Unemployment Insurance Take-up Rates in an Equilibrium Search Model*

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Abstract

In the US unemployment insurance system, only a fraction of those eligible for benefits actually collect them. We argue this empirical fact can be explained by the equilibrium interaction between workers and firms. Firms finance UI benefits via a payroll tax and can partially control these costs via their search behavior. In equilibrium, offer workers an alternative UI scheme featuring a faster job arrival rate and a higher wage upon match formation. Quantitatively, we find this mechanism can produce the observed fraction of eligible workers who collect. This fraction is positively correlated with the replacement rate and negatively correlated with the potential duration of benefits.

Keywords: unemployment insurance, take-up, matching frictions, search
JEL classification: E61, J32, J64, J65

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1 Introduction

The unemployed *not* collecting benefits they are eligible for may represent the most important issue regarding the provision of unemployment insurance. We find the "take-up rate" (the fraction of eligible unemployed collecting benefits) averaged 63% from $1989-2011$. At these take-up rates, the unclaimed benefits typically exceed the extended benefit programs in the U.S. that have recently received increasing attention, and in some years the unclaimed benefits actually exceed those paid. The relatively low take-up rates have persisted despite reductions in the costs to applying for benefits, a fact unexplained by traditional theories of take-up rates. In this paper, we develop a theory to explain these facts at the macro-level, and analyze the effects of changes in the unemployment insurance system when the take-up rate responds endogenously.

Traditional theories of the take-up decision assume an explicit application cost. It could be the specifics of the administrative procedures, or lack of anonymity, i.e. a "stigma" attached to collecting benefits. While these theories certainly account for some aspects of the take-up decision, application costs in the U.S. have decreased over time. For example, in 1988 94% of initial unemployment insurance claims were filed in person, while in 2009, 85% were filed via phone and internet. Moreover, observed replacement rates and potential benefit durations show no evidence of changes in benefit generosity over time (see Figures 1(a) and 1(b) for details).

Given the decrease in application costs, under the traditional theory one expects to see a corresponding increase in the take-up rate. We find, however, that outside of cyclical variations, the take-up rate has remained relatively constant since 1989. We calculate the take-up rate for $1989-2011$ following a method similar to Blank and Card (1991), using CPS data along with detailed, state-level eligibility criteria. On average, for the period from $2003-2006$ (the period we calibrate to), the take-up rate is 64%.

We develop an alternative theory based on the equilibrium interaction between workers and firms. Specifically, we use a search model with matching frictions, in the class considered by Pissarides (2000). Workers are risk averse, heterogenous in productivity, and exert variable search effort looking for a job. Firms post vacancies and search/advertise for workers to fill them. We allow for firms to pay different taxes based on whether a separated worker collects unemployment benefits. This feature captures the "experience rating" in US system, where a firms' tax rate depends on the experience it has sending workers to collect unemployment benefits. Since firms finance the benefits of their workers, their costs are reduced when fewer workers collect benefits. In our model firms can partially control these costs by varying advertising intensity to attract workers who would not collect benefits if separated in the future.

In our model, the cost of collecting unemployment benefits is endogenously determined by firm and worker decisions. The economy is populated by two types of workers, workers who collect benefits and those who do not. If separated, workers decide whether to collect benefits. That is, they decide which type they prefer. Firms prefer to hire the non-collecting workers, and thus search harder to meet them. In equilibrium, workers choosing to be non-collectors receive job offers more frequently relative to those who do collect. Wages are determined by Nash Bargaining, and given the experience rated taxes, workers collecting benefits receive lower wage offers relative to an equivalent worker who does not collect.

The unemployment benefits in our model represent a stylized version of the US system. Workers receive a constant fraction of their previous wage, up to a maximum benefit amount. We also allow for a "two-tiered" benefit system, similar to Fredriksson and Holmund (2001) and Albrecht and Vroman (2005), where with a Poisson arrival rate a worker collecting benefits may lose them.

In equilibrium, the market effectively offers the worker two possible unemployment insurance schemes. The first is determined by the government, but financed by firms. It offers relatively high consumption smoothing during the unemployment spell. The second scheme is offered by firms to workers who decide to forgo the government provided benefits. This scheme does not directly provide consumption insurance while unemployed, but offers a faster job arrival rate and a higher wage offer when one does arrive. In general, given the aforementioned benefit structure, for both very low and very high productivity workers, the market provided scheme may be more appealing. In our model economy, we then explore whether this endogenous mechanism is quantitatively feasible for the take-up rates observed in the U.S.

Our results suggest the model performs well in matching observed take-up rates. For example, we calibrate to match the observed replacement rate among those in the data for whom the maximum benefit is binding; however, the fraction of agents for whom the maximum benefit binds is a free parameter. With regards to this moment, the model does well, predicting that 19% of agents who collect benefits face a binding maximum, while the data indicates 23% actually do.

Given this parametrization, we consider several policy experiments to analyze how changes to unemployment benefits affect the take-up rate. We find that the take-up rate is positively correlated with the basic replacement rate (the replacement rate for anyone with benefits below the maximum amount), but negatively correlated with the maximum benefit amount and the potential duration of benefits. Moreover, the two latter effects tend to be relatively large, while the effect of the basic replacement rate is relatively small.

Changes to the maximum benefit amount and the potential duration of benefits have large effects on the overall cost of unemployment insurance relative to changes in the basic replacement rate. As a result, firm and worker decisions respond more, magnifying the effects. Firm behavior also explains the negative relationship between the maximum benefit and potential duration, and the take-up rate. Since changes in these two parameters has a large effect on the cost of the unemployment insurance system, firms respond and the difference in job finding rates and wages between the two types of workers increases. This makes the market provided scheme look more appealing, decreasing the take-up rate.

Another contribution of our paper is that is allows us to analyze how the generosity of unemployment benefits affects equilibrium outcomes, such as the unemployment rate and average unemployment duration, in a model where the take-up rate responds endogenously. Davidson and Woodbury (1998) and Wang and Williamson (2002) are two examples where unemployment insurance policies are considered in models with take-up rates less than 1, but in these papers the take-up rate is exogenous, and thus invariant to changes in policy. To evaluate how much this affects the results, we calibrate an alternative model assuming a take-up rate of 100%, and perform the same aforementioned policy experiments. We find that including the take-up rate matters for the results.

