible if he gets hit by a shock s which forces him to quit and move to state J^{U0} . These future deviations from the original bargaining positions will be taken into account in the subsequent Nash bargain, resulting in the "future entitlement" effects I will soon discuss.

The free entry condition for firms is given by

$$J^V = 0. \tag{5}$$

Wage determination is given by the Nash bargaining solution over the match surplus. The worker's share of the match surplus is given by (for $i = 0, 1$)

$$J^{Ei}(y) - J^{Ui} = \beta(J^{Fi}(y) - J^V + J^{Ei}(y) - J^{Ui}) = \frac{\beta}{1-\beta}(J^{Fi}(y) - J^V). \tag{6}$$

In addition, in a steady-state equilibrium, the following flow equations must hold. The flows into and out of uninsured unemployment must be equal; that is,

$$u_0\theta q(\theta) = (1 - u_0 - u_1)s. \tag{7}$$

The flows into and out of insured unemployment must be equal,

$$u_1\theta q(\theta) = (1 - u_0 - u_1)\lambda. \tag{8}$$

The flow into and out of low wage employment must be equal,

$$u_0\theta q(\theta) = l_0(s + \lambda). \tag{9}$$

These equations are the extension of the Beveridge curve to the two-type (four states) environment.

2.2 Equilibrium: Definition and Characterization

In this section I define and solve for the equilibrium and prove an existence and uniqueness result. In discussing the equations which describe the equilibrium, I show that a wage gap exists between insured and uninsured workers. This wage gap, which exists because of UI benefits, is discounted by the expected duration of unemployment, and hence negatively related to equilibrium market tightness. I also show that individual wages take into account future deviations from current eligibility status. Insured workers face the risk of losing their eligibility if they quit their job in the future. Hence, they are compensated in advance for this contingency. Uninsured workers take a wage cut to reflect the benefit of future eligibility which the current job provides. I further show that the wage differential is reduced by cross subsidization.

A steady-state equilibrium is a solution to the wages, the flow variables, and the state values $\{w_0,\, w_1,\, \widehat{u}_0,\, \theta,\, u_0,\, u_1,\, l_0,\, v\} \cup \{J^{ji}\}$ satisfying

(i) the flow equations (7) to (9)

(ii) the Bellman equations (1) to (4)

(iii) the free entry condition (5), and

(iv) the wage equations (6).

The equilibrium can be characterized as follows (see Figure 2). Define the average (or expected) wages in the economy as $Ew \equiv \widehat{u}_0 w_0 + (1 - \widehat{u}_0) w_1$. Then equilibrium and average wages are given by the intersection of two curves: the creation curve and the expected wages curve. The equilibrium differential wages w_0 and w_1 are then calculated using the equilibrium market tightness. Consider first the creation curve[10],

$$Ew = y - (r + \lambda + s)\frac{\gamma_0}{q(\theta)}. \tag{10}$$

This can also be thought of as the free entry condition. For expected profits to be zero, the expected wage bill must be equal to productivity minus flow search costs. As search costs increase when there are many firms (high market tightness), the expected wages must be lower. Thus, the creation curve is downward sloping in (θ, Ew) space, and it can be interpreted as a labor demand curve.

The second equilibrium equation is derived in steps. First, the two individual wage equations are the solution to the Nash bargaining problem, and next the two wage equations are combined as a weighted average to give the expected wage curve.

The two individual wage equations are derived from the Nash solution using the above

[10] Plugging (5) into (1), and replacing $J^{Fi}(y)$ from (2).

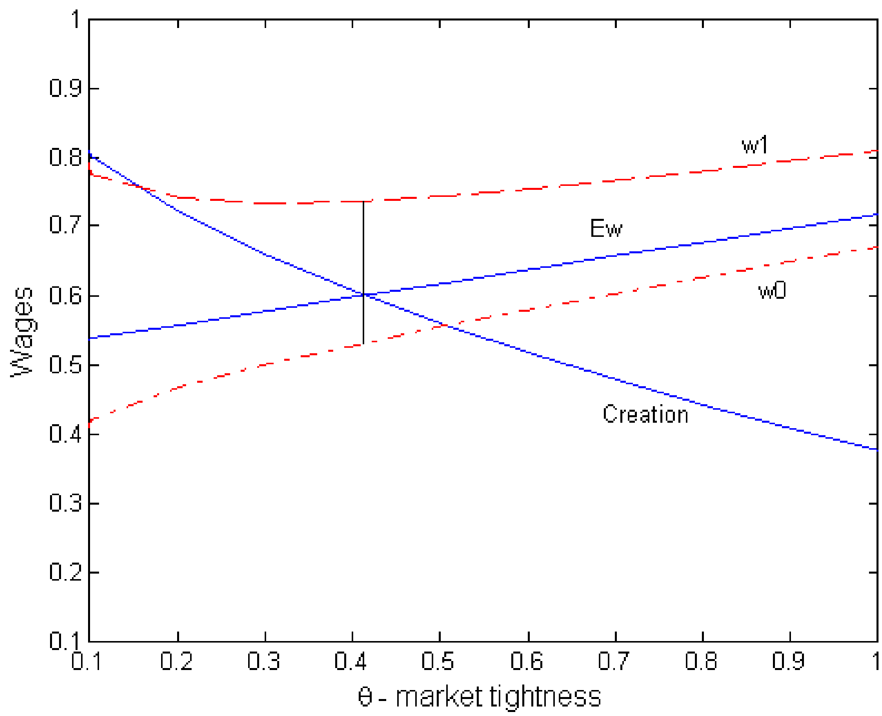

Figure 2: Equilibrium

creation curve (10).[11]

$$w_0(y) = \beta y + (1-\beta) r J^{U0} - \lambda(1-\beta)(J^{U1} - J^{U0}) \tag{11}$$

$$= \beta[y + \gamma_0\theta + (1-\widehat{u}_0)\frac{(1-\beta)\theta q(\theta)}{r+\beta\theta q(\theta)} z] - \lambda(1-\beta)\frac{z}{r+\beta\theta q(\theta)} \tag{12}$$

$$w_1(y) = \beta y + (1-\beta) r J^{U1} + s(1-\beta)(J^{U1} - J^{U0}) \tag{13}$$

$$= \beta[y + \gamma_0\theta - \widehat{u}_0\frac{(1-\beta)\theta q(\theta)}{r+\beta\theta q(\theta)} z] + (1-\beta)z + s(1-\beta)\frac{z}{r+\beta\theta q(\theta)}. \tag{14}$$

These equations dissect the various components of wages and trace the ways in which workers' eligibility for UI affects wages directly and indirectly. I identify a direct entitlement and future entitlement effect, an external pecuniary effect through the size of the insurance market, and an additional general equilibrium effect through market tightness, the last of which I discuss in the next section.

Consider first the direct effect of UI. If all workers were always insured, the standard wage solution would be $w = z + \beta(y + \gamma_0\theta - z)$, which prescribes workers with a share β of surplus above their entitlement to benefits, z.[12] Here, each worker receives a fraction β of the surplus from production relative to his *current* insurance position. Hence, future deviations from the current position are taken into account and corrected for. I call these corrections the *future entitlement effect*.

To see these, inspect first the wage of the uninsured (11). The usual Nash bargaining terms $\beta y + (1-\beta) r J^{U0}$ correspond to the worker's share from flow output above his bargaining position. The additional term $-\lambda(1-\beta)(J^{U1} - J^{U0})$ corrects for future receipt of benefits, which are beyond the worker's entitlement given his current bargaining position. There's a probability rate of λ that the firm will lay him off, and he'll end up unemployed and insured. He needs to pay the firm a share of $1-\beta$ from this gain in advance, through lower wages. This is the future entitlement effect. Note that the wage of the insured, w_1, has a similar future entitlement effect, $+s(1-\beta)(J^{U1} - J^{U0})$, which is working in the opposite direction. An insured worker

[11] Using (6) , (4) and (2) I get $w(y) = \beta y + (1-\beta) r J^{U} - \lambda(1-\beta)(J^{U1} - J^{U})$. The unemployment values substituted into this equation are found by replacing (2) into (3) and using the creation equation (10) to replace $y - w_0$. The process is similar for w_1.

