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Unemployment Insurance and the Uninsured

Tali Regev[1]

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[1] Tali Regev – The Eitan Berglas School of Economics, Tel Aviv University, Ramat Aviv, Tel Aviv 69978. Email: talir@post.tau.ac.il

Abstract

More than half of the unemployed in the U.S. are not insured. For them the provision of employment-dependent UI creates an additional benefit from work: future UI eligibility. This paper explores the overall and distributional effects of providing unemployment insurance under partial coverage. I extend a standard search model to accommodate insured and uninsured workers, where insurance eligibility status is determined by previous separation history. While the effect of unemployment insurance on unemployment duration and post unemployment wages is theoretically ambiguous, a calibration of the model to the U.S. economy shows that unemployment insurance raises the unemployment rate. In addition I show that wage gaps and unemployment duration differentials between the uninsured and insured exist and are larger during recessions.
J.E.L. Classification:J31, J65

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1 Introduction

The fraction of unemployed who are not covered by unemployment insurance (UI) has been estimated to be as high as 57 percent.[1] In contrast to the disincentive effects of UI on the search efforts of the insured, for the uninsured, an increase in employment dependent UI creates an incentive to work, so as to gain future eligibility. With such a large pool of uninsured workers it is not clear a priori how average wages are affected by more generous UI benefits, nor is it clear how the vacancy to unemployment ratio or the unemployment rate would be affected. This paper answers these questions within a general equilibrium setting. A search model is extended to accommodate insured and uninsured workers with insurance eligibility status determined by previous separation history, as in most developed countries. The model is then calibrated to the U.S. economy, to show that despite the large fraction of uninsured, raising unemployment insurance still raises the unemployment rate. This paper also shows that the differential effects of unemployment insurance on the wages and unemployment durations of insured and uninsured exist, that they are muted in equilibrium, and larger during recessions.

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.[2] 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 are willing to accept.

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 non-recipients of benefits.[3] For them, work has an

[1] Blank and Card (1991).

[2] See also Topel (1983) for the effects on layoffs, Kuhn and Riddell (2010) for the long term effects of unemployment insurance and Krueger and Meyer (2002) for a survey of labor supply effects of unemployment insurance.

[3] Blank and Card (1991) estimate the fraction of eligible unemployment to be 0.57 using states laws and the observed fraction of insured unemployment for 1968-1987. Eligible unemployment is slightly higher (42 percent) than insured unemployment (34 percent) due to a slack in insurance takeup. See also Anderson and Meyer (1997).

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 paper, disentitlement of the elderly from UI resulted in their withdrawal from the labor force.[4] In the second paper, an increase in benefits was shown to reduce the unemployment duration of the uninsured.[5]

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 sign of the effect of an increase in benefits on unemployment duration is ambiguous."[6] Recently Krueger and Meyer (2002) restated the ambiguity result and suggested general equilibrium could possibly magnify the adverse employment effects of UI.

I test these conjectures theoretically and quantitatively. I expand a general equilibrium search model á la Diamond-Mortensen-Pissarides (Diamond 1982, Mortensen and Pissarides 1994, Pissarides 2000) to include both eligible and non eligible workers. Unemployment insurance eligibility is determined by previous employment separation history. In particular, if the firm had to layoff the worker because of lack of jobs the worker is eligible for insurance, while if the worker quit the job or was fired for cause he is not eligible. Both type of separations are driven by shocks: layoffs occur when productivity become too low to sustain a surplus in the employment relationship; quits are driven by relocation shocks or other match-specific shocks which make the current employment match unsuitable for the worker. 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. While the model

[4] 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.

[5] 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.

[6] Mortensen (1977) pg. 506.

chooses to focus on quitting as the reason for non-insurance, this is not crucial, and is simply a modeling choice. The model can easily extend to incorporate any constant flow of uninsured into unemployment, with the main insights of the analysis unchanged.[7]

The effect of raising benefits on average wages and unemployment is theoretically ambiguous, since the insured tend to increase their reservation wages and extend their unemployment durations, while the uninsured decrease their reservation wages and find employment faster. Wage differentials arise because eligible workers use their higher unemployment value to reach a higher Nash wage bargain. This "pure entitlement" effect of unemployment benefits is further reenforced by a "future entitlement" loss (and gain). Since eligible workers may lose eligibility in the future, they are currently compensated by receiving even higher wages. Non eligible workers face the gain of future eligibility, and are thus willing to accept even lower wages.[8] Another insight of the analysis is that the differential effects on the insured and uninsured are muted when both types coexist. Because search is not directed, a searching firm expects to meet an average type of worker. If the realized match is with an uninsured worker, the firm experiences a gain relative to expectations. Sharing these gains with the low wage worker increases his wage somewhat but leaves the overall effect of benefits on his wage negative. Since the gains to insured workers are transferred to uninsured workers, it is a form of "cross subsidization". A final 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.

To resolve the theoretical ambiguity and estimate the size of the effects predicted by the model, I calibrate the model to the U.S. economy. I find that for the relevant parameter values, the total effect is not ambiguous and is the one found by the empirical literature: increasing generosity of UI increases wages and unemployment even in the presence of a large share of uninsured workers. This result holds because the direct effect of higher benefits on the insured

[7] For instance, eligibility also depends on employment and unemployment duration. As long as these are exogenous, duration dependence can be modeled by an exogenous rate of acquiring or loosing eligibility, similar to the analysis here. For the main results it hardly matters which mechanism created the heterogeneity in eligibility.

[8] 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.

dominates the indirect effect of benefits through the future higher value of unemployment. The increase in expected wages and unemployment is accompanied by a decline in market tightness. This general equilibrium effect of deteriorating market tightness reinforces the result while reducing the wages of both types of unemployed: reducing the wages of the uninsured even further and mitigating the wage increase of the insured. The wage gap between the insured and the uninsured implied by the model is around 2% and higher during recessions. Another result of the quantitative analysis is that market tightness is sensitive to an increase in benefits, whereas the sensitivity of wages is low.

There is a small but growing literature on time-limits in UI benefit receipt in general equilibrium settings. In these models, UI eligibility depends on employment and unemployment duration history. Albrecht and Vroman (2005) present a model where UI eligibility status is determined by the passing of the time limit on UI, and their analysis is focused on discussing the resulting wage distribution. Similarly, Ortega and Rioux (2010) analyze an unemployment compensation system, where eligibility status depends on the duration of employment. They quantify the re-entitlement effect and characterize the optimal eligibility requirement for UI. While their work focuses on the firm's decision, my work allows also for a worker's decision through an endogenous match formation decision. This turns the effect of benefits on unemployment to be theoretically ambiguous: while firms' vacancy creation always suffers from higher benefits, the effect on workers depends on their eligibility status. In addition, the insurance rate of the economy is now endogenously determined and is increasing with the generosity of unemployment insurance. Furthermore, workers' decision margin amplifies the differential effects of unemployment compensation on wages and duration, resulting in larger calibrated effects. The other models in this literature are concerned with the normative aspects of the UI system, and spend less time discussing the positive aspects (e.g. Boone and van Ours 2009, Coles and Masters 2007, Fredriksson and Homlund 2006, Shimer and Werning 2006).