The remainder of the paper proceeds as follows. In Section 2 we present the data, our procedure for estimating the take-up rate, and provide a discussion of how the data supports our modeling choices. Next, Section 3 describes the model, while Section 4 presents the calibration, empirical results, and policy experiments. Finally, we conclude in Section 7.

2 Evidence on take-up rates

This section has three purposes. First, we explain some features of the unemployment insurance system in the U.S. relevant for our analysis. Second, we present data that support our attempt to model alternative costs to applying for unemployment benefits. Finally, we detail our estimation of the take-up rate, and explore the key features of our estimates.

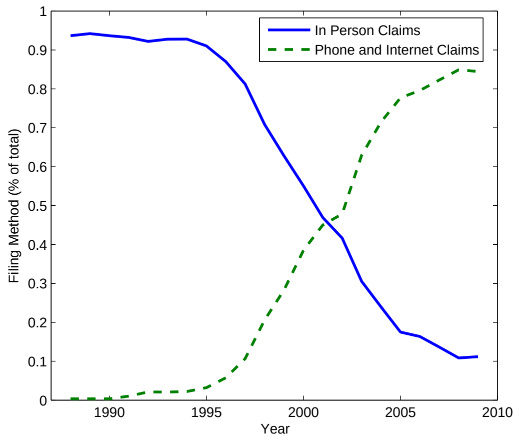
2.1 Unemployment Insurance System in the U.S.

The costs imposed on firms by workers who collect benefits represents the key element of our theory. The specifics of the U.S. unemployment insurance system help illuminate these costs. These costs arise from the administrative procedures related to a worker who files a claim for benefits, and the tax rates imposed on firms to finance the benefits.

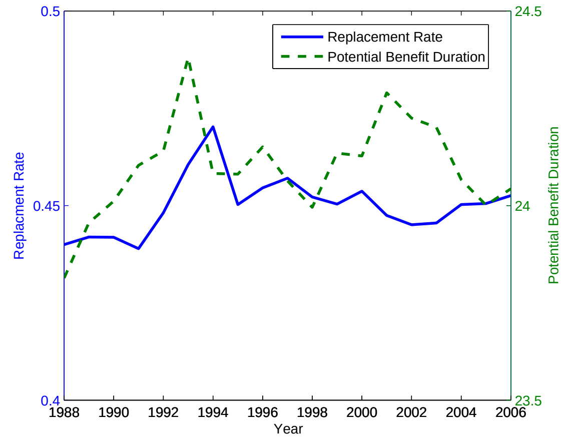
When a worker files a claim for unemployment benefits, the Unemployment Insurance authority in that U.S. state then contacts the worker's previous employer(s) to verify the relevant information. For example, they need to verify the wages claimed by the worker to determine eligibility and calculate the proper benefit. They also have to verify that the nature of the separation is proper, since certain separations render the worker ineligible for benefits (we discuss these criteria below in Section 2.3). When there are disagreements between the worker and the firm the case may move to the legal system to resolve the dispute. Thus, even before paying taxes, the administrative procedures related to a worker filing a claim for benefits may be substantial.

The payroll tax levied on firms to finance benefits is experienced rated. Firms pay a tax rate that is positively correlated with their contribution to *insured* unemployment in their particular U.S. state. For example, a firm that has never separated from a worker who collects benefits pays a lower tax rate than a firm that has frequent layoffs collecting benefits. Note, for the firm's tax rate, it does not matter how frequently they separate from workers, but how frequently they separate from workers who collect benefits. The precise nature of this experience rating depends on the U.S. state, with both the tax rates and the taxable wage base varying across states. In 2010 for example, the smallest taxable wage base was $7000 (several states) and the maximum was $37,300 in Washington. The experience rated taxes are subject to maximum and minimum amounts. In 2010 the lowest minimum tax rate was 0% (several states) and the highest maximum rate was 13.5576% in Pennsylvania.

In this paper, we examine how this experience rating affects the hiring decisions of firms. It remains possible, however, that the aforementioned experience rating also affects firm layoff decisions. Feldstein (1976) and Topel (1983) both examine how the partial experience rating in the U.S. affects firm separation decisions. For example, a firm may find it beneficial



(a) Filing Methods



(b) Benefit Generosity

to reduce the hours worked as opposed to a layoff to economize on unemployment insurance taxes. While in our model we assume separations are exogenous, an interesting direction for further research is to incorporate this dimension into our analysis of take-up decisions.

2.2 Filing methods for initial claim

If there do exist explicit costs to applying for unemployment benefits, these should manifest themselves in the specifics of the application process. Examining data on the initial filing method represents one way to determine how the costs to applying may have changed over time. Such data is available from a program called BAM (Benefit Accuracy Measurement) run by the U.S. Department of Labor. BAM selects a random sample of UI recipients/applicants and audits each case to examine the accuracy of paid claims, as well as the appropriateness of any benefit denials. Among the many variables of interest in the BAM data, the audit determines the method used for filing the initial claim. In Figure 1(a) we present this data from $1988 - 2009$.

There exist five possible initial filing methods. These include, in person, mail (including e-mail), telephone, employer filed claim, and internet claim. Figure 1(a) plots the fraction of agents who file in person, compared to the fraction filing by phone and/or internet (the other filing methods account for a small fraction of the total).[1] The graph indicates that there has been a large shift in how unemployment benefit applications are filed in the U.S.; in person claims and phone and internet claims have switched as the dominant method. This change has almost certainly had an effect on the explicit application costs of applying for UI. First, since an in person application is typically no longer required, at a minimum, the time associated with filing a claim has been dramatically reduced. Second, applying via phone or internet makes the process more anonymous, which reduces any negative stigma associated with applying for benefits.

One could also argue that changes in the generosity of benefits may affect the take-up rate. That is, although application costs have decreased, benefits may be less generous. In Figure 1(b) we plot the average replacement ratio and potential benefit duration (average across US states) over time. These averages are for individuals who collected benefits. There is some cyclical behavior, but otherwise it appears that the generosity of the US system has been relatively constant over the period from $1988 - 2010$.