[12] Recall that the monetary utility from being unemployed was normalized to zero.

is entitled to his unemployment benefits, but might lose them if he quits at the rate s. He is compensated in advance for this contingency by having his wages increase further, above the standard entitlement (or bargaining position) effect of $(1-\beta)z$.

Apart from the entitlement and future entitlement effects, there is yet another direct impact of benefits on wages, through a pecuniary externality, whereby the insured and uninsured cross-subsidize each other. This arises because a firm opens up a vacancy expecting to pay an average wage, but ends up paying an uninsured worker (for instance) a lower wage. The firm's gain from paying lower wages than expected is shared with the (uninsured) worker, thus increasing his wages slightly, in proportion with the fraction who are insured, $(1-\widehat{u}_0)$. When the creation relation is replaced in the unemployment values and then substituted into the wage equations (12) and (14), I can track down this effect resulting from the existence of the two worker-types together. The uninsured experience a gain of $\beta(1-\widehat{u}_0)\frac{(1-\beta)\theta q(\theta)}{r+\beta\theta q(\theta)}z$, while the insured have their wages adjusted by $-\beta\widehat{u}_0\frac{(1-\beta)\theta q(\theta)}{r+\beta\theta q(\theta)}z$.

It is also useful at this stage to consider the wage gap, Δw, between workers who were previously UI recipients and those who were not eligible. It is given by

$$\begin{aligned} \Delta w &\equiv w_1(y) - w_0(y) \\ &= \frac{(1-\beta)(r+\lambda+s)z}{r+\beta\theta q(\theta)}. \end{aligned} \tag{15}$$

Benefits, z, are the reason the wage gap exists in the first place. The wage bargain gives insured workers a share $1-\beta$ of these benefits to correct for future changes in worker status and the consequent loss of $(1-\beta)z$ to employers. The present value of this share of benefits is discounted by $r+\beta\theta q(\theta)$. Effectively the wage gap decreases as vacancies increase. The reason is that higher vacancies imply a higher exit rate from unemployment, so that the gains from benefits are given for a shorter period of time.

The second equilibrium equation, the expected wage equation, is derived as the average of the two individual wage equations (12) and (14),

$$\begin{aligned} Ew &\equiv \widehat{u}_0 w_0(y) + (1-\widehat{u}_0) w_1(y) \\ &= \beta(y+\gamma_0\theta) + (1-\widehat{u}_0)(1-\beta)z + (1-\beta)\frac{z}{r+\beta\theta q(\theta)}[(1-\widehat{u}_0)s - \widehat{u}_0\lambda]. \end{aligned} \tag{16}$$

The expected wage equation has three terms. The first is the usual share β of employment gain $(y+\gamma_0\theta)$. The second term arises from the worker's entitlement to benefits z but only by the fraction of unemployed who are actually entitled to it, $(1-\widehat{u}_0)$. The last term keeps track of the wage corrections due to expected deviations from the initial bargaining position. Below I show that when separations are exogenous, this last term disappears.

To solve for the insurance rate, $\widehat{u}_0$, I use two of the steady-state flow equations. From (7) and (8) I find

$$\widehat{u}_0 = \frac{s}{\lambda+s},$$

or,

$$\lambda\widehat{u}_0 = s(1-\widehat{u}_0). \tag{17}$$

A steady-state equilibrium requires the measure of uninsured who later become insured to be equal to the measure of insured who later become uninsured.

Plugging this relationship into the expected wage equation (16) eliminates the last term. The corrections for future deviations from the initial bargaining position are washed out across the two groups. This also implies that the expected wage curve is unambiguously increasing in market tightness, $Ew = \beta(y+\gamma_0\theta) + (1-\widehat{u}_0)(1-\beta)z$.

The creation equation (10), the expected wage equation (16), and the equation for steady-state flows (17), solve for the market tightness and average wages in the economy, (θ, Ew). To provide a complete solution I need to solve further for u_0 and u_1. Using the last steady-state equation (9) I get

$$u_0 = \frac{s}{\theta q(\theta)+\lambda+s}$$

and

$$u_1 = u_0 \frac{\lambda}{s} = \frac{\lambda}{\theta q(\theta) + \lambda + s}.$$

Note that the solution for the insurance rate, $\widehat{u}_0 = \frac{s}{\lambda + s}$, is solely determined by the exogenous rates of separations. When I extend the model in the next section to allow for workers' entry decisions I will endogenize this insurance rate of the unemployed.

Using the solution for $\widehat{u}_0$, I can now write the second equilibrium equation, the expected wage equation, as

$$Ew = \beta(y + \gamma_0 \theta) + \frac{\lambda}{\lambda + s}(1 - \beta)z. \tag{18}$$

Thus the equilibrium conditions are reduced to two equations, (10) and (18), and the following existence result can be proved:

Proposition 1 *An equilibrium exists if* $y > \frac{\lambda}{s+\lambda} z$ *and it is unique.*

Proof. An equilibrium exists if there is a solution to the creation (10) and expected wage equation (18). Substituting out Ew, an equilibrium exists if there is a solution to $\beta \gamma_0 \theta + (r + \lambda + s)\frac{\gamma_0}{q(\theta)} = (1 - \beta)(y - \frac{\lambda}{\lambda + s} z)$. Since the $F(\theta) \equiv \beta \gamma_0 \theta + (r + \lambda + s)\frac{\gamma_0}{q(\theta)}$ is positive and increasing in θ and has $\lim_{\theta \to 0} F(\theta) = 0$ and $\lim_{\theta \to \infty} F(\theta) = \infty$, there exists a unique solution for θ as long as $y - \frac{\lambda}{\lambda + s} z > 0$. Uniqueness of the equilibrium follows since the rest of the equilibrium variables are uniquely determined from θ. ■

2.3 Results: Total and Differential Effects of Benefits

Introducing a system of partial UI creates wage dispersion and has aggregate effects on average wages, market tightness, and the derived unemployment rate. This section provides the relevant comparative static results on the effect of benefits, and proves the main results.

Since equilibrium is determined by the market tightness and the average wages in the market, this is the natural starting point:

Proposition 2 *The total effect of benefits on expected wages and market tightness*

(*i*) *Expected wages increase with benefits.*

(*ii*) *Market tightness decreases with benefits.*

Proof. See appendix. ■

Even in the presence of the uninsured, the standard aggregate results hold. Benefits have a positive effect on the average wage and a negative effect on market tightness. Although the uninsured are willing to accept lower wages in the current match, their loss is more than compensated for by the gains of the insured. This is intuitively true since the reason for current lower wages is the expectation of future gains from the insurance system. So overall, workers can expect to have higher wages. In this exogenous separation case the wage adjustments due to future deviations from current eligibility status are exactly washed out across the two groups. The overall expected wage gain is proportional to the fraction of unemployed workers who are insured, $(1 - \widehat{u}_0)$. Since this leaves the firm with lower profits, the creation margin suffers, with a smaller relative number of firms entering the market or a lower market tightness.