Section 2 presents the model of insured and uninsured unemployment and solves for the equilibrium. Section 3 discusses the equilibrium and explores the sources of the differential effects of unemployment benefits on wages, the total average effects and the general equilibrium effects. For expositional reasons I first explore a simplified version of the model where the stochastic productivity component is shut down, and then extend the analysis to the full model.[9] In section 4 I calibrate the model. Section 5 concludes.

2 A Model of Insured and Uninsured Unemployment

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. When a firm and an unemployed worker meet, they observe their joint match productivity and decide whether to form an employment relationship or not. If productivity is higher than a threshold value, the firm and worker form an employment relationship. They negotiate a wage contract which splits the quasi rents created by search frictions. The wage contract is conditional on the productivity of the match and on unemployment insurance eligibility and is completely specified at the time of engagement. This pins down the original disagreement point as the only one relevant to surplus sharing.

2.1 Model

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 $\theta = \frac{v}{u_0+u_1}$. Workers and firms meet via a matching technology, where the rate of job matches per unit of time is given by $m(u_0 + u_1, v)$. Assume this matching function exhibits constant returns-to-scale, is increasing in both arguments, and satisfies the Inada conditions for $q(\theta) \equiv m(u_0 + u_1, v)/v$, which is the rate at which vacant firms meet workers. The rate at which workers find jobs is then $\theta q(\theta)$.

[9] An alternative specification with an endogenous layoff decision was also calibrated. Allowing search effort instead is discussed in the text.

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 observe their joint match productivity y which is randomly drawn from a distribution $G(y)$ with support $[\underline{y}, \overline{y}]$. After observing y, 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 threshold productivities (or reservation productivities) R_0 for the uninsured and R_1 for the insured. If a worker decides to form an employment relationship, the uninsured negotiate a wage contract $w_0(y)$, and the insured negotiate a wage contract $w_1(y)$. 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 $w_1(y) > w_0(y)$ for every y, 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. Following a bad productivity shock a worker is laid off and becomes eligible for a flow unemployment benefit of z. The government finances benefits by levying lump sum taxes on all individuals. 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. This shock represents a relocation shock, whereby a worker needs to quit his current job due to a physical move, change in his taste for the specific job, etc. The value of leisure to an unemployed worker is normalized to zero. 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 ($J^{F0}(y)$ or $J^{F1}(y)$), since the bargaining position of an insured worker is better 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 $J^{E1}(y)$.

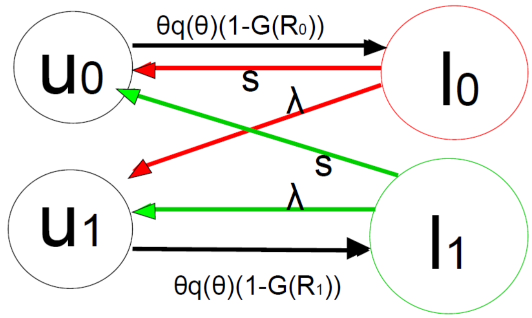

Figure 1: Flows

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 worker 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 $J^{F0}(y)$ if productivity is above the threshold value R_0. Alternatively, the firm meets an insured unemployed worker and transitions to have a value of $J^{F1}(y)$ if productivity is above the threshold R_1,

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

A filled firm that employs a previously uninsured worker gets a flow of $y - w_0(y)$, 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, the wages contracted are denoted by $w_1(y)$ and the firm value by $J^{F1}(y)$. Therefore, the values of a firm with a filled position are, for $i = 0, 1$:

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

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 $J^{E0}(y)$ if the match productivity exceeds the reservation value R_0. An insured worker in addition receives a flow z while unemployed, so that the flow of benefits received is given by $z * i = \left\{\begin{smallmatrix} z & \text{if } i=1 \\ 0 & \text{if } i=0 \end{smallmatrix}\right\}$. The unemployed values are given by

$$rJ^{Ui} = z * i + \theta q(\theta) \int_{R_i}^{\overline{y}} (J^{Ei}(x) - J^{Ui}) dG(x). \tag{3}$$

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

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

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 he might 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 two threshold productivities R_i (for $i = 0, 1$) are defined by the indifference conditions,

$$J^{Ei}(R_i) = J^{Ui} \tag{5}$$

The free entry condition for firms is given by

$$J^V = 0. \tag{6}$$

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 $i = 0, 1$)

$$J^{Ei}(y) - J^{Ui} = \beta(J^{Fi}(y) - J^V + J^{Ei}(y) - J^{Ui}) = \frac{\beta}{1-\beta}(J^{Fi}(y) - J^V). \tag{7}$$

In addition, in a steady-state equilibrium, the flow of workers into and out of each employment state must be equal. Recall that a worker becomes employed if a meeting takes place (at a rate $\theta q(\theta)$) and if the realized productivity is high enough (which occurs with probability $1 - G(R_i)$). Hence, equating the flows into and out of uninsured unemployment yields,

$$u_0 \theta q(\theta)[1 - G(R_0)] = (l_0 + l_1)s. \tag{8}$$

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

$$u_1 \theta q(\theta)[1 - G(R_1)] = (l_0 + l_1)\lambda. \tag{9}$$

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

$$u_0 \theta q(\theta)[1 - G(R_0)] = l_0(s + \lambda). \tag{10}$$

Finally, the accounting equality is

$$l_0 + l_1 = 1 - u_0 - u_1. \tag{11}$$

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

2.2 Equilibrium

In this section I define and solve for the equilibrium and prove an existence result.

Definition 1 ***A steady-state equilibrium*** *is a solution to the wage schedules, the reservation productivities, the market tightness, the flow variables, and the state values* $\{w_0(y),\ w_1(y),\ R_0,\ R_1,\ \theta,\ u_0,\ u_1,\ l_0,\ l_1\} \cup \{J^{ji}\}$ *satisfying*

1. *the Bellman equations (1) to (4),*
2. *the indifference conditions (5),*
3. *the free entry condition (6),*

4. the wage equations (7),

5. the flow equations (8) to (10), and

6. the accounting equality (11).