Given these facts, if indeed explicit application costs explain the majority of the take-up decision, we should observe an increase in the take-up rate as these costs have clearly decreased, with no change in benefit generosity. We argue the take-up rate has remained relatively constant, and below we present the details of our calculations.

2.3 Take-up rate estimates

While many statistics and data on the labor market are readily available for public use, there exists little information on take-up rates of unemployment insurance. There is data on the characteristics of the insured unemployed, as well as data on the ratio of insured unemployed to total unemployed (hereafter IUR). The IUR series is the ratio of insured

[1] Prior to 2002, there were no internet claims observed, so this represents a recent phenomenon.

unemployed (those collecting benefits) to total unemployment. While this provides some characterization of the take-up rate, the IUR does not control for eligibility. For example, there exist limits on the duration one may collect benefits for (typically 26 weeks); as a result, the IUR includes individuals who are not eligible to collect because they have been unemployed for longer than 26 weeks. Moreover, each state has specific eligibility criteria, further complicating the calculation of take-up rates since each state must be considered separately. To calculate the *take-up rate*, we first find the fraction of unemployed agents who are currently eligible to collect, and then take the ratio to insured unemployed to total *eligible* unemployed.

We follow a method similar to Blank and Card (1991). Specifically, we use data from the March Supplement of the CPS (Current Population Survey) along with the specific eligibility criteria of each state, for each year from $1989-2011$.[2] Eligibility depends primarily on three factors, and Figure 1 displays our estimate of the take-up rate, IUR, and the contribution of each of the three eligibility criteria. The line labeled IUR plots the insured to total unemployment ratio from $1989-2011$, and the line labeled TUR plots our estimate of the take-up rate. We now explain our approach to estimating each of the three primary eligibility categories.

First, there exist monetary eligibility requirements. These require an agent to have accumulated a sufficient amount of earnings in a specified "base-period," or worked a minimum number of weeks.[3] To estimate monetary eligibility, we use the earnings information contained in the March CPS. The line labeled MNE in Figure 1 displays the increase in the take-up rate from the IUR when only monetary eligibility requirements are imposed.

The nature of the separation leading to the spell of unemployment represents the second

[2]Both Blank and Card (1991) and Anderson and Meyer (1997) provide estimates of the take-up rate prior to 1989.

[3]The base-period differs across states. Many use a year, while others use two quarters. The base-period is used both to determine monetary eligibility and to calculate the specific benefit an agent is entitled to.

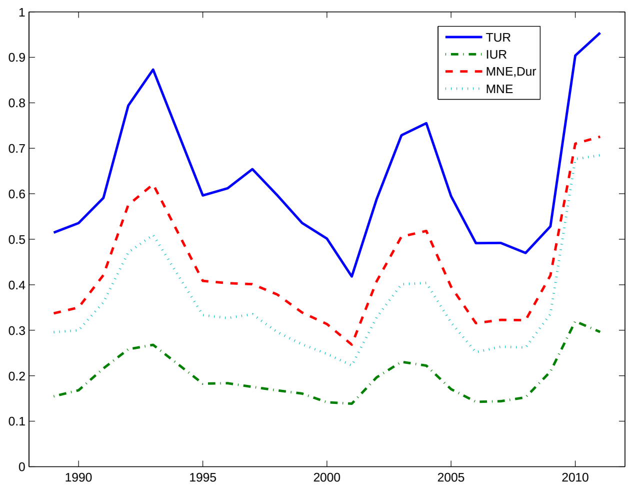


Figure 1: Take-up Rates by Eligibility Criteria

element of eligibility criteria. Specifically, in most states, agents who quit their previous job, or were fired for cause, are not eligible to collect benefits.[4] This criteria is intended to limit benefits to only those individuals who have lost their job through no fault of their own. In the CPS data, we can eliminate quits; however, we can not determine whether or not the agent was fired for cause. In addition, the total unemployed in the CPS contain re-entrants (those who had previously left the labor-force, but are now re-entering), and new entrants (those never previously in the labor force). Since these later two groups are clearly not eligible to collect benefits, we exclude them.

Finally, eligibility for benefits depends on the length of the unemployment spell. All states have a maximum potential duration of benefits, which typically limits benefits to 26 weeks. There are some exceptions to this rule, as some states allow for 30 weeks of benefits, and in times of high unemployment, eligibility may be extended through the Federal-State Extended Compensation Program, and we account for these where applicable. In addition to the maximum length of benefits, many states also have a minimum waiting period, typically

[4]Georgia is an exception, and does allow job leavers (quits) to collect benefits, but they face an increased waiting period before eligible.

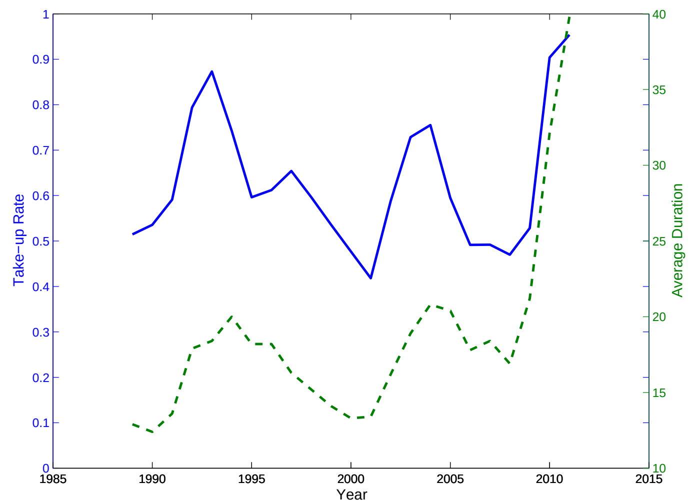


Figure 2: Take-up Rates and Average Duration of Unemployment

1 week. Since the CPS contains information on the agent's length of unemployment spells, we are able to control for this criteria. In Figure 1, the line labeled MNE-Dur displays the take-up rate when only the aforementioned duration criteria are removed, and eligibility is determined by the monetary and separation requirements. Overall, Figure 1 displays that the monetary and duration criteria contribute the most to the difference between the take-up rate and IUR, and the separation criteria less so.