Since higher benefits decrease the equilibrium ratio of vacancies to unemployment, matching becomes slower for workers, and they can expect to have longer unemployment spells. The next result formally shows that,

Proposition 3 *Unemployment increases with benefits.*

Proof. Solving for l_0 and l_1, the ratio of unemployment to employment is[13]

$$\frac{U}{E} = \frac{u_0 + u_1}{l_0 + l_1} = \frac{u_0}{l_0} = \frac{s + \lambda}{\theta q(\theta)}.$$

By Proposition 2 $d\theta/dz < 0$, and since $d(\theta q(\theta))/d\theta > 0$ by the assumption on the matching technology, the result follows. ■

However, the partial UI system does introduce new differentials between the insured and the uninsured. First is the wage gap:

Proposition 4 *Benefits increase the wage gap.*

13

$$\begin{aligned} l_0 &= \frac{u\theta q(\theta)}{s + \lambda} = \widehat{u}_0 \frac{\theta q(\theta)}{\theta q(\theta) + \lambda + s} \\ l_1 &= l\frac{\lambda}{s} = (1 - \widehat{u}_0)\frac{\theta q(\theta)}{\theta q(\theta) + \lambda + s} \end{aligned}$$

Proof. See appendix. ■

Recall that the wage gap is driven by the discounted present value of benefits which insured workers have, $\Delta w = \frac{(1-\beta)(r+\lambda+s)z}{r+\beta\theta q(\theta)}$. An increase in benefits, z, directly increases the wage gap, and this increase is magnified through the lower creation margin (that is, θ is lower). A multiplier effect exists because a lower vacancy-to-unemployment rate means that the unemployed workers have a harder time matching with firms, will stay unemployed longer, and thus will enjoy the gains from UI benefits longer. The gain to the insured is therefore enhanced by the market tightness response.

Since benefits increase both the average wage and the wage gap, the following corollary results:

Corollary 1 *Benefits increase the wages of the insured.*

Higher benefits increase the wage of the insured directly through the higher bargaining position of workers (or the "entitlement effect"). However, there is an additional effect through lower market tightness. The corollary states that the complex contribution of the lower matching rate $\theta q(\theta)$ does not overturn the initial wage increase.

Finally, the effects of benefits on the wages of the uninsured are:

Proposition 5 *Benefits decrease the wages of the uninsured.*

Proof. See appendix. ■

An increase in UI directly decreases the wages uninsured workers get. While their bargaining position is not affected by the increase in benefits, they stand to gain higher unemployment benefits when they will be laid off in the future. In the bargaining outcome, this future gain is deducted from their wage, since currently they are not entitled to any benefits. In other words, workers are willing to take lower wages because of the prospects of future insurance.

Think of the wage curves as the wages workers demand for a given labor supplied.[14] In other words, the wage equations are the labor supply curves. If higher unemployment benefits

[14] This is a natural interpretation when the creation equation is not substituted into the wage equation, as it is done in the appendix.

reduce the wage demanded by the uninsured, they are in fact willing to work for lower wages. Their incentive to work has increased. Adding an entry decision permits workers to change their behavior in response to changes in market conditions. I can then explicitly talk about the differential incentive effects of UI and derive an endogenous rate of insurance.

3 Endogenous Entry Decision

In the simple model above, workers didn't make any employment decisions since productivity was such that they always preferred working to unemployment. Since workers didn't make any work decision, all effects went through the wage bargain and the adjustment of creation by firms. To be able to speak about an incentive effect, workers must be given a choice to make. I do this by introducing a stochastic matching productivity, and the worker's entry decision or his reservation wage.[15]

Adding stochastic productivity and an entry decision produces two more worthwhile results. First, the economy's insurance rate is now endogenous. In the steady state, the fraction of insured out of the unemployed ($\widehat{u}_0$) is not simply the exogenous rate of quits to total separations ($\frac{s}{s+\lambda}$) as before, but is determined in equilibrium through both types' decision to enter the employment relationship. This takes away the convenient but artificial feature of the previous model where the wage compensations across the two groups disappear. Also, adding uncertainty to the model introduces an amplification of the wage/entry gap through a term resembling an option value. I discuss this later. Note that the entry decision can also be interpreted as a search decision, whereby a worker can decide to prolong search and unemployment duration.[16]

I now extend the model to allow for stochastic job matches. Productivity y is realized after the match is made, and then the worker decides whether to continue searching or to take up employment (his decision also corresponds to the firm's decision). Since a worker's value increases with productivity, this decision defines entry productivities (or reservation productivities) R_0 for the uninsured and R_1 for the insured.

[15] Similar results are obtained when the layoff decision is endogenized, that is, when a worker-firm pair decides when to dissolve a match due to low productivity.

[16] However, the results are different if a search intensity choice is added to the model, in which case the worker's choice must be made prior to meeting a firm and before the worker's and the firm's interests are aligned.

Formally I introduce the two entry conditions (for $i = 0, 1$)

$$J^{Ei}(R_i) = J^{Ui} \tag{19}$$

and modify all employment values and wages to depend on productivity and all unemployment values to incorporate the appropriate expectation given the decision variables R_i.

The Bellman equation for a vacant firm is

$$rJ^V = -\gamma_0 + q(\theta)\left[\widehat{u}_0 \int_{R_0}^{\overline{y}} (J^{F0}(s) - J^V)dF(s) + (1 - \widehat{u}_0)\int_{R_1}^{\overline{y}} (J^{F1}(s) - J^V)dF(s)\right]. \tag{20}$$

The profits $J^{Fi}(y) - J^V$ now depend on the realized productivity, y, for all matches that proceed to the production phase, $y \in [R_i, \overline{y}]$.

The value for a firm employing a previously uninsured worker ($i = 0$) or previously insured worker ($i = 1$) also depends on realized productivity, y,

$$rJ^{Fi}(y) = y - w_i(y) + \lambda\left[J^V - J^{Fi}(y)\right] + s[J^V - J^{Fi}(y)]. \tag{21}$$

Similarly for workers, the value for an unemployed worker depends on his eligibility status $i = 0, 1$ and his expected gains from future employment,

$$rJ^{Ui} = zi + \theta q(\theta)\int_{R_i}^{\overline{y}} (J^{Ei}(s) - J^{Ui})dF(s). \tag{22}$$

The value for an employed worker again depends on his previous insurance status, $i = 0, 1$ and the realized productivity, y,

$$rJ^{Ei}(y) = w_i(y) + \lambda[J^{U1} - J^{Ei}(y)] + s[J^{U0} - J^{Ei}(y)]. \tag{23}$$

The wage bargaining solutions satisfy

$$J^{Ei}(y) - J^{Ui} = \beta(J^{Fi}(y) - J^V + J^{Ei}(y) - J^{Ui}) = \frac{\beta}{1-\beta}(J^{Fi}(y) - J^V),$$

with θ and $\widehat{u}_0$ defined as before.

The flow equations are also modified (see Figure 3). Now the flows out of unemployment depend on the entry variables R_i. A worker becomes employed if a match takes place (at a rate $\theta q(\theta)$) and furthermore if the realized productivity is high enough (which occurs with probability $1 - F(R_i)$). This gives the following steady-state flow equations. Equating the flows in and out of uninsured unemployment yields,

$$u_0\theta q(\theta)[1 - F(R_0)] = (l_0 + l_1)s. \tag{24}$$

Equating the flows in and out of insured unemployment yields,

$$u_1\theta q(\theta)[1 - F(R_1)] = (l_0 + l_1)\lambda. \tag{25}$$

The flow in and out of low wage employment is given by

$$u_0\theta q(\theta)[1 - F(R_0)] = l_0(s + \lambda). \tag{26}$$

Finally, the accounting equality is

$$l_0 + l_1 = 1 - u_0 - u_1. \tag{27}$$

3.1 Solution

The solution for θ , R_0 , R_1, and $\widehat{u}_0$ are given by the four equations: ER^{firm} (the firms' creation equation), the two entry equations for R_0 and R_1 by which I construct ER^{work} (the average entry

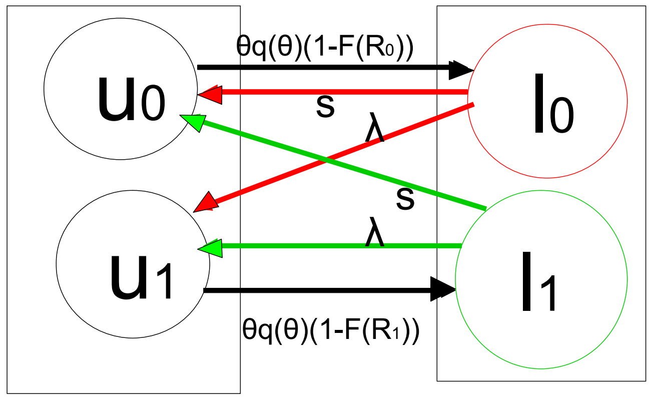

Figure 3: Flows (Endogenous Entry)

by workers), and the equation for $\widehat{u}_0$ derived from the condition for a steady-state equilibrium.