The solution can be summarized by four equations which together solve for θ , R_0 , R_1, and $\widehat{u}_0$. These equations (12 - 15) are the firms' creation equation, the two reservation equations for R_0 and R_1, and the equation for $\widehat{u}_0$. The derivation of these equations is left for the appendix.

The creation equation is

$$\frac{\gamma_0}{q(\theta)}\frac{r+\lambda+s}{(1-\beta)} = \widehat{u}_0 \int_{R_0}^{\overline{y}} (s-R_0)dG(s) + (1-\widehat{u}_0)\int_{R_1}^{\overline{y}} (s-R_1)dG(s). \tag{12}$$

This is a free entry condition. For expected profits to be zero, the expected surplus from a match (RHS) must be equal the discounted cost of opening up a vacancy (LHS).

The threshold productivity of the uninsured is given by,

$$\theta q(\theta)\beta \int_{R_0}^{\overline{y}} (s-R_0)dG(s) = (r+s)R_0 + \lambda R_1. \tag{13}$$

Similarly, the threshold productivity of the insured is given by,

$$\theta q(\theta)\beta \int_{R_1}^{\overline{y}} (s-R_1)dG(s) = sR_0 + (r+\lambda)R_1 - (r+\lambda+s)z. \tag{14}$$

These two equations are derived from uninsured and uninsured workers indifference between remaining unemployed with their share of the expected surplus (LHS) or accepting a match with their threshold productivity (RHS).

Finally, the steady-state insurance rate is given by $1-\widehat{u}_0$ where

$$\widehat{u}_0 = \frac{s(1-G(R_1))}{s(1-G(R_1)) + \lambda(1-G(R_0))}. \tag{15}$$

This equation is derived from the condition for a steady state equilibrium. Note that this share of uninsured unemployment, $\widehat{u}_0$, is also the share of uninsured employment[10].

I next prove an existence result:

Proposition 2 *There is a steady state equilibrium.*

Proof. Substitute the expression for $\widehat{u}_0$ from equation (15) into the creation equation (12). Let $\mathbf{y} = \mathbf{f}(R_0, R_1, \theta)$ denote the system of equations comprising of this substituted creation equation (12), and the threshold equations (13) and (14). Define the compact and convex set $\boldsymbol{K} = [\underline{y}, \overline{y}]X[\underline{y}, \overline{y}]X[0, \theta^M]$ where θ^M is the upper bound on all the possible values of θ obtained when solving for $\theta(R_0, R_1)$ in the creation equation. This bound is finite since the (LHS) is increasing in θ and the (RHS) is bounded by $E[y]-\underline{y}$ when $R_0 = R_1 = \underline{y}$. ($\widehat{u}_0 \int_{R_0}^{\overline{y}}(s-R_0)dG(s)+(1-\widehat{u}_0)\int_{R_1}^{\overline{y}}(s-R_1)dG(s) \leq \widehat{u}_0 \int_{\underline{y}}^{\overline{y}}(s-\underline{y})dG(s)+(1-\widehat{u}_0)\int_{\underline{y}}^{\overline{y}}(s-\underline{y})dG(s) = \int_{\underline{y}}^{\overline{y}}(s-\underline{y})dG(s) = E[y]-\underline{y}$). Now $\mathbf{f} : \boldsymbol{K} \to \boldsymbol{K}$ is a continuous function mapping the compact and convex set $\boldsymbol{K} \subset \boldsymbol{R}^3$ into $\boldsymbol{K}$. By Brouwer's fixed point theorem, $\mathbf{f}$ has a fixed point. ■

The equilibrium is depicted in Figure 2.[11] Let O_{R_i} denote the expected surplus of a match with worker of type i, $O_{R_i} \equiv \int_{R_i}^{\overline{y}}(s-R_i)dG(s)$. With probability $\widehat{u}_0$ the firm may meet an uninsured worker and face an expected surplus of O_{R_0} and with probability $(1-\widehat{u}_0)$ the firm will meet an insured worker and face an expected surplus of O_{R_1}. The average expected surplus from a match is thus $\widehat{u}_0 O_{R_0} + (1-\widehat{u}_0)O_{R_1}$. From the creation equation (12) we have that this surplus must be equal to $\frac{\gamma_0}{q(\theta)}\frac{r+\lambda+s}{(1-\beta)}$, which is the discounted cost of opening a vacancy. When market tightness θ increases, these search costs are higher since with more firms around it is harder to meet a worker. Thus the (LHS) of the creation curve is upward sloping as function of θ.

An alternative expression for the average expected surplus is derived from the two threshold equations (13) and (14). For a given market tightness θ, the two threshold equations are solved to produce $R_0(\theta)$ and $R_1(\theta)$, plugging these into (15) we can solve for $\widehat{u}_0(\theta)$. Adding equa-

[10] The fraction of uninsured *unemployment*, $\widehat{u}_0 \equiv \frac{u_0}{u_0+u_1}$, is equal to the fraction of uninsured *employment* $\frac{l_0}{l_0+l_1}$. The equality follows from the flow equation $u_0\frac{\theta q(\theta)[1-G(R_0)]}{(s+\lambda)} = l_0$.

[11] Parameter values used to create Figure 2 are $y\tilde{\ }U[0,2], r = 0.012, z = 0.4, \beta = 0.5, \gamma_0 = 1.47, q(\theta) = 10.6\theta^{-0.5}, s = 0.018, \lambda = 0.082$.