Another interesting feature displayed in Figure 1 is the cyclical nature of these data. Figure 2 plots our estimate of the take-up rate from 1989−2011, along with the corresponding average duration of unemployment in March of each year. The left-hand y-axis plots the take-up rate, and the right hand y-axis the average duration of unemployment. There are two interesting features of this graph. First, there is a clear cyclical dimension to the take-up rate, as its movements track very closely the movements in the average duration of unemployment. Second, outside of these cyclical variations, the take-up rate appears to have remained relatively constant, or may have slightly declined.

3 Model

3.1 Setup

The economy consists of a unit-measure of infinitely-lived, risk-averse agents, and a large measure of risk-neutral firms. Time is continuous and goes on forever, and agents and firms both discount the future at rate $r > 0$. Each agent has an endowment of one unit of time. Agents have preferences over consumption and leisure, with per-period utility function given by $h(c, \ell)$, where c represents consumption and ℓ is leisure. Let h_c and h_ℓ denote the partial derivatives of h with respect to its first and second arguments, respectively.

Agents are heterogenous with respect to their permanent productivity y. Let $\mathbf{Y}$ denote the set of all productivity levels. Let F be the distribution of agents over $\mathbf{Y}$. Firms are composed of a single job, either filled or vacant, and discount future profits at rate r. Vacant firms are free to enter and pay a flow cost, $ak > 0$, to advertise a vacancy. Vacant firms produce no output. The flow output of a firm with a filled job is given by productivity of its employee y.

Both workers and firms are allowed to vary the intensity with which they search for a match. Specifically, an unemployed worker exerts search effort $s \in [0, 1]$ looking for a firm, and firms exert effort $a \in [0, 1]$ "advertising" vacancies. For an unemployed worker exerting search intensity s, the leassure is $\ell = 1 - s$. While employed, a worker supplies one unit of labor inelastically and thus has zero leisure.[5] Unemployment benefits are financed by lump-sum taxes levied on firms. These taxes are experienced rated in the following manner: only firms that hire workers who collect benefits pay taxes, while a firm that hires an agent who does not collect benefits does not pay the tax.

[5]We have assumed that employed workers enjoy leisure equal to the time endowment. Alternatively, we could assume agents spend some fixed amount of time working; however, our assumption simply represents a normalization, which we explain in more detail in Section 4.1 when discussing the calibration.

3.1.1 Flow income, benefits and wages

Unemployed agents can be in one of three possible states. The states are differentiated based on whether or not the agent collects unemployment benefits. First, upon being separated from an employer, the agent decides whether to enter unemployment state $i = 1$ or $i = 3$, where $i = 1$ denotes unemployed collecting benefits, while $i = 3$ denotes unemployed not collecting benefits. Finally, if collecting benefits, we assume that with Poisson arrival rate δ, benefit eligibility ends, and the agent enters state $i = 2$. This feature captures the empirical fact that in the U.S., unemployment benefits are paid for a fixed period of time. Let $\mu_{u,i}(y)$ denote the number of unemployed workers of productivity y in state $i \in \{1, 2, 3\}$. Let $\mu_e(y)$ denote the total number of employed workers of productivity y.

The wages are determined via Nash Bargaining between the worker and firm. Anticipating our result that the wage is unique to productivity, let $w(y)$ denote the productivity-specific wage. The flow income of an unemployed worker collecting benefits is modeled using the key features of the U.S. system. This system involves payments that are a constant fraction of the previous wage, for a fixed length of time. an agent's unemployment benefit is given by $bw(y)$, where b is the replacement rate. We also model the feature of the U.S. system by restricting the benefits subject to a maximum amount denoted by B. Then, the actual unemployment benefit of the agent is given by $\min\{bw(y), B\}$. The base level of income is given by $gw(y)$, where $g < b$.[6] So, the consumption of an unemployed agent can be summarized by the following function:

$$z_i(y) = \begin{cases} gw(y) + \min\{bw(y), B\} & \text{if } i = 1, \\ gw(y) & \text{if } i \in \{2, 3\}. \end{cases} \tag{1}$$

[6] Depending on the specific utility function, it might be necessary to set g to a positive number. There are several possible ways to interpret this value. A natural interpretation of non-market income is home production. Another possibility is that d serves as a proxy for other assets or savings. The main idea is that for positive g, an agent's total consumption while not employed is not equal to only UI benefits if collecting.

3.1.2 Matching technology and frictions

Let S be the total search intensity of all unemployed workers. Suppose that the number of vacant firms searching for an unemployed worker be v. We allow a firm to search, or advertise, with different intensity for these two types of workers. Denote a firms' advertising effort for the former by a_1 and for the latter by a_3. We constrain total advertising effort of a firm to 1, i.e. $a_1 + a_3 = 1$. Let A_1 and A_3 be the sum of a_1 and a_3, respectively, over the v vacancies.

The number of the new matches formed between the v vacancies and $n_1 + n_2$ unemployed workers is given by $m(S, A_1)$, while the number of the new matches formed between the v vacancies and n_3 unemployed workers is given by $m(S, A_3)$. The matching function, m, is continuous, strictly increasing, strictly concave (with respect to each of its arguments), and exhibits constant returns to scale. Furthermore, $m(0, \cdot) = m(\cdot, 0) = 0$ and $m(\infty, \cdot) = m(\cdot, \infty) = \infty$. Given this matching technology, a vacancy is filled with Poisson arrival rate $a_j m(S/A_j, 1)$, where $j \in \{1, 3\}$. Similarly, each unemployed worker looking for a job of type j exerting search intensity s finds a job according to a Poisson process with arrival rate $sm(1, A_j/S)$. For notational convenience, let $q_j = m(S/A_j, 1)$ and $p_j = m(1, A_j/S)$ for $j \in \{1, 3\}$.

Filled jobs receive negative idiosyncratic productivity shocks rendering the match unprofitable with a Poisson arrival rate λ.

3.2 Value functions and wages

This section details the Bellman equations describing the behavior of workers and firms and the mechanism of the wage determination.