The creation equation is

$$\widehat{u}_0 R_0 + (1-\widehat{u}_0)R_1 = \overline{y} - \frac{(r+\lambda+s)}{(1-\beta)}\frac{\gamma_0}{q(\theta)} - \widehat{u}_0 \int_{R_0}^{\overline{y}} F(s)ds - (1-\widehat{u}_0)\int_{R_1}^{\overline{y}} F(s)ds. \tag{28}$$

The uninsured entry equation is

$$(r+s+\theta q(\theta)\beta)R_0 + \theta q(\theta)\beta \int_{R_0}^{\overline{y}} F(s)ds = \theta q(\theta)\beta\overline{y} - \lambda R_1. \tag{29}$$

The insured entry equation is

$$(r+\lambda+\theta q(\theta)\beta)R_1 + \theta q(\theta)\beta \int_{R_1}^{\overline{y}} F(s)ds = (r+\lambda+s)z + \theta q(\theta)\beta\overline{y} - sR_0. \tag{30}$$

The steady-state insurance rate is given by

$$\widehat{u}_0 = \frac{s(1-F(R_1))}{s(1-F(R_1)) + \lambda(1-F(R_0))}. \tag{31}$$

From the two entry equations (29) and (30) I construct the average entry, ER^{work}, and the entry gap, ΔR,

$$\widehat{u}_0 R_0 + (1-\widehat{u}_0)R_1 = (1-\widehat{u}_0)z + \frac{\beta}{1-\beta}\theta\gamma_0 + [(1-\widehat{u}_0)s - \lambda\widehat{u}_0]\frac{(R_1 - R_0)}{r+\lambda+s}, \tag{32}$$

$$R_1 - R_0 = \frac{(r+\lambda+s)}{r+\theta q(\theta)\beta}z + \frac{\theta q(\theta)\beta}{r+\theta q(\theta)\beta}\left[\int_{R_0}^{R_1} F(s)ds\right]. \tag{33}$$

Wages are given by

$$\begin{aligned} w_0(y) &= \beta y + (1-\beta)R_0 \\ w_1(y) &= \beta y + (1-\beta)R_1, \end{aligned} \tag{34}$$

so that

$$\begin{aligned} w_1(y) - w_0(y) &= (1-\beta)(R_1 - R_0) \\ &= (1-\beta)\frac{(r+\lambda+s)}{r+\theta q(\theta)\beta}z + \frac{(1-\beta)\theta q(\theta)\beta}{r+\theta q(\theta)\beta}\left[\int_{R_0}^{R_1} F(s)ds\right]. \end{aligned} \tag{35}$$

The first term is the same as in the model without stochastic matching. The second (new) term is due to uncertainty. It reflects the higher option value that nonrecipients get from a relationship because they begin employment sooner ($R_0 < R_1$). They pay $(1-\beta)$ of this in their wages, reducing their wages by this extra term.

The unique equilibrium can be depicted by the intersection of the ER^{firm} (expected creation) and ER^{work} (average entry) curves. This gives the equilibrium market tightness θ^*. The equilibrium entry productivities R_0 and R_1 are then found given this market tightness (see Figure 4).

3.2 Discussion

The firm's creation decision is basically unchanged. As before, free entry implies that vacancies will be opened to the point where the costs of opening a vacancy γ_0 are covered by the expected value of a producing firm. The difference is that now the firm will produce only above the

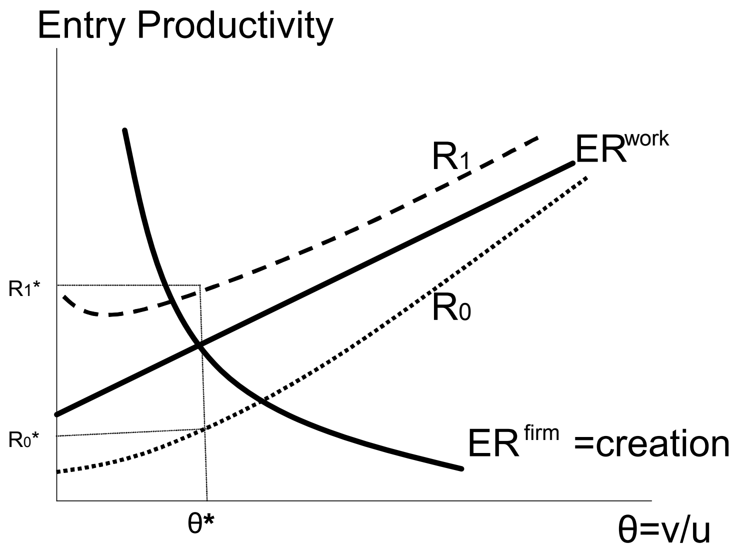

Figure 4: Equilibrium (Endogenous Entry)

threshold productivities R_0 and R_1. The expected creation curve is thus given by

$$\begin{aligned}\frac{\gamma_0}{q(\theta)} &= \widehat{u}_0 \int_{R_0}^{\overline{y}} J^{F0}(s)dF(s) + (1-\widehat{u}_0)\int_{R_1}^{\overline{y}} J^{F1}(s)dF(s) \\ &= \widehat{u}_0 \frac{(1-\beta)}{r+\lambda+s}\int_{R_0}^{\overline{y}}(s-R_0)dF(s) + (1-\widehat{u}_0)\frac{(1-\beta)}{r+\lambda+s}\int_{R_1}^{\overline{y}}(s-R_1)dF(s).\end{aligned} \tag{36}$$

That is, firms choose market tightness (their vacancy opening) such that the expected cost of a vacancy is equal to the expected productivity. Firms take the expected entry decisions (R_0, R_1 and $\widehat{u}_0$) as given, so that this curve does not shift with benefits, z. Increasing UI is represented by a shift along this curve to a new equilibrium, due to the shift of the worker's entry curve.

The model's value-added is the additional entry decisions which introduces the incentive effect of UI. Workers decide to enter the productive relationship with the matched firm if the value they get is higher than the value of staying unemployed. Higher values of unemployment induce workers to postpone entry by increasing the threshold productivity defined by $J^{E0}(R_0) = J^{U0}$. Note that, given Nash bargaining, this corresponds to the point where the firm is indifferent between staying vacant and producing. This in turn means that at the threshold, productivity is equal to wages ($R_0 = w_0(R_0)$). Using this fact in the wage bargaining solution I find that

$$\begin{aligned} R_0 &= rJ^{U0} - \lambda(J^{U1} - J^{U0}) \\ R_1 &= rJ^{U1} + s(J^{U1} - J^{U0}). \end{aligned} \tag{37}$$

In their entry decision workers realize there's an additional value to employment due to the expected change in eligibility. Since the uninsured expect a future entitlement of UI benefits through work, they are willing to enter earlier, at a point where productivity equals their current unemployment value minus the future gain due to eligibility change, and similarly, for the insured, the entry decision is postponed due to the expected loss of benefit eligibility in case of a quit. Wages simply track the entry productivities in a very simple way: $w_i(y) = \beta y + (1-\beta)R_i$.

For the entry/wage gap $R_1 - R_0 = \frac{(r+\lambda+s)}{r+\theta q(\theta)\beta} z + \frac{\theta q(\theta)\beta}{r+\theta q(\theta)\beta} \left[\int_{R_0}^{R_1} F(s)ds\right]$, note the new term, which resembles an option value term. Uninsured workers are now willing to enter the relationship for lower productivities, not only because of the increased value of employment due to future unemployment benefits, but also because there is an amplifying effect of this entry gap. Given the earlier entry, uninsured workers' option value from work is larger, which increases the value from employment even further, reducing entry productivity.