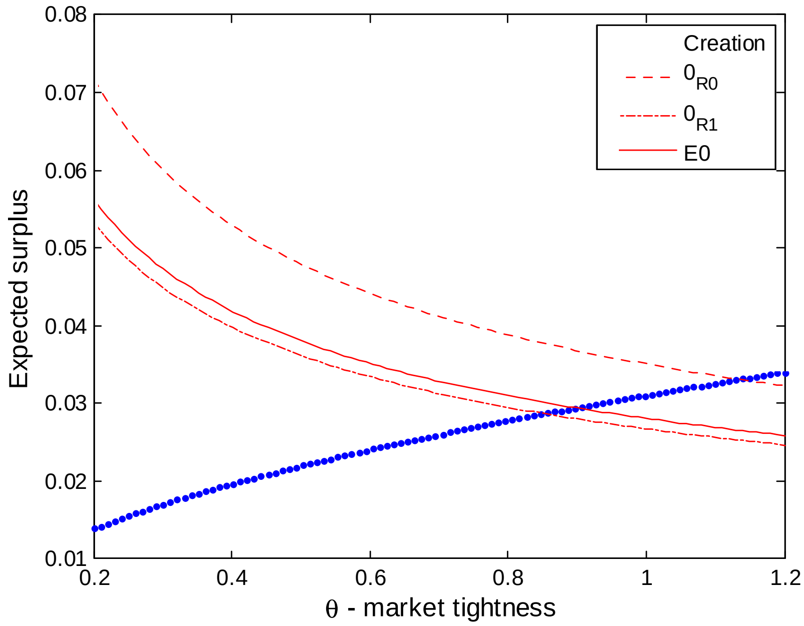

Figure 2: Equilibrium

tions (13) and (14) with weights $\frac{\widehat{u}_0(\theta)}{\theta q(\theta)\beta}$ and $\frac{1-\widehat{u}_0(\theta)}{\theta q(\theta)\beta}$ we get that $\frac{\widehat{u}_0(\theta)}{\theta q(\theta)\beta}\left((r+s)R_0(\theta)+\lambda R_1(\theta)\right)+\frac{1-\widehat{u}_0(\theta)}{\theta q(\theta)\beta}\left(sR_0(\theta)+(r+\lambda)R_1(\theta)-(r+\lambda+s)z\right)=\widehat{u}_0 O_{R_0}+(1-\widehat{u}_0)O_{R_1}\equiv EO(\theta)$. The (RHS) is the same average expected surplus as in the (RHS) of the creation equation. The equilibrium market tightness is then given by the intersection of the two curves: the upward sloping creation curve, and the $EO(\theta)$ curve constructed above.

The equilibrium is not necessarily unique. While the creation curve and the O_{R_0} curve decline with θ, the O_{R_1} curve may increase with θ. This happens whenever there are large gains from unemployment benefits, but a high probability of falling into uninsured unemployment. In such a case the weighted average of the two O_{R_i} curves can be non monotonic, creating multiple equilibria.[12] However, it can be shown that an equilibrium is stable if and only if the slope of the $E0(\theta)$ curve is smaller than the slope of the creation curve.

[12] Multiple equilibria arise, for instance, using the following parameter values: $y\tilde{}U[0,2], r=0.012, z=0.8, \beta=0.5, \gamma_0=1.47, q(\theta)=2.6\theta^{-0.5}, s=0.3, \lambda=0.08$.

3 Discussion

In this section I show the existence of a wage gap and an employment gap between insured and uninsured workers, and explore the sources of the differential effects of unemployment benefits on wages and unemployment. I first discuss the special case when the match specific productivity distribution is degenerate. For this special case I show that benefits increase expected wages and the wage gap, as they increase the wages of the insured and decrease the wages of the uninsured. Unemployment increases with benefits while market tightness decreases. I next extend the analysis to the stochastic productivity case to further explore the employment margins and show that the effect of UI benefits is now ambiguous. The full model is calibrated in the next section.

3.1 A Special Case: Degenerate Productivity Distribution

Consider first the case in which the match productivity distribution is degenerate. When a worker and a firm meet, they can jointly produce y, where y is large enough so that it is always efficient to produces.[13] In this simplified setting, there is no match formation decision, and hence I can focus on wages and the wage gap before moving on.

3.1.1 Wages

The two individual wage equations are derived from the Nash solution and a simplified creation curve.

$$\begin{aligned}
w_0 &= \beta y + (1-\beta) r J^{U0} - \lambda(1-\beta)(J^{U1} - J^{U0}) && (16)\\
&= \beta[y + \gamma_0\theta + (1-\widehat{u}_0)\frac{(1-\beta)\theta q(\theta)}{r+\beta\theta q(\theta)} z] - \lambda(1-\beta)\frac{z}{r+\beta\theta q(\theta)} && (17)\\
w_1 &= \beta y + (1-\beta) r J^{U1} + s(1-\beta)(J^{U1} - J^{U0}) && (18)\\
&= \beta[y + \gamma_0\theta - \widehat{u}_0\frac{(1-\beta)\theta q(\theta)}{r+\beta\theta q(\theta)} z] + (1-\beta)z + s(1-\beta)\frac{z}{r+\beta\theta q(\theta)}. && (19)
\end{aligned}$$

[13] This requires that $J^{F_i}(y) > 0 \iff y - w_1(y) > 0 \iff y > (1 + \frac{s}{r+\beta\theta q(\theta)})z$ which is verified after the equilibrium is solved.

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, a future entitlement effect, and an external pecuniary effect through the size of the insurance market. In addition, there is a general equilibrium effect arising from the response of equilibrium market tightness θ to benefits, an effect which I discuss later.

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 assigns to workers a share β of surplus above their entitlement to benefits, z.[14] 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 (16). The usual Nash bargaining terms $\beta y + (1-\beta)rJ^{U0}$ 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 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

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

relation is replaced in the unemployment values and then substituted into the wage equations (17) and (19), 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

$$\begin{aligned}\Delta w &\equiv w_1 - w_0 \qquad (20)\\ &= \frac{(1-\beta)(r+\lambda+s)z}{r+\beta\theta q(\theta)}.\end{aligned}$$

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.

3.1.2 Equilibrium

Define the average wages in the economy as $Ew \equiv \widehat{u}_0 w_0 + (1-\widehat{u}_0)w_1$. The equilibrium in this case can be summarized by two equations. The first is a simplified creation equation,

$$Ew = y - (r+\lambda+s)\frac{\gamma_0}{q(\theta)}. \qquad (21)$$

The second is an average wage equation, derived by adding the weighted individual wage equations (17) and (19),

$$\begin{aligned}Ew &\equiv \widehat{u}_0 w_0 + (1-\widehat{u}_0)w_1 \qquad (22)\\ &= \beta(y+\gamma_0\theta) + (1-\widehat{u}_0)(1-\beta)z + (1-\beta)\frac{z}{r+\beta\theta q(\theta)}[(1-\widehat{u}_0)s - \widehat{u}_0\lambda]\\ &= \beta(y+\gamma_0\theta) + \frac{\lambda}{\lambda+s}(1-\beta)z. \qquad (23)\end{aligned}$$

Observing the second line of the average wage equation, we notice 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. This term disappears because the insurance rate in this case is exogenous and given by $\widehat{u}_0 = \frac{s}{\lambda+s}$, or $\lambda\widehat{u}_0 = s(1 - \widehat{u}_0)$. In the general stochastic productivity case the insurance rate is endogenous and this term does not vanish, as discussed below.

These two equations solve for average wages and market tightness. The equilibrium differential wages w_0 and w_1 are then calculated using the equilibrium market tightness. From the steady-state flow equations we further have $u_0 = \frac{s}{\theta q(\theta)+\lambda+s}$ and $u_1 = u_0\frac{\lambda}{s} = \frac{\lambda}{\theta q(\theta)+\lambda+s}$. In this special case the equilibrium is also unique:

Proposition 3 *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 (21) and expected wage equation (22). 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 $H(\theta) \equiv \beta\gamma_0\theta + (r+\lambda+s)\frac{\gamma_0}{q(\theta)}$ is positive and increasing in θ and has $\lim_{\theta\to 0} H(\theta) = 0$ and $\lim_{\theta\to\infty} H(\theta) = \infty$, 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. ■

3.1.3 Effect of Benefits for the Special Case

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 when the stochastic productivity component is shut down.