3.2.1 Workers

Let $U_i(y)$ denote the expected value of searching for a job to an unemployed worker of productivity y who is in state $i \in \{1, 2, 3\}$. Let $W(y)$ denote the expected lifetime utility of employment to a worker of productivity y. These values are given by the following equations:

$$\begin{aligned}
rU_1(y) &= \max_s \{h(z_1(y), 1-s) + p_1 s\,(W(y) - U_1(y)) + \delta\,(U_2(y) - U_1(y))\} & (2)\\
rU_2(y) &= \max_s \{h(z_2(y), 1-s) + p_1 s\,(W(y) - U_2(y))\} & (3)\\
rU_3(y) &= \max_s \{h(z_3(y), 1-s) + p_3 s\,(W(y) - U_3(y))\} & (4)\\
rW(y) &= h(w(y), 1) + \lambda\,(\max\{U_1(y), U_3(y)\} - W(y))\,. & (5)
\end{aligned}$$

Equation (2) says that an unemployed agent collecting benefits receives instantaneous flow utility $h(z_1(y), 1-s)$ from unemployment compensation and the utility cost of search effort s. With arrival rate $p_Y s$ the worker matches with a firm and transitions to employment, while at rate δ unemployment benefits expire, and the agent transitions to state $i = 2$. Equation (3) and (4) have similar interpretations for an agent who has exhausted benefits and one who never collected, respectively. Finally, equation (5) states that, given the productivity-specific wage $w(y)$, an employed agent receives instantaneous flow utility $h(w(y), 0)$. With Poisson arrival rate λ, the job dissolves and the agent then decides whether or not to collect unemployment benefits.

3.2.2 Firms

Denote by V the value of a vacancy. Let J_1 be the value of a matched firm whose employee collects unemployment benefits, while J_3 be the value of a matched firm whose employee does not collect benefits. Further, let $\mathbf{Y}_1 \subset \mathbf{Y}$ denote the subset of productivity levels where workers collect benefits and $\mathbf{Y}_3 \subset \mathbf{Y}$ ($\mathbf{Y}_3 = \mathbf{Y} \setminus \mathbf{Y}_1$) denote the subset of productivity levels where workers do not collect benefits. Then, a firm's vacancy creation and advertising decisions can be captured by

$$rV = \max_{a_1,a_3}\{-k(a_1+a_3)+q_1a_1\int_{\mathbf{Y}_1}(J_1(y)-V)\,\psi_1(y)dy+q_3a_3\int_{\mathbf{Y}_3}(J_3(y)-V)\,\psi_3(y)dy\} \quad (6)$$

subject to

$$a_1+a_3=1, \quad (7)$$

where $\psi_1(y)$ ($\psi_3(y)$) is the probability that a firm hires a worker of productivity y who collects (does not collect benefits) benefits conditional on hiring a worker.

When hiring a worker who collects benefits, the firm pays per-period lump sum taxes τ. Thus, the Bellman equations describing the value of a matched firm are given by:

$$rJ_1(y) = y - w - \tau + \lambda\,(V - J_1(y)) \quad (8)$$

and

$$rJ_3(y) = y - w + \lambda\,(V - J_3(y))\,. \quad (9)$$

3.2.3 Wages

Upon meeting and deciding to form a match, wages are determined by the generalized Nash Bargaining solution between workers and firms. Letting $\beta \in (0,1)$ denote the worker's bargaining power, the wage for an agent of productivity $y \in \mathbf{Y}_i$ for $i \in \{1,3\}$ is determined by:

$$\max_{w}\,(W(y;w)-U_i(y))^{\beta}\,(J_i(y;w)-V)^{1-\beta} \quad (10)$$

We also assume that wages can be re-negotiated at any time, so that the threat value of an agent who collects benefits is $U_1(y)$, regardless of whether or not benefits have expired.

3.3 Behavior of workers and firms

In the remainder of the section, we characterizes the equilibrium of the model economy. The F.O.C. of equation 10 is given by,

$$W(y) - U_i(y) = \frac{\beta}{1-\beta} \left(J_i(y) - V\right) h_c(w(y), 0). \tag{11}$$

Let $s_i(y)$ be the optimal choice of search effort for an unemployed worker with productivity y. Then, at equilibrium, we must have

$$\psi_1(y) = \frac{\mu_{u,1}(y)s_1(y) + \mu_{u,2}(y)s_2(y)}{S_1} \tag{12}$$

and

$$\psi_3(y) = \frac{\mu_{u,3}(y)s_3(y)}{S_3}. \tag{13}$$

Moreover, using the F.O.C. in the agent's problem with respect to s,

$$p_i \left(W(y) - J_i(y)\right) = h_\ell(z_i(y), 1 - s_i(y)). \tag{14}$$

Combing the value functions of the firms with the free entry condition that $V = 0$, it can be shown that

$$q_1 \int_{\mathbf{Y}_1} J_1(y)\psi_1(y)dy = q_3 \int_{\mathbf{Y}_3} J_3(y)\psi_3(y)dy. \tag{15}$$

Furthermore, using $V = 0$, (8) and (9) to solve for J_1 and J_3, respectively, and plugging into (6) and using (15) give

$$\frac{k}{q_1} = \int_{\mathbf{Y}_1} \frac{y - w_1(y) - \tau}{r + \lambda} \psi_1(y)dy \tag{16}$$

Given the decision rules for effort in (14), the Bellman equations for unemployed workers are simplified to the following:

$$
\begin{aligned}
rU_1(y) &= h(z_1(y), 1-s_1(y)) + s_1(y)h_\ell(z_1(y), 1-s_1(y)) + \delta\,(U_2(y) - U_1(y)) && (17)\\
rU_2(y) &= h(z_2(y), 1-s_2(y)) + s_2(y)h_\ell(z_2(y), 1-s_2(y)) && (18)\\
rU_3(y) &= h(z_3(y), 1-s_3(y)) + s_3(y)h_\ell(z_3(y), 1-s_3(y)). && (19)
\end{aligned}
$$

Using these equations, it can be shown that the following must hold for an unemployed agent who is currently collecting benefits:

$$
\begin{aligned}
W(y) - U_1(y) &= \frac{1}{r+\lambda}\Big\{h(w(y),0) - \\
&\quad \frac{r}{r+\delta}\Big(h(z_1(y),1-s_1(y)) + s(y)h_\ell(z_1(y),1-s_1(y))\Big) - \\
&\quad \frac{\delta}{r+\delta}\Big(h(z_2(y),1-s_2(y)) + s_2(y)h_\ell(z_2(y),1-s_2(y))\Big)\Big\}. \qquad (20)
\end{aligned}
$$