Endogenous entry also implies that the fraction of uninsured to insured ($\widehat{u}_0$) is now endogenously determined. Relative to the case where the steady-state flows were exogenously determined, now a larger fraction of uninsured are working, and the fraction of uninsured is smaller: $\widehat{u}_0 = \frac{s(1-F(R_1))}{s(1-F(R_1))+\lambda(1-F(R_0))} < \frac{s}{s+\lambda}$. This also implies that $(1-\widehat{u}_0)s - \widehat{u}_0\lambda > 0$. Inspecting the worker's average productivity, shows

$$\widehat{u}_0 R_0 + (1-\widehat{u}_0)R_1 = (1-\widehat{u}_0)z + \frac{\beta}{1-\beta}\theta\gamma_0 + [(1-\widehat{u}_0)s - \lambda\widehat{u}_0]\frac{(R_1 - R_0)}{r+\lambda+s}. \tag{38}$$

Note that now the last term does not vanish as it did in the exogenous separation case. Rather, the expected minimum productivity margin, $\widehat{u}_0 R_0 + (1-\widehat{u}_0)R_1$, is increasing with UI benefits twice. First it increases directly because of the benefits given to the insured, $(1-\widehat{u}_0)z$. Next, this effect is magnified by allowing the unemployed to adjust their behavior. Since the fraction of insured to uninsured is higher than when no entry decision was allowed, there is now a positive discrepancy across the two groups which increases the average reservation wage and leads to higher unemployment.

The comparative static results concerning the effect of increased benefits on the equilibrium outcomes are similar to those derived when productivity took only two values. There is an additional prediction regarding the effect on the differential and total reservation productivities. These effects follow the effects on wages. In particular, higher unemployment benefits increase the average entry productivity, increase the entry productivity for the insured worker, and decrease the entry productivity for the uninsured worker. Proofs are provided in the appendix.

4 Calibration

To assess the magnitude of the differentials created by a partial insurance system, I now calibrate the model to fit U.S. unemployment behavior and other estimated parameters of the model. The end of the section discusses how the model's prediction fits the available evidence.

The new feature of the model is that eligibility status is based on the reason for being unemployed. From 1988 the Current Population Survey (CPS) has coded the reasons for unemployment based on five categories. The categories and their average rates over the period 1988-2005 are: job loser on layoff (0.16), other job loser (0.35), job leaver (0.11), new entrant (0.08) and re-entrant (0.29).[17] The model considers all job losers as eligible for UI, whether on layoff or otherwise. Those who were fired for cause are ignored because they cannot be identified. However, over time these series show that termination levels spike up during recessions, suggesting the bulk of termination is not due to workers' behavior (see Figure 5). The eligibility measure is also consistent with that of Blank and Card (1991) calculated for an earlier period (1977-1987). Separations that are due to a job quit result in ineligibility. Accordingly, the rate of quits to job loss is taken to be $\frac{s}{\lambda} = 0.22$. The calibration follows the model and abstracts from flows into and out of the labor force. Including those flows will further discount the value

[17] Although the CPS has slightly changed this variable in 1994, the edited variable is comparable to the previous period. Note also that a person is considered to be on layoff if he perceives his job loss as temporary and has high expectations of returning to the same job.

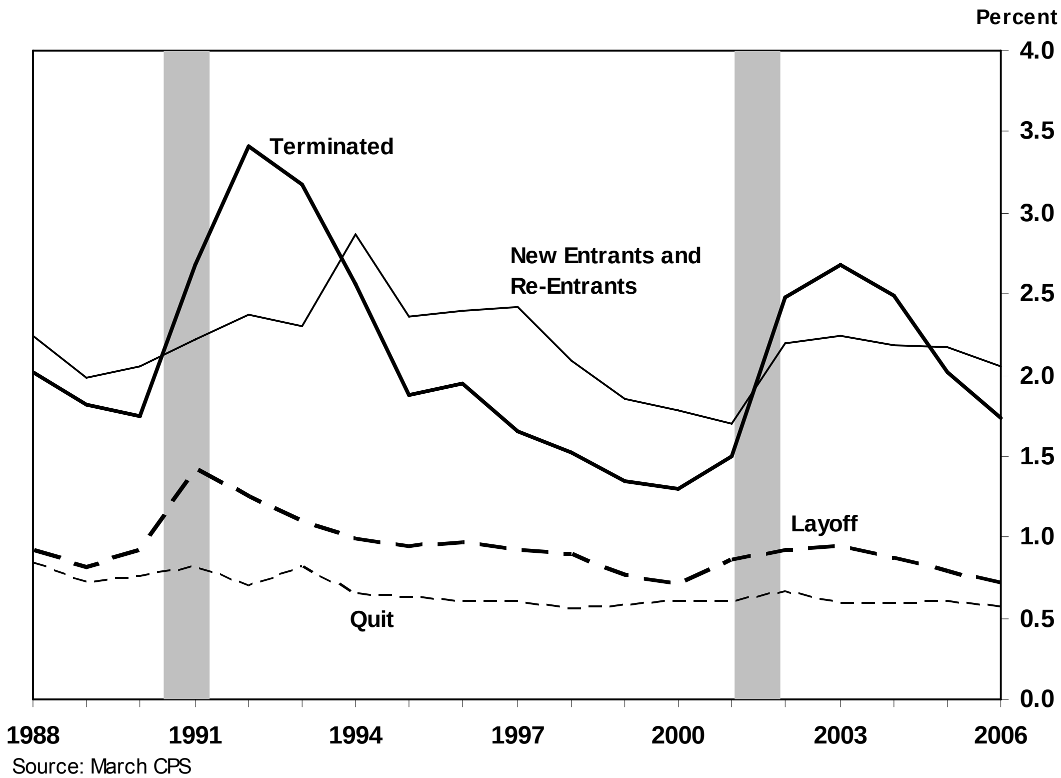

Figure 5: Reason for Unemployment (1988-2006)

of being unemployed – assuming most of the flows out of the labor force are due to discouraged workers. The only number that would fundamentally change is the insurance rate, which would be substantially lower when the new flows are considered and for this reason is not reported. Ignoring those fired and those entering and re-entering the labor force, as well as ignoring the limit on the duration of benefits, all tend to overstate the effect of insurance. The results is therefore an upper limit to the effect of benefits.

The time period is normalized to be a quarter. The rate of separation is taken to be $s + \lambda = 0.1$, which is the average quarterly rate estimated by Shimer (2005). Productivity is normalized to $y = 1$ and the value of unemployment benefits is taken to be initially $z = 0.4$ which is around the average replacement rate across U.S. states.[18] The yearly discount rate is 0.05 (or a quarterly $r = 0.012$). For the matching function I adopt the following constant

[18] The after-tax replacement rate is probably higher. See Gruber (1994) table A1 for estimates on replacement rates.

returns-to-scale functional form: $q(\theta) = \mu\theta^{1-\alpha}$ and use a midrange estimate of the matching elasticity from Petrongolo and Pissarides (2001) of $\alpha = 0.5$. This is a useful benchmark, since in an efficient market the bargaining power is equal to the matching elasticity, which in this case would produce the conventional bargaining power of $\beta = 0.5$. The last two parameters, the cost of opening up a vacancy (γ) and the parameter of the matching function (μ), jointly determine the unemployment rate and vacancy to unemployment rate. As there is very little information about the latter, it is set equal to one in the initial equilibrium to ($\theta = 1$). Then I match the average unemployment rate (1988-2005) of 5.8. This pins down $\gamma = 0.59$ and $\mu = 1.6$ (see Table 1).[19]

Parameter Values in Calibration of the Model

Parameter	
Productivity	y=1
Replacement rate	z=0.4
Discount rate	r=0.012
Quit rate	s=0.02
Layoff rate	λ=0.08
Matching function	$q(\theta) = 1.6\theta^{-0.5}$
Bargaining power	β=0.5
Cost of vacancy	γ=0.59

Table 1: Model Parameters

Using the above parameter values I find that an initial unemployment replacement rate of 0.4 is creating a 3% wage gap between the insured and the uninsured. Since this is an upper limit, the calibrated model predicts a small wage gap. This is mostly due to the low incidence of unemployment found in the data. The average unemployment duration is around three months. These values are quite responsive to a change in benefits. An increase in the generosity of benefits by 10 percentage points increases unemployment duration by 6% (elasticity of 0.3), and while on average wages hardly increase (0.3% or elasticity of 0.01), the wage gap increases by 33%

[19] Alternatively, I could try to match the empirical job finding rate of 0.45 a month, or 1.35 quarterly (Shimer 2005). Given that the separation rate is 0.1, this would imply an equilibrium unemployment rate of 6.8%. The results below would not be much changed.