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

Proposition 4 *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 special 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.

Higher unemployment benefits decrease the equilibrium ratio of vacancies to unemployment. Workers are therefore matched at a slower rate, and have longer unemployment spells. The next result formally shows that,

Proposition 5 *Unemployment increases with benefits.*

Proof. Solving for l_0 and l_1, the unemployment rate is[15]

$$\frac{unemployemnt}{labor\_force} = \frac{u_0 + u_1}{l_0 + l_1 + u_0 + u_1} = \frac{s+\lambda}{\theta q(\theta) + s + \lambda}.$$

By Proposition 4 $d\theta/dz < 0$, and since $d(\theta q(\theta))/d\theta > 0$ by the assumption on the matching technology, the result follows. ■

[15]

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

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

Proposition 6 *Benefits increase the wage gap.*

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 7 *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.

One can think of the wage curves as the labor supply curves.[16] If higher unemployment benefits reduce the wage uninsured workers accept, they are in fact willing to work for lower wages. Their incentive to work has increased. To illustrate the above mechanism when workers do have a decision margin, I add in the next section a match formation decision. When workers change their behavior in response to changes in market conditions, I can explicitly talk about the differential incentive effects of UI, and derive an endogenous rate of insurance.

3.2 Stochastic Match Productivity

I now allow for stochastic match productivity. The value-added is the additional match formation decision and the employment margins R_0 and R_1. Since an insured worker's outside value is higher than an uninsured worker's, insured workers will have a higher reservation productivity. In addition to the wage gap of the previous section, now higher unemployment benefits will also increase the employment gap between the insured and the uninsured by simultaneously reducing the insured employment and increasing the uninsured employment. These differential adjustments of the employment margin also imply that the insurance rate in the economy is now endogenous and higher than in the special case above. Also, the stochastic productivity component introduces an amplification of the wage gap and the threshold productivity gap through a term resembling an option value, as discussed below.

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 job acceptance 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

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

find that

$$
\begin{aligned}
R_0 &= rJ^{U0} - \lambda(J^{U1} - J^{U0}) \\
R_1 &= rJ^{U1} + s(J^{U1} - J^{U0}).
\end{aligned} \tag{24}
$$

In their match formation 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 form matches which are less productive, to a point where productivity equals their current unemployment value minus the future gain due to eligibility change, and similarly, for the insured, only higher productivity matches are accepted due to the expected loss of benefit eligibility in case of a quit. Wages simply track the threshold productivities in a very simple way: $w_i(y) = \beta y + (1-\beta)R_i$, and so the wage gap is also simply a fraction $(1-\beta)$ of the threshold gap.

For the threshold/wage gap we get $R_1 - R_0 = (r+s+\lambda)(J^{U1} - J^{U0}) = \frac{(r+\lambda+s)}{r+\theta q(\theta)\beta} z + \frac{\theta q(\theta)\beta}{r+\theta q(\theta)\beta}\left[\int_{R_0}^{R_1} G(x)dx\right]$. Note the new term, which resembles an option value term. Uninsured workers are now willing to accept jobs with a lower productivity, not only because of the increased value of employment due to future unemployment benefits, but also because there is an amplifying effect of this threshold gap. Given the lower threshold, uninsured workers' option value from work is larger, which increases the value from employment even further, reducing the threshold productivity.

Endogenous match formation also implies that the fraction of uninsured unemployment ($\widehat{u}_0$) is now endogenously determined. When unemployment benefits are more generous, the reservation productivity increases for the insured but decreases for the uninsured, resulting in a higher insurance rate of the unemployed. 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: $\widehat{u}_0 = \frac{s(1-G(R_1))}{s(1-G(R_1))+\lambda(1-G(R_0))} < \frac{s}{s+\lambda}$. This also implies that

$$
(1-\widehat{u}_0)s - \widehat{u}_0\lambda > 0 \tag{25}
$$

Inspecting workers' average threshold productivity, we have

$$\widehat{u}_0 R_0 + (1-\widehat{u}_0) R_1 = (1-\widehat{u}_0) z + \frac{\beta}{1-\beta}\theta\gamma_0 + [(1-\widehat{u}_0)s - \lambda\widehat{u}_0]\frac{(R_1 - R_0)}{r+\lambda+s}. \qquad (26)$$

The effect of unemployment insurance on the average reservation wages is now ambiguous. Reservation wages increase directly because of the benefits given to the insured, $(1-\widehat{u}_0)z$, an effect which is magnified by allowing the unemployed to adjust their behavior and increase the share of insured unemployment $(1-\widehat{u}_0)$. The ambiguity arises because of the third term, which now does not vanish as we saw from (25). The positive reservation wage gap $R_1 - R_0$ is larger when benefits are larger, because the values of insured employment and uninsured employment diverge. However, whether the term $[(1-\widehat{u}_0)s-\lambda\widehat{u}_0]$ decreases or increases with benefits depends on the distribution of productivities and the relative size of the separation shocks.

To see the similar ambiguity result for unemployment, use the flow equations to derive the unemployment rate

$$\begin{aligned}\frac{u_0+u_1}{u_0+u_1+l_0+l_1} &= \frac{s(1-F(R_1))+\lambda(1-F(R_0))}{\theta q(\theta)(1-F(R_0))(1-F(R_1))+s(1-F(R_1))+\lambda(1-F(R_0))} \\ &> \frac{s+\lambda}{\theta q(\theta)+s+\lambda}\end{aligned}$$

As can be seen, for a steady state equilibrium to hold, the unemployment rate must be proportional to the fraction of non eligible workers who are laid off and gain eligibility plus the fraction of eligible worker who quit and lose their eligibility. An increase in benefits raises the share of uninsured employment $(1-F(R_0))$, but lowers the share of insured employment, $(1-F(R_1))$, and thus the overall effect depends on the ratio of quits to layoffs and the density of the productivity distribution $G()$ at the threshold points R_0 and R_1. However, assuming similar densities, the response of the insured will tend to be larger, since he is directly affected by benefits, and not only through the future value of unemployment, as can be seen from the equations (13) and (14) determining R_0 and R_1. When UI benefits increase, the flow of eligible workers out of unemployment decreases by more than the same flow of noneligible workers increases. This result is reinforced whenever the layoff probability dominates the quit probability. Finally, the general equilibrium decline in market tightness magnifies the effect, increasing unemployment even further.