Combining (5), (18), and (20), for an agent who has exhausted benefits,

$$
\begin{aligned}
(r+\lambda)(W(y) - U_2(y)) &= h(w(y),1) + \frac{\lambda}{r+\delta}\Big(h(z_1(y),1-s_1(y)) + \\
&\quad s_1(y)h_\ell(z_1(y),1-s(y))\Big) - \frac{r+\lambda+\delta}{r+\delta}\times \\
&\quad \Big(h(z_2(y),1-s_2(y)) + s_2(y)h_\ell(z_2(y),1-s_2(y))\Big). \qquad (21)
\end{aligned}
$$

Finally, for a non-collector, using (5) and (19) we have

$$
(r+\lambda)(W(y) - U_3(y)) = h(w(y),0) - h(z_3(y),1-s_3(y)) - s(y)h_\ell(z_3(y),1-s_3(y)). \qquad (22)
$$

Combining (20) and (22) with the Nash F.O.C. in (11) determines $w(y)$, and combining (20)-(22) with (14) determines the optimal search intensity $s_i(y)$ for each i.

3.3.1 Endogenous segmentation by productivity

To determine equilibrium, we also need to determine the set $\mathbf{Y}_1$. This can be characterized by $U_1(y)$ and $U_3(y)$ crossing either once or twice (of course they need not cross for every parametrization). In all parameterizations that we tried, however, the difference $U_3(y) - U_1(y)$ had the non-monotonic shape displayed in the figure and so, in general there can be two crossing points between $U_1(y)$ and $U_3(y)$. Figure 3 plots the difference $U_3(y) - U_1(y)$ across y for our baseline calibration. Let y_0 and y_1 denote these crossing points, i.e. $U_1(y_0) = U_3(y_0)$ and $U_1(y_1) = U_3(y_1)$. The difference $U_3(y) - U_1(y)$ starts increasing at the value of y where the maximum benefit level begins to bind. Once the maximum benefit binds, as y (and thus $w(y)$) increases, the replacement rate is decreasing, and eventually becomes low enough that the benefits of not collecting (higher job arrival rate) outweigh the benefits of collecting. Thus, for productivity values below y_0 and above y_1 (i.e., when $U_1(y) < U_3(y)$) agents do not collect benefits, while for intermediate productivity values, agents do collect. So, $\mathbf{Y}_1 = \{y \in \mathbf{Y} | y_0 < y < y_1\}$. Given the common match separation rate, the take-up rate of the model economy can be calculated as the following ratio:

$$\text{TUR} = \frac{\displaystyle\int_{\mathbf{Y}_1} \mu_e(y)dy}{\displaystyle\int_{\mathbf{Y}} \mu_e(y)dy}. \tag{23}$$

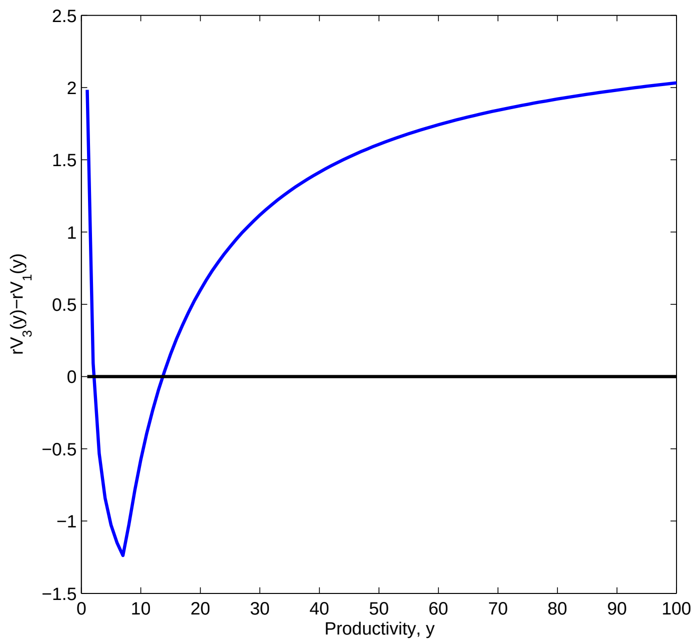


Figure 3: Determination of $\mathbf{Y}_1$

3.3.2 Labor market flows and stocks

Our description of equilibrium also requires the flow equations associated with the measures $\{\mu_{u,1}, \mu_{u,2}, \mu_{u,3}, \mu_e\}$:

$$\lambda\mu_e(y) = p_1\mu_{u,1}(y)s_1(y) + p_1\mu_{u,2}(y)s_2(y), \forall y \in \mathbf{Y}_1 \tag{24}$$

$$\lambda\mu_e(y) = p_3 s_3(y)\mu_e(y), \forall y \in \mathbf{Y}_3 \tag{25}$$

$$\delta\mu_{u,1}(y) = p_1 s_2(y)\mu_{u,2}(y), \forall y \in \mathbf{Y}_1 \tag{26}$$

$$\mu_e(y) + \mu_{u,1}(y) + \mu_{u,2}(y) + \mu_{u,3}(y) = f(y), \forall y, \tag{27}$$

where f denotes the p.d.f of F. Equation (24) states that the flows into and out of insured employment remain equal, while equation (25) equates the flow into and out of un-insured unemployment. The flows of agents who have exhausted benefits is governed by equation

(26), and equation (27) ensures measure 1 of agents since $F(\infty) = 1$.

We can now summarize the equilibrium conditions.