(elasticity of 1.3). The large response of the wage differential is partially due to a multiplier effect for which the equilibrium vacancy/unemployment rate is responsible. As benefits rise, the vacancy to unemployment ratio declines, making the duration of unemployment – and hence the value of unemployment benefits – larger. To asses how large the general equilibrium effect is I hold constant the ratio of vacancies to unemployment and compare this analytic "counterfactual" to the true effect. Thus a quarter of the increase in the wage gap is attributed to the general equilibrium adjustment in market tightness. The large general equilibrium effect is in part due to the large elasticity of market tightness with respect to unemployment benefits, which is $\varepsilon_\theta = -0.56$. Note that this market tightness elasticity is much higher than the wage elasticities (ε_{w0} =–0.01 and ε_{w1} =0.03 for the low and high wages). Adding heterogeneity to workers' unemployment values creates the sensitivity of market tightness relative to wage adjustment that is missing from the standard search model.[20]

Given the small magnitude of the predicted wage gap, it is not surprising that this differential is hard to detect empirically.[21] More importantly, any attempt to detect the differential effects of benefits on wages will encounter a more fundamental identification problem: since receipt of benefits is nonrandom, the difference between wages of insured and uninsured workers will largely reflect differences between these two groups. This selection problem is inherent in the U.S. insurance system since eligibility status is derived from the reason for unemployment, which is largely endogenous.[22] Nevertheless, using such a selection-biased comparison between outcomes of recipients and nonrecipients, Ehrenberg and Oaxaca (1976) found a 7% increase in post-unemployment wages of older males. However, more recent studies, which use exogenous variation in benefits receipt to identify the effect of UI on the insured, find small or negligible effects on post-employment wages but sizeable effects on unemployment duration, consistent with my results. The estimated elasticities of duration with respect to the benefit amount range

[20] See Pries (2006) for an account of how workers' heterogeneity can possibly solve the Shimer (2005) critique of the low volatility implied by the standard search model.

[21] Recall that the predicted wage gap is even smaller once we allow for heterogeneous productivity and an entry productivity choice.

[22] In the CPS data, a striking difference between between the groups is that those who quit are on average four years younger than those whose jobs were terminated by the employer. This difference is indicative of selection on other unobservables.

from 0.4 to 0.6.[23] Recent work by Card, Chetty and Weber (2006) attempts to find wage and employment effects of benefit receipt. Using a regression discontinuity design, they find that there is an economically significant effect of benefits on the duration of unemployment, but only less than a 1% increase in mean subsequent wages (at the 95% confidence interval). While these studies are free of selection problems, they only identify the effects on the insured. The analysis in this paper suggests that a wage gap may exist between the two groups that can be attributed not only to an increase in the wages of the insured but also to a decline in the wages of the uninsured.

5 Conclusion

In this, I augmented a search model to account for the existence of unemployed workers who are not currently receiving UI benefits; I then investigated whether their increased incentive to work can dominate the lower incentives of the insured unemployed. I have shown that the conjecture in the literature is false, and that in equilibrium the total effect of unemployment benefits is driven by the fraction of workers who are insured and receiving benefits. Higher unemployment benefits have the standard average effect. They decrease the vacancy/unemployment rate and increase expected wages. However, benefits have a different effect on the uninsured than on the insured. When benefits increase, the uninsured value employment more because of the possibility of future benefits receipt. They are therefore willing to take lower wages. The insured experience a wage increase due to the direct increase in their bargaining position and an additional increase to compensate them for the possibility that they will need to quit the job and lose their UI eligibility.

In equilibrium, these partial effects are attenuated by the existence of two types of unemployed through a pecuniary externality. Because firms' entry decision is targeted at an average employee, there is a form of cross-subsidization between the two types of workers. General equilibrium also works to reduce wages of all workers through the lower market tightness. This results in a further reduction in the wages of the uninsured and a smaller increase in the wages

[23] See Krueger and Meyer (2002) for a survey.

of the insured. When the unemployed respond endogenously to employment incentives, these results are intensified. Given the stronger incentive to work (through future entitlement), the uninsured leave unemployment at a higher rate than the insured, resulting in a higher insurance rate of the economy. The calibration of the model is consistent with the empirical finding of small wage effects and larger duration elasticities.

There are a few lessons to be drawn from the discussion in the paper. In the context of the benchmark search model, ultimately what matters for welfare is the net increase in insurance. That there is another population that does not directly benefit from the program has distributional consequences but only small aggregate effects. Furthermore, while the ineligible population suffers from reduced wages in the short run, they too experience an increase in their expected lifetime utility.

It is worthwhile to point out the limitations of the analysis. First, since this is a steady-state analysis, it does not rule out that during the adjustment process the response of the uninsured will overwhelm the response of the insured. Second, it may be possible to augment the model such that, even in the steady-state, the response of the uninsured will dominate. However, the analysis here suggests that an additional mechanism would be required, one that would overturn the intuitive result that the average effect depends on net benefits.

The distinction between layoffs and quits and its implication for policy and for wage setting can be further explored. In this paper, separate groups are formed because identical workers are hit with different shocks. More realistically, adding ex ante heterogeneity between workers will entail different characteristics of quitters and laid-off workers, including different response elasticities. Another way to carve a more natural distinction between layoffs and quits is through the introduction of incomplete contracts. When the objectives of employed workers and filled firms are no longer aligned, there is a meaningful difference between quit-shocks that hit workers and layoff-shocks that hit firms. Furthermore, adding a contracting friction, which is likely to be present due to workers' limited liability, enriches the set of tools the government can use to influence the bilateral employment relationship. Then policy instruments, such as experience-rated taxes, become consequential.[24]

[24] Blanchard and Tirole (2004) address some of these questions. Exploring the policy implications of the worker-

6 Appendix

6.1 Proofs for Section 2

Claim 1 *Total effect of benefits on expected wages and market tightness:*

(i) *Expected wages increase with benefits.*

(ii) *Market tightness decreases with benefits.*

Proof. By implicit differentiation of the equilibrium equations. creation (10) and expected wages (18) give us a system in (θ, Ew) :

$$\begin{aligned} F^1 &: \quad Ew - \left[\overline{y} - (r+\lambda+s)\frac{\gamma_0}{q(\theta)} \right] = 0 \\ F^2 &: \quad Ew - [\beta(y+\gamma_0\theta) + (1-\widehat{u}_0)(1-\beta)z] = 0. \end{aligned}$$

Implicitly differentiating results in,

(i)

$$\frac{dEw}{dz} = \frac{(1-\widehat{u}_0)(1-\beta)(r+\lambda+s)\frac{\gamma_0}{q^2}q'}{-\beta\gamma_0 + (r+\lambda+s)\frac{\gamma_0}{q^2}q'} > 0.$$

Both numerator and denominator are negative since $q^{'}(\theta) < 0$. Also

$$\frac{\frac{dEw}{dz}}{d\beta} < 0,$$

(ii) similarly,

$$\frac{d\theta}{dz} = \frac{(1-\widehat{u}_0)(1-\beta)}{-\beta\gamma_0 + (r+\lambda+s)\frac{\gamma_0}{q^2}q'} < 0$$

and

$$\frac{\frac{d\theta}{dz}}{d\beta} < 0$$

■

firm relationship is in the spirit of the Atkinson and Micklewright (1991) program.