4 Calibration

To check for the sign and magnitude of the effect of an increase in unemployment benefits on unemployment and wages and to assess the magnitude of the differentials created by a partial insurance system, I now calibrate the full stochastic match productivity model to fit U.S. unemployment behavior and other estimated parameters of the model. The simulation results are similar to those derived analytically when productivity took only two values. Higher unemployment benefits increase the average threshold productivity, increase the threshold productivity for the insured worker, and decrease the threshold productivity for the uninsured worker. I show how the model's results vary with the business cycle, and check how sensitive are the results to the choice of parameters. 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] For the purpose of the calibration I will consider all job losers as eligible for UI, whether on layoff or otherwise. This is an upper bound on the fraction eligible for UI, as the job losers pool includes also those who were fired for cause and are not eligible but 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 3). The eligibility measure is also consistent with that of Blank and Card (1991) calculated for an earlier period (1977-1987). For the rate of ineligibility we will take separations that are due to a job quit. Accordingly, the rate of quits to job loss is taken to be $\frac{s}{\lambda} = 0.22$. The baseline

[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.

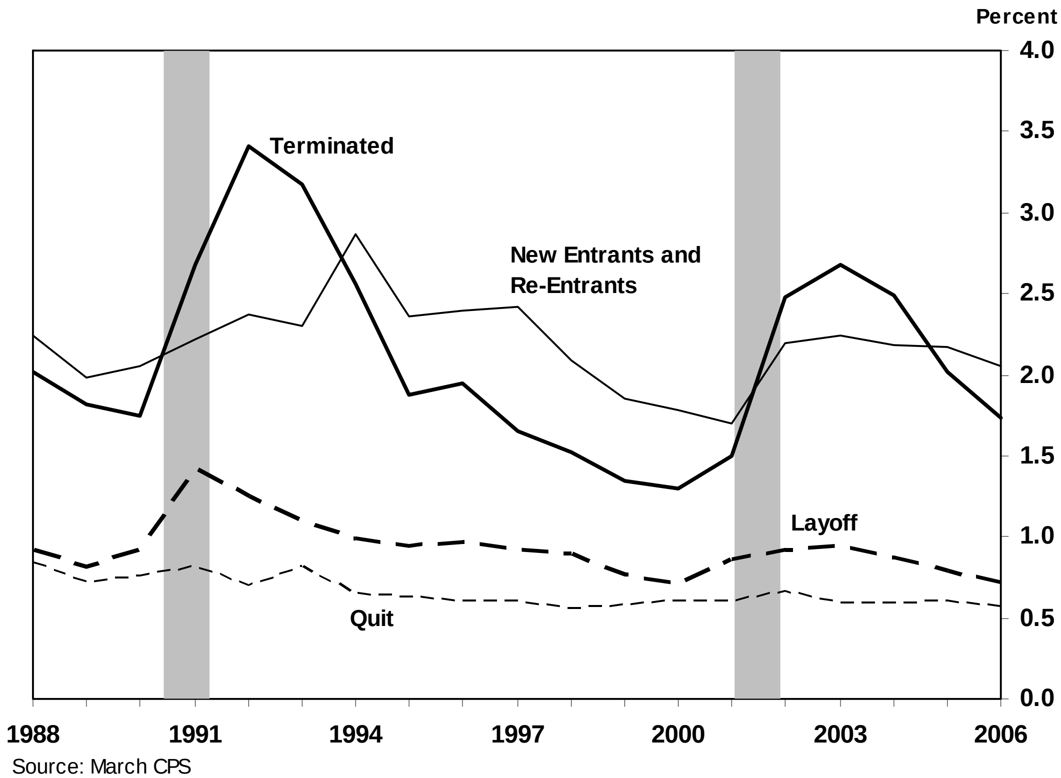

Figure 3: Reason for Unemployment (1988-2006)

calibration follows the model and abstracts from flows into and out of the labor force, although these are considered below.

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 uniformly distributed on the $[0, 2]$ interval. The benchmark value of unemployment benefits is taken to be $z = 0.4$, which is around the observed 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 returns-to-scale functional form: $q(\theta) = \mu\theta^{\alpha-1}$ 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

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

of opening up a vacancy (γ) and the parameter of the matching function (μ), jointly determine the unemployment rate and vacancy to unemployment rate. The Job Openings and Labor Turnover Survey (JOLTS) provides data on the number of vacancies to unemployed persons since December of 2001. This ratio fluctuates, and I set it equal to 0.9 in the initial equilibrium ($\theta = 0.9$), which is approximately its value at the onset of the 2001 recession (Bureau of Labor Statistics 2011). Then I match the average unemployment rate (1988-2005) of 5.8. This pins down $\gamma_0 = 1.47$ and $\mu = 10.6$ (see Table 1).[19]

Parameter Values in Simulations of the Model				
Parameter				
Mean productivity		y=1		
Benefits		z=0.4		
Discount rate		r=0.012		
Quit rate		s=0.018		
Layoff rate		λ=0.082		
Matching function		$q(\theta) = 10.6\theta^{-0.5}$		
Bargaining power		β=0.5		
Cost of vacancy		γ=1.47		

Table 1: Parameter Values

Using the above parameter values the equilibrium is unique. I find that unemployment benefits of 0.4 units of output is creating a 2 percent gap in wages between the insured and the uninsured. Since this is an upper limit, the calibrated model predicts a small wage gap, mostly due to the low incidence of unemployment insurance found in the data. This gap increases with unemployment benefits, and decreases with workers bargaining power β. The calibrated unemployment rate of 5.8 percent is associated with an average unemployment duration of 7.5 weeks, where the insured, compromising 84 percent of the unemployed, remain unemployed a week longer than the uninsured.

[19] Alternatively, I matched 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 implies an equilibrium unemployment rate of 6.8%.