3.3.3 Equilibrium

Definition 1 *An equilibrium is functions* $\{w, s_1, s_2, s_3\}$*, measures* $\{\mu_{u,1}, \mu_{u,2}, \mu_{u,3}, \mu_e\}$*, quantities* $\{q_1, q_3, S_1, S_3, \tau\}$ *and subsets* $\{\mathbf{Y}_1, \mathbf{Y}_3\}$ *such that*

1. *Given equations (20)-(22),*

   (a) $\{q_1, q_3\}$ *satisfy (15) and (16) subject to (12) and (13),*

   (b) *the function* w *satisfies (11), and*

   (c) *the function* s_i*, satisfies (14) for each* i*;*

2. $\{\mu_{u,1}, \mu_{u,2}, \mu_{u,3}, \mu_e\}$ *satisfy (24)-(27);*

3. *Subsets* $\{\mathbf{Y}_1, \mathbf{Y}_3\}$ *and total search intensities* $\{S_1, S_2\}$ *are consistent with individuals' behavior:*

$$s_1(y) = s_2(y) = 0 \text{ for all } y \in \mathbf{Y_3}, \tag{28}$$

$$s_3(y) = 0 \text{ for all } y \in \mathbf{Y_1}, \tag{29}$$

$$S_1 = \int_{\mathbf{Y}_1} (\mu_{u,1}(y)s_1(y) + \mu_{u,2}(y)s_2(y))dy, \tag{30}$$

$$S_3 = \int_{\mathbf{Y}_3} \mu_{u,3}(y)s_3(y)dy \tag{31}$$

   and;

4. τ *satisfies the government's budget constraint:*

$$\int_{\mathbf{Y}_1} \min\{bw(y), B\}\mu_{u,1}(y)dy = \tau \int_{\mathbf{Y}_1} \mu_e(y)dy, \tag{32}$$

where the L.H.S. gives total benefits paid, the R.H.S. total revenue collected from firms.

4 Empirical implementation

In this section, we present a quantitative analysis of the aforementioned model and equilibrium. The goal in this section is to evaluate how well the endogenous mechanism explains observed take-up rates. Our calibration focuses on the time period from $2003 - 2006$, and all moments are taken as the average over this time period.

4.1 Calibration

The model described in Section 3 leaves the following parameters to be determined: β, r, b, B, d, λ, δ, k, $h(c, l)$, $F(y)$, and functional forms for the matching function m and the utility function h.

4.1.1 Preferences

The time period is set to one quarter, so a per-annum risk-free interest rate of 0.04 implies $r = 0.01$. The utility function is given by

$$h(c, \ell) = \frac{(c\ell^{\gamma})^{1-\phi} - 1}{1 - \phi} \tag{33}$$

For the coefficient of relative risk aversion, we use a standard value of 1.0, which falls within the range considered in Hansen and Imrohoroglu (1992) and the existing RBC literature.

4.1.2 Matching technology and separation

For the matching function, m, we use the standard constant returns to scale form given by $m(S, A_j) = S^\eta A_j^{1-\eta}$ where $j \in \{1, 3\}$.[7] As in Fredriksson and Holmund (2001), we use a value of 0.5 for β; furthermore, to set η, we impose the Hosios (1990) condition. The job separation rate λ is set to the observed transition between employment and unemployment, $\lambda = 0.017$. This value is based on the data constructed by Robert Shimer, who uses CPS (Current Population Survey) data to calculate the flows in and out of the different labor market states.[8]

4.1.3 Search cost

The remaining parameters are determined by targeting different moments in the data. First, we choose γ so that average search effort in the model is consistent with the data. Since we have normalized leisure while employed to equal the time endowment, average search effort in the model needs to be compared to the ratio of time spent searching to time spent working in the data. From the ATUS (American Time Use Survey), we calculate that on average, unemployed individuals who are actively searching for a job spend 194 minutes a day engaged in this activity.[9] From the same survey, we also calculate that employed individuals spend 399 minutes a week-day working. If we use this as the time spent working, the model must produce average search effort equal to $\frac{194}{399} = 0.486$. If we include all 7 days, we find that employed individuals spend 39.9 hours per week working, implying 479 minutes per day working. Using this as time spent working, we find the aforementioned ratio as $\frac{194}{479} = 0.405$. We calibrate to the average of these two estimates, 0.445. In our model, this

[7]An equivalent alternative, used by others including Shimer (2005), is $m(S, A) = m_0 S^\eta A^{1-\eta}$ where S/A is normalized to 1, and m_0 is chosen to target the number of matches.

[8]For additional details, please see Shimer (2007) and his web page http://robert.shimer.googlepages.com/flows.

[9]Note, our estimate is much higher than that calculated in Krueger and Mueller (2010). The discrepancy arises because we restrict attention only to those unemployed individuals, while Krueger and Mueller (2010) include those who do not spend any time on job search.

implies $\gamma = 7.4$. We choose non-market income, g, to match an unemployment rate of 5.34% during the period from $2003 - 2006$.

4.1.4 Productivity and advertising cost

For the productivity distribution, in the baseline analysis we assume an exponential distribution, so that $F(y) = 1 - \exp(-y/\sigma)$, where $\sigma > 0$. We set the latter parameter so that the standard deviation of log wages predicted by the model matches that observed in the CPS (average from $2003 - 2006$), which is 0.801; this implies $\sigma = 1/6.8 = 0.1471$. Finally, the marginal cost of advertising k is set so that the equilibrium value of θ implies an average unemployment duration of 19.48 weeks, or 1.4981 quarters, which matches the average duration observed from $2003 - 2006$.

4.1.5 U.S. unemployment insurance system

Our model in Section 3 specifies a stylized, but relatively detailed version of the U.S. unemployment insurance system. The next step in our calibration is to determine the relevant parameters describing this system. To do so, we need to find three values: b, the basic replacement rate; B the maximum benefit level; and δ, the inverse of the potential duration of benefits. While the CPS does contain some information about the actual amount of benefits collected, given the incomplete nature of the earnings information, any calculations of replacement rates is likely to be relatively inaccurate. Moreover, there exist many idiosyncracies among states regarding unemployment insurance laws, regulations, and benefit calculations; as a result, difficulties arise determining the actual replacement rate for a given state, let alone for the overall U.S. economy. In addition to the variability across states, a particular state often has complicated rules for calculating benefits, with many possible deductions and limits. To circumvent this difficulty, we use data from BAM (Benefit Accuracy Measurement) from $2003 - 2006$ to directly calculate the replacement rate, maximum

Table 1: Parameters

r	0.1	Discount rate
ϕ	1.0	Coefficient of relative risk aversion
β	0.5	Bargaining parameter
η	0.5	Elasticity of matching function
λ	0.017	Job separation rate
b	0.48	Replacement rate, UI, non-binding
B	2.20	Maximum UI benefit
g	0.037	Minimum consumption rate
δ	0.5	Length of unemployment benefits
k	15.4	Marginal cost of vacancy advertising
γ	7.4	Utility parameter
σ	1/6.8	Scale parameter of $F(y)$

benefit amount, and potential duration of benefits. Since the data are from careful audits of unemployment claims, the earnings and benefit information is more complete and accurate for this task than the CPS data.