The total effect is therefore only due to the actual increase in benefits, which is only by the fraction who are insured, $(1-\widehat{u}_0)$.

Claim 2 *Benefits increase the wage gap.*

Proof. *Totally differentiating the wage gap,*

$$\Delta \equiv w_1(y) - w_0(y) = \frac{(1-\beta)(r+\lambda+s)z}{r+\beta\theta q(\theta)}$$

$$\begin{aligned}
\frac{d\Delta}{dz} &= \frac{\partial\Delta}{\partial z} + \frac{\partial\Delta}{\partial\theta}\frac{d\theta}{dz} \\
&= \frac{(1-\beta)(r+\lambda+s)}{r+\beta\theta q(\theta)} - \left(\frac{(1-\beta)(r+\lambda+s)z\beta(q+\theta q')}{(r+\beta\theta q(\theta))^2}\right) \\
&\quad * \left(\frac{(1-\widehat{u}_0)(1-\beta)}{-\beta\gamma_0 + (r+\lambda+s)\frac{\gamma_0}{q^2}q'}\right) \\
&> 0
\end{aligned}$$

since $q\prime < 0$. ■

Claim 3 *Benefits decrease the wages of the uninsured.*

Proof. To derive the total effect of benefits on the uninsured it is useful to present the wage equations without substitution of the creation equation. In this alternative representation of the equilibrium, the wage equations (which can now be interpreted as labor supply curves) are given by[25]

$$\begin{aligned}
w_0(y) &= \beta\overline{y}\left(\frac{r+\lambda+s+\theta q(\theta)}{r+\lambda+s+\beta\theta q(\theta)}\right) - \lambda(1-\beta)\frac{z}{r+\beta\theta q(\theta)}\left(\frac{r+\lambda+s}{r+\lambda+s+\beta\theta q(\theta)}\right) \\
w_1(y) &= \beta\overline{y}\left(\frac{r+\lambda+s+\theta q(\theta)}{r+\lambda+s+\beta\theta q(\theta)}\right) + (1-\beta)z\frac{r+s+\beta\theta q(\theta)}{r+\beta\theta q(\theta)}\left(\frac{r+\lambda+s}{r+\lambda+s+\beta\theta q(\theta)}\right) \\
Ew &= \beta\overline{y}\left[\frac{r+\lambda+s+\theta q(\theta)}{r+\lambda+s+\beta\theta q(\theta)}\right] + (1-\widehat{u}_0)(1-\beta)z\frac{r+\lambda+s}{r+\lambda+s+\beta\theta q(\theta)} \\
&\quad +(1-\beta)\frac{z}{r+\beta\theta q(\theta)}\left(\frac{r+\lambda+s}{r+\lambda+s+\beta\theta q(\theta)}\right)\left[(1-\widehat{u}_0)s - \widehat{u}_0\lambda\right].
\end{aligned}$$

[25] To derive these, proceed as before to derive $w(y) = \beta y + (1-\beta)rJ^U - \lambda(1-\beta)(J^{U1} - J^U)$. However, the solution for rJ^U does not use the creation relation. Rather, the expression above is used to replace the term $y - w$.

We can then show

$$\begin{aligned}\frac{dw_0}{dz} &= \frac{\partial w_0}{\partial z} + \frac{\partial w_0}{\partial \theta}\frac{d\theta}{dz} \\ &= (-) + (+)(-) < 0.\end{aligned}$$

■

6.2 Proofs and Derivations for Section 3

I first present a brief guide to deriving the equilibrium equations. Using the creation equation (28) with the firm vacancy value (20) yeilds,

$$\frac{\gamma_0}{q(\theta)} = \widehat{u}_0 \int_{R_0}^{\overline{y}} J^{F0}(s)dF(s) + (1 - \widehat{u}_0) \int_{R_1}^{\overline{y}} (J^{F1}(s)dF(s). \tag{39}$$

The value for unemployed workers is derived by plugging the wage equation (**??**) into the unemployment values (22) to get

$$\begin{aligned} rJ^{U0} &= \frac{\beta}{1-\beta}\theta q(\theta) \int_{R_0}^{\overline{y}} J^{F0}(s)dF(s) \\ rJ^{U1} &= z + \frac{\beta}{1-\beta}\theta q(\theta) \int_{R_1}^{\overline{y}} J^{F1}(s)dF(s). \end{aligned} \tag{40}$$

In the wage bargain equation (**??**) replace J^{Ei} and J^{Fi} from (23) and (21) to get wages in terms of productivity and unemployment values,

$$\begin{aligned} w_0(y) &= \beta y + (1-\beta)rJ^{U0} - \lambda(1-\beta)(J^{U1} - J^{U0}) \\ w_1(y) &= \beta y + (1-\beta)rJ^{U1} + s(1-\beta)(J^{U1} - J^{U0}). \end{aligned} \tag{41}$$

Next solve for the entry decision by using the wage equation (**??**) at $y = R_i$. Note that $J^{Ei}(R_i) = J^{Ui}$ so that the firms must also be indifferent between producing or not at the entry level, or $J^{Fi}(R_i) = 0$. Using this with (21) $J^{Fi}(y) = \frac{y - w_i(y)}{r+\lambda+s}$ results in $R_i = w_i(R_i)$. Substitute for the above wage equations (41) at R_i, to find

$$\begin{aligned} R_0 &= rJ^{U0} - \lambda(J^{U1} - J^{U0}) \\ R_1 &= rJ^{U1} + s(J^{U1} - J^{U0}). \end{aligned} \tag{42}$$

This results in $J^{U1} - J^{U0} = \frac{R_1 - R_0}{r+\lambda+s}$ and in a linear relationship between wages and entry productivity, $w_i(y) = \beta y + (1-\beta)R_i$. Plug this wage into (21) to solve for the firm values

$$J^{Fi}(y) = \frac{(1-\beta)(y - R_i)}{r+\lambda+s}. \tag{43}$$

Plug these into the unemployment values derived in (40) to have (after integrating by parts),

$$rJ^{Ui} = zi + \frac{\theta q(\theta)\beta}{r+\lambda+s}\left[\overline{y} - R_i - \int_{R_i}^{\overline{y}} F(s)ds\right].$$

This also gives the difference between unemployment values as

$$r(J^{U1} - J^{U0}) = z + \frac{\theta q(\theta)\beta}{r+\lambda+s}\left[R_0 - R_1 + \int_{R_0}^{R_1} F(s)dF(s)\right].$$

Use this in (42) to solve implicitly for the entry productivities (29) and (30) in the text. Replacing (43) in (39) gives the creation equation(28). This completes the derivation.

I now prove the main comparative statics result. Note that in the firm's creation equation (28) firms choose market tightness (their vacancy opening) such that the expected cost of a vacancy is equal to the expected productivity. Firms take the expected entry decisions (R_0, R_1 and $\widehat{u}_0$) as given, so that this curve does not shift with the level of benefits, z. Increasing UI is represented by a shift along this curve to a new equilibrium, due to the shift of the worker's entry curve.

To find the find how the entry curve shifts with benefits, z, I need to see how all its components shift with z. I begin with these partial derivatives, and continue to show the total equilibrium effect of increased z is to reduce market tightness, to increase R_1, to reduce R_0, and to increase the wage/entry gap.