Policy Experiment				
unemployment benefits z	0.1	0.4	0.5	0.8
low threshold R0	1.63	1.62	1.61	1.59
high threshold R1	1.64	1.67	1.67	1.70
wage gap Δw	0.006	0.025	0.032	0.057
unemployment u (percent)	5.12	5.81	6.10	7.26
u duration of uninsured (weeks)	6.44	6.69	6.79	7.16
u duration of insured (weeks)	6.64	7.67	8.10	9.85
insurance rate $1-\overline{u}_0$ (percent)	82.45	83.93	84.46	86.25
market tightness θ	1.06	0.90	0.84	0.67
output	1.648	1.645	1.610	1.633

Table 2

These outcomes are quite responsive to a change in unemployment benefits (see Table 2).[20] An increase in the generosity of benefits by 10 percentage points (from 0.4 to 0.5) increases the wage gap by 30 percent (elasticity of 1.3) and unemployment duration of insured individuals increases by 6 percent (elasticity of 0.07). The large response of the wage differential is partially due to a multiplier effect for which the equilibrium vacancy to 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 assess the magnitude of the general equilibrium effect, I hold constant the ratio of vacancies to unemployment and compare this analytic "counter factual" to the true effect. Such a decomposition shows a quarter of the increase in the wage gap is attributed to the general equilibrium adjustment in market tightness. The large general equilibrium effect results from a moderate elasticity of market tightness with respect to unemployment benefits, $\varepsilon_\theta = -0.052$. Note that this market tightness elasticity is still much higher than the wage elasticities ($\varepsilon_{w0} = -0.004$ and $\varepsilon_{w1} = 0.005$ for the low and high wages). Adding heterogeneity to workers' unemployment values makes market tightness much more sensitive than wages are with respect to changes in the environment. This sensitivity of market tightness relative to wage adjustment is apparent in the data, but has been missing from the standard search model. Accounting for workers' heterogeneity generates larger volatility

[20] Output is calculated as $l_0 \int_{R_0}^{\overline{y}} s dG(s) + l_1 \int_{R_1}^{\overline{y}} s dG(s) - \gamma_0 v$

of vacancies to unemployment than implied by the standard search models, thus providing yet another solution to the Shimer (2005) critique.[21]

For robustness I consider all reasons for non-insured unemployment by incorporating the flows into and out of the labor force. Using the CPS data above, the flows into uninsured unemployment now consist of new entrants to the labor market (0.08), re-entrants (0.29) and quitters (0.11). When adding to the pool of uninsured the new entrants and re-entrants, the flow into uninsured unemployment over the flow into insured unemployment is about 1.[22] Using these parameters the results are as follows. The wage gap remains at 2 percent. Increasing the relative flow of uninsured into unemployment, fundamentally changes the insurance rate which declines to 0.53 (from 0.84 in the baseline calibration). The complementary non eligibility rate of 0.47 is comparable to the 0.57 rate estimated by Blank and Card (1991). While the unemployment durations of the insured and the uninsured hardly change, the average unemployment duration declines to 7.1 weeks, because there is a larger pool of uninsured unemployed. Increasing the flows into uninsurance further discounts the value of unemployment benefits since there is a higher chance of being uninsured when unemployed. But the results show that the wage gap and unemployment duration barely change. However, sensitivity declines because of an increase in market tightness: with the increase in vacancies to unemployment, workers are less likely to remain unemployed, and thus are less sensitive to changes in UI policy. Now an increase in the generosity of benefits by 10 percentage points increases unemployment duration by 3.4 percent (was 5.2 percent in the baseline calibration), and the wage gap increases by 28.5 percent (was 29.2 percent). Thus, the baseline calibration which ignores 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. Nevertheless, the outcome differences between the two calibrations are negligible.

Next, I calculate how the gains of the insured vary with the business cycle (see Table 3).

[21] Pries (2006) also shows that adding hetrogeneity to worker's value from leisure delivers high sensitivity of the employment margin and lower sensitivity of wages.

[22] In the calibration, we use $s/\lambda = \frac{Quit+entrance+re\_entrance}{layoff+job\_lost} = \frac{0.11+0.08+0.29}{0.16+0.35} \simeq 1$. The results reported are holding fixed the cost of opening a vacancy, γ_0. Unemployment rate is therefore 5.5%, lower than the benchmark calibration. When matching the benchmark unemployment rate of 5.8%, by changing $\gamma_0 = 1.24$, the results are not qualitatively changed.

During recessions, the value of UI benefits rises not only because there is a higher chance of being unemployed, but also because the increase in layoffs results in a higher insurance rate. From CPS data I find that on average quits barely move while layoffs and other terminations rise from peak to bust from 2.3 percent of the labor force to 4.7 percent. Using these numbers I exactly match the average monthly separation rate of 0.034 with one standard deviation movement of 0.08 around this mean during high to low cycles, and a 4.4 percent unemployment during cycle boom to a 7.8 percent unemployment during the cycle low point. As expected, I find that the wage gap between the insured and uninsured rises during recessions, and that it is 60 percent higher (although this is a small 1 percentage point difference). This analysis shows that recessions have yet another cost, increasing inequality between the insured and the uninsured.

Business Cycle			
layoff probability λ	0.05	0.08	0.14
low threshold R0	1.68	1.62	1.53
high threshold R1	1.72	1.67	1.60
wage gap Δw	0.020	0.025	0.031
unemployment u (percent)	4.33	5.81	7.78
u duration of uninsured (weeks)	7.81	6.69	5.70
u duration of insured (weeks)	8.91	7.67	6.58
insurance rate $1-\bar{u}_0$ (percent)	74.86	83.93	89.78
market tightness θ	0.96	0.90	0.84
output	1.71	1.65	1.56

Table 3

Finally, table 4 present a sensitivity analysis, reporting how the wage gap, employment duration and averages wages vary with the choice of parameters. The results for the two models are reported: the simple model of section 3 and the model of section 2 with a match formation decision by workers.

			Elasticities			
model:	simple model			stochastic productivity		
outcome:	wage gap	average wages	duration	wage gap	average wages	duration
Parameter						
Max Productivity	-0.69	1.05	-0.74	NA	NA	NA
Replacement rate	1.11	0.03	0.12	1.23	NA	0.47
Discount rate	0.05	-0.01	0.02	0.00	NA	0.01
Quit rate	0.20	-0.03	0.02	0.22	NA	0.01
Layoff rate	0.91	-0.10	0.21	0.80	NA	0.24
Matching technology	-1.17	0.16	-1.25	-0.98	NA	-1.25
Bargaining power	-1.00	0.21	1.00	-0.98	NA	1.01
Cost of vacancy	0.58	-0.07	0.63	0.51	NA	0.63

Table 4: Sensativity analysis of the simple model and the model with stochastic productivity.

Given the 2% predicted wage gap, it is not surprising that this differential is hard to detect empirically.[23] 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 the characteristics of the 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. In the CPS data, a striking difference 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. It not obvious which are better workers. On the one hand, those who are laid off are probably the worst workers. Also, those who quit probably expect to fair better in their next employment relationship. On the other hand, those who quit may rather be of the quitting type, unable to hold a stable job.

Nevertheless, using such a selection-biased comparison between outcomes of recipients and nonrecipients, Ehrenberg and Oaxaca (1976) found that among older males there was a 7% differential in the post-unemployment wages of UI recipients relative to non-recipients. In their survey, Krueger and Meyer (2002) report on some recent studies, which use exogenous variation in benefits receipt to identify the effect of UI on the insured to find small or negligible effects on post-employment wages but sizeable effects on unemployment duration, consistent with my

[23] Recall this predicted wage gap is small because we allowed workers and firms to choose an entry productivity. Insured now differ from the uninsured also in their entry margin, and thus relaxes the wage gap differences. Without an entry choice the wage gap would have been almost twice as large.

results. The estimated elasticities of duration with respect to the benefit amount range from 0.4 to 0.6.