For the U.S. overall, we calculate the average benefit duration is 24 weeks and the average replacement rate is 0.45. These are similar to the commonly used 26 week duration and 0.50 replacement rate. When we take into account the maximum benefit amount, we find that on average 23% of those collecting are receiving the maximum benefit level in their respective state. We find that for those agents receiving below the maximum benefit, the replacement rate is $b = 0.48$, and we thus set b accordingly. To set the maximum benefit, we target the average replacement rate among those receiving the maximum benefit, which is 0.36. Accordingly, we set the maximum benefit to $B = 3$. We also set the value of δ to match the expected potential duration of benefits of 24 weeks, or 2 quarters, implying $\delta = 0.5$.

Given the aforementioned parameters, we compute the equilibrium and compare its moments to those observed in the U.S. economy from $2003 - 2006$.

Table 2: Calibration Results

Moment	Model	Data
Unemployment rate	5.34%	5.34%
Unemployment duration	1.4962 (19.45) weeks	1.4981 (19.48)
Take-up rate	0.6462	0.6424
Market Tightness, θ	2.3116	0.6
Average search intensity	0.444	0.445
Average unemployment duration, collect	1.5856	1.5063
Average unemployment duration, non-collect	1.2251	0.597
Replacement rate, binding benefit	0.35	0.36
Fraction with binding benefit	0.21	0.23
Standard deviation of log wages	0.809	0.801

4.2 Results

Table 2 presents the results from our calibration. There are several interesting features of the results that we now explore in more detail. First, notice that relative to the case of fixed search effort, the difference in job finding rates between collectors and non-collectors remains much smaller. These job arrival rates imply an average duration of unemployment of 1.6720 (21.7360 weeks) for agents who are collecting benefits, 1.4331 (18.6303 weeks) for agents who have exhausted benefits, and 1.3617 (17.7021 weeks) for agents who never collect. Notice, this implies a duration elasticity (with respect to the benefit level) of 0.39, as a 58% decrease in the benefit (from 0.48 to 0.2) decreases the average unemployment duration by 23%.

Second, it is interesting to look at the differences in search effort across unemployment states. Figures 4-6 plot search effort over productivity for different unemployment states. First, in Figure 4, the main feature is the kink in s, which occurs at the level of y where the maximum benefit begins to bind. While the benefit does not bind, the since the benefit remains a constant fraction of the previous wage, the difference in value functions $W(y) - U_1(y)$ remains constant. After the maximum benefit binds, however, the replacement rate decreases with y causing $W(y) - U_1(y)$ to increase, and thus search intensity to increase.

The change in search effort upon benefit expiry represents another interesting dimension to analyze, and we plot this in Figure 5. While a binding benefit increases search intensity with y, it has the opposite effect on s_2, search intensity of agent's for whom the benefit has expired. Once benefits have expired, search intensity increases, which is evident in Figure 5, as s_2 lies everywhere above s_1. This difference, however, decreases with y, implying that unemployment benefits have a smaller effect on the unemployment duration for higher wage earners relative to low earners. Finally, in Figure 6 we plot the difference in search intensity for agents in unemployment state $i = 2$ and $i = 3$. First notice that search effort remains constant over y for $i = 3$, the non-collectors. Since they do not collect benefits, the difference between employment and unemployment remains constant over y (i.e. the binding benefit issue does not arise). This figure also illuminates the effect of a binding benefit on s_2, collectors who have exhausted benefits.

Finally, notice in Table 2 the model does well matching the fraction of individuals collecting benefits who are receiving the maximum benefit. Further, recall we have not made any parametric restrictions targeting this moment, so the model's success along this dimension is encouraging.

5 Policy analysis

This section conducts several policy experiments, changing the relevant parameters of the stylized UI system. Here, there exist three parameters defining the system: the basic replacement rate, b, the maximum benefit level, B, and the potential duration of benefits, δ. Below we explore the implications of changes in each of these three parameters. Tables 4-6 display the results from these experiments. We consider a 10% and 50% increase in each variable, and for each of these the column "Take-up" refers to the results in our baseline model, and "No Take-up" refers to the model with no take-up decision presented below.

First, consider changes to the basic replacement rate, b, which assumes a baseline value of 0.48. Table 4 displays the results from increases in the basic replacement rate. The results imply the unemployment rate and average duration of unemployment respond slowly to changes in b, which represents a surprising result, as micro estimates (for example in Meyer (1990)) appear to imply a higher duration elasticity with respect to the benefit level. There are several interesting points to note about this result. First, as the other policy experiments highlight below, the key factor in determining the effect of changes to the benefit system on labor market outcomes is their effect on the taxes imposed on firms. Our analysis indicates changes to the benefit system have relatively small effects on the incentives of job searchers (i.e. search effort), but relatively larger effects on the incentives of firms to (i) create vacancies and (ii) to search with more intensity (a_1) for individuals not collecting benefits. The total cost of financing the UI system is changing slowly as b increases. With little additional taxes, firm behavior does not change drastically. Finally, also note that the take-up rate is increasing in b. The increase in the basic replacement rate implies that more higher productivity workers are subject to the maximum benefit amount, and as a result, fewer of such workers collect benefits. On the other end, however, the increase in the basic replacement rate does increase the benefit to applying for lower productivity workers, and among this group the take-up rate increases. For our baseline parametrization the latter effect dominates, but the opposing forces helps explain the overall small response of the take-up rate to changes in the basic replacement rate.

Another experiment to consider changes in the benefit levels is to change the maximum benefit amount, B. When B increases, this effectively increases the overall replacement rate, as fewer agents are constrained by the maximum amount. In Table 5, we present