Claim 4 *Partial equilibrium effects on entry productivity (holding θ fixed)*

(i) $\frac{dR_1}{dz} > 0$

(ii) $\frac{dR_0}{dz} < 0$

(iii) $\frac{d\Delta R}{dz} > 0.$

Proof. *Define:*

$$F^1: \quad (r + s + \theta q(\theta)\beta)R_0 + \theta q(\theta)\beta \int_{R_0}^{\overline{y}} F(s)ds - \theta q(\theta)\beta\overline{y} + \lambda R_1 = 0$$

$$F^2: \quad (r + \lambda + \theta q(\theta)\beta)R_1 + \theta q(\theta)\beta \int_{R_1}^{\overline{y}} F(s)ds - (r + \lambda + s)z - \theta q(\theta)\beta\overline{y} + sR_0 = 0$$

so that, holding θ fixed,

(i)

$$\begin{aligned}
\frac{dR_0}{dz} &= -\frac{(r + (r + \lambda + s)\lambda)}{[r + s + \theta q(\theta)\beta(1 - F(R))]\,[r + \lambda + \theta q(\theta)\beta(1 - F(R_1))] - \lambda s} \\
&= -\lambda A < 0 \\
A &\equiv \frac{(r + \lambda + s)}{[r + s + \theta q(\theta)\beta(1 - F(R_0))]\,[r + \lambda + \theta q(\theta)\beta(1 - F(R_1))] - \lambda s} > 0.
\end{aligned}$$

(ii)

$$\begin{aligned}
\frac{dR_1}{dz} &= -\frac{-[r + s + \theta q(\theta)\beta(1 - F(R_0))](r + \lambda + s) - 0}{[r + s + \theta q(\theta)\beta(1 - F(R_0))]\,[r + s + \theta q(\theta)\beta(1 - F(R_1))] - \lambda s} \\
&= [r + s + \theta q(\theta)\beta(1 - F(R_0))]\,A > 0.
\end{aligned}$$

(iii)

$$\Delta R \equiv R_1 - R_0 = \frac{(r + \lambda + s)}{r + \theta q(\theta)\beta} z + \frac{\theta q(\theta)\beta}{r + \theta q(\theta)\beta}\left[\int_{R_0}^{R_1} F(s)ds\right]$$

$$
\begin{aligned}
\frac{d\Delta R}{dz} &= \frac{\partial \Delta R}{\partial z} + \frac{\partial \Delta R}{\partial R_0}\frac{\partial R_0}{\partial z} + \frac{\partial \Delta R_0}{\partial R_1}\frac{\partial R_1}{\partial z} \\
&= \frac{(r+\lambda+s)}{r+\theta q(\theta)\beta} - \frac{\theta q(\theta)\beta}{r+\theta q(\theta)\beta}F(R_0)(-\lambda A) \\
&\quad + \frac{\theta q(\theta)\beta}{r+\theta q(\theta)\beta}F(R_1)\left[r+s+\theta q(\theta)\beta(1-F(R_0))\right]A \\
&= \frac{(r+\lambda+s)+\theta q(\theta)\beta A\{F(R_0)\lambda + F(R_1)\left[r+s+\theta q(\theta)\beta(1-F(R_0))\right]\}}{r+\theta q(\theta)\beta} \\
&> 0.
\end{aligned}
$$

■

Claim 5 *Partial equilibrium effect on the fraction of uninsured and other derivatives of* $\frac{dR_0}{dz}$ *(holding* θ *fixed):*

(i) $\frac{d\widehat{u}_0}{dz} < 0$

(ii) $\frac{d(1-\widehat{u}_0)}{dz} = -\frac{d\widehat{u}_0}{dz} > 0$

(iii) $\frac{d[(1-\widehat{u}_0)s-\lambda\widehat{u}_0](R_1-R_0)}{dz} > 0$

Proof. *(ii)* can be seen, but formally,

$$
\begin{aligned}
1-\widehat{u}_0 &= \frac{\lambda(1-F(R_0))}{s(1-F(R_1))+\lambda(1-F(R_0))} \\
\frac{d\left(1-\widehat{u}_0\right)}{dz} &= \frac{\partial\left(1-\widehat{u}_0\right)}{\partial R_0}\frac{\partial R_0}{\partial z} + \frac{\partial\left(1-\widehat{u}_0\right)}{\partial R_1}\frac{\partial R_1}{\partial z} \\
&= \frac{-\lambda f(R_0)\left[s(1-F(R_1))+\lambda(1-F(R_0))\right] - \lambda^2 f(R_0)(1-F(R_0))}{\left[s(1-F(R_1))+\lambda(1-F(R_0))\right]^2}\frac{\partial R_0}{\partial z} \\
&\quad + \frac{\lambda(1-F(R_0))sf(R_1)}{\left[s(1-F(R_1))+\lambda(1-F(R_0))\right]^2}\frac{\partial R_1}{\partial z} \\
&= \frac{-\lambda f(R_0)\left[s(1-F(R_1))+\lambda(1-F(R_0))-\lambda(1-F(R_0))\right]\frac{\partial R_0}{\partial z} + \lambda s f(R_1)(1-F(R_0))\frac{\partial R_1}{\partial z}}{\left[s(1-F(R_1))+\lambda(1-F(R_0))\right]^2} \\
&= \frac{\lambda s}{\left[s(1-F(R_1))+\lambda(1-F(R_0))\right]^2}\left[-f(R_0)(1-F(R_1))\frac{\partial R_0}{\partial z} + f(R_1)(1-F(R_0))\frac{\partial R_1}{\partial z}\right] \\
&\equiv YX > 0 \quad \text{since } \frac{\partial R_0}{\partial z} < 0 \quad \text{and} \quad \frac{\partial R_1}{\partial z} > 0 \\
Y &\equiv \frac{\lambda s}{\left[s(1-F(R_1))+\lambda(1-F(R_0))\right]^2} \\
X &\equiv \left[-f(R_0)(1-F(R_1))\frac{\partial R_0}{\partial z} + f(R_1)(1-F(R_0))\frac{\partial R_1}{\partial z}\right]
\end{aligned}
$$

(i)

$$\frac{d\widehat{u}_0}{dz} = -\frac{d\left(1-\widehat{u}_0\right)}{dz} = -YX < 0.$$

(iii)

$$\frac{d[(1-\widehat{u}_0)s - \lambda\widehat{u}_0](R_1 - R_0)}{dz} = \frac{d[(1-\widehat{u}_0)s - \lambda\widehat{u}_0]}{dz}(R_1 - R_0) + \frac{d(R_1 - R_0)}{dz}[(1-\widehat{u}_0)s - \lambda\widehat{u}_0] > 0,$$

because all terms are positive. The only term I need to show is positive is

$$\begin{aligned}\frac{d[(1-\widehat{u}_0)s - \lambda\widehat{u}_0]}{dz} &= \frac{d[s - \widehat{u}_0(s+\lambda)]}{dz} \\ &= -(s+\lambda)\frac{d\widehat{u}_0}{dz} = -(s+\lambda)(-YX) > 0.\end{aligned}$$

■

Claim 6 *Market tightness declines with unemployment benefits* ,$\frac{d\theta^*}{dz} < 0$.

Proof. Define the two equilibrium equations for ER and θ (equations ER^{firm} and ER^{work}),

$$\begin{aligned} G^1 \quad &: \quad \widehat{u}_0 R_0 + (1-\widehat{u}_0)R_1 - \overline{y} + \frac{(r+\lambda+s)}{(1-\beta)}\frac{\gamma_0}{q(\theta)} + \widehat{u}_0\int_{R_0}^{\overline{y}} F(s)ds + (1-\widehat{u}_0)\int_{R_1}^{\overline{y}} F(s)ds = 0 \\ G^2 \quad &: \quad \widehat{u}_0 R_0 + (1-\widehat{u}_0)R_1 - (1-\widehat{u}_0)z - \frac{\beta}{1-\beta}\theta\gamma_0 - [(1-\widehat{u}_0)s - \lambda\widehat{u}_0]\frac{(R_1 - R_0)}{r+\lambda+s} = 0.\end{aligned}$$

Implicitly differentiating and using the partial derivatives from above shows,

$$\frac{d\theta^*}{dz} = -\frac{(0-(-)1^+)}{(-\frac{(r+\lambda+s)}{(1-\beta)}\frac{\gamma_0}{q(\theta)}q'(\theta)1^- - (-\frac{\beta}{1-\beta}\gamma_0)1^+)} = -\frac{+}{+} < 0.$$

■

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