More recent work by Card, Chetty and Weber (2007) 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). Similarly, using regression discontinuity design on European data, van Ours and Vodopivec (2006) and Lalive (2007) do not find any effect of extended benefit duration on the quality of post unemployment jobs. Caliendo et al. (2009), on the other hand, find an effect of extended benefit duration not only on the duration of unemployment but also on the duration and wages of accepted jobs, an effect which is always smaller than 5 percent. While these studies are free of selection problems, they only identify the effects on the insured.

The analysis in this paper suggests that the institutional design of unemployment insurance creates a wage gap between insured and uninsured workers, and that this gap arises not only due to an increase in the wages of the insured but also to a decline in the wages of the uninsured.

5 Conclusion

Accounting for the existence of unemployed workers who are not currently receiving UI benefits, I investigated whether their increased incentive to work can dominate the depressed 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 to 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 causes further reduction in the wages of the uninsured and a smaller increase in the wages 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 that even in the steady-state the response of the uninsured will dominate, if the productivity distribution is more dense at their employment margin. In such a case, even a slight decline in their decision rule, will have large consequences.

There are other decision margins to explore. Similar results can be obtained if instead of a match formation decision I allow for a layoff decision. In a match with a previously insured worker, the threshold productivity for laying off a worker will be higher, again creating an employment wedge between the insured and the uninsured. Endogenizing quits would be more complex, but similar in spirit. First, we need to introduce a continuous quit shock, which could be a shock to a worker's value from leisure (here normalized to zero). Again, a previously insured worker will tend to quit for smaller shocks, and fall further into unemployment.[24] Prolonged unemployment for insured workers can also be derived from a search intensity decision, instead of a match formation decision. Similar wage and employment gaps will exist, but the results on average wages and unemployment will largely depend on the specification of the cost function, and in particular, how costs depend on effort and income. In addition, the mechanics will be different, since the worker's search choice must be made prior to meeting a firm and before the worker's and the firm's interests are aligned. I have chosen to present the mechanics of heterogenous insurance through the match formation decision margin, in order to make the discussion concrete.

The distinction between layoffs and quits and its implication for wage setting and policy are not well understood and can be further researched. In this paper, separate groups are formed because identical workers are hit with different shocks. Layoff shocks are shocks to productivity, which can be transferred between workers and firms. Quit shocks can be thought of as shocks to the non-transferable utility a worker derives from the current match, which could be due to a variety of reasons, ranging from the need to relocate, to boredom with the current job, or the placement of a new hostile supervisor. Potentially, quits may also be driven by shocks to workers' outside option. For instance, the value of leisure may increase because of a positive wealth shock or a relative needing more care. If this is the case, workers have, in effect, heterogenous preferences for leisure. Such quitters will continue to favor leisure in all future encounters. Implementing both types of quits is a possible extension. An alternative way to carve a 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.[25]

[24] However, having a continuous distribution of this value of leisure will entail a continuous distribution of unemployment values, which complicates the discussion, without new insights. Furthermore, if we follow this path and model a continous shock to leisure, we need to consider that it is likely to hit the unemployed workers as much as it affects the employed.

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

6 Appendix

6.1 Derivations of Equilibrium in Section 2

I first present a brief guide to deriving the equilibrium equations. Using the creation equation (12) with the firm vacancy value (1) yields,

$$\frac{\gamma_0}{q(\theta)} = \widehat{u}_0 \int_{R_0}^{\overline{y}} J^{F0}(x)dG(x) + (1-\widehat{u}_0)\int_{R_1}^{\overline{y}} (J^{F1}(x)dG(x). \tag{27}$$

The value for unemployed workers is derived by plugging the wage equation (7) into the unemployment values (3) to get

$$\begin{aligned} rJ^{U0} &= \frac{\beta}{1-\beta}\theta q(\theta)\int_{R_0}^{\overline{y}} J^{F0}(x)dG(x) \\ rJ^{U1} &= z + \frac{\beta}{1-\beta}\theta q(\theta)\int_{R_1}^{\overline{y}} J^{F1}(x)dG(x). \end{aligned} \tag{28}$$

In the wage bargain equation (7) replace J^{Ei} and J^{Fi} from (4) and (2) to get wages in terms of productivity and unemployment values,

$$\begin{aligned} w_0(y) &= \beta y + (1-\beta)rJ^{U0} - \lambda(1-\beta)(J^{U1} - J^{U0}) \\ w_1(y) &= \beta y + (1-\beta)rJ^{U1} + s(1-\beta)(J^{U1} - J^{U0}). \end{aligned} \tag{29}$$

Next solve for the threshold productivity by using the wage equation (7) 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 threshold level, or $J^{Fi}(R_i) = 0$. Using this with (2) $J^{Fi}(y) = \frac{y-w_i(y)}{r+\lambda+s}$ results in $R_i = w_i(R_i)$. Substitute for the above wage equations (29) at R_i, to find

$$\begin{aligned} R_0 &= rJ^{U0} - \lambda(J^{U1} - J^{U0}) \\ R_1 &= rJ^{U1} + s(J^{U1} - J^{U0}). \end{aligned} \tag{30}$$

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

This results in $J^{U1} - J^{U0} = \frac{R_1 - R_0}{r+\lambda+s}$ and in a linear relationship between wages and threshold productivity, $w_i(y) = \beta y + (1-\beta)R_i$. Plug this wage into (2) to solve for the firm values

$$J^{Fi}(y) = \frac{(1-\beta)(y - R_i)}{r+\lambda+s}. \tag{31}$$

Plug these into the unemployment values derived in (28) to have (after integrating by parts),

$$rJ^{Ui} = z * i + \frac{\theta q(\theta)\beta}{r+\lambda+s}\left[\overline{y} - R_i - \int_{R_i}^{\overline{y}} G(x)dx\right].$$

This also gives the difference between unemployment values as

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

Use this in (30) to solve implicitly for the threshold productivities (13) and (14) in the text. Replacing (31) in (27) gives the creation equation(12). This completes the derivation.

6.2 Proofs for Section 3

Proof of Proposition 2. By implicit differentiation of the equilibrium equations. creation (21) and expected wages (22) give us a system in (θ, Ew) :

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

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

Proof of Proposition 6. Totally differentiating the wage gap,

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

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

since $q\prime < 0$. ■

Proof of Proposition 7. 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[26]

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

We can then show

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

■

7 Bibliography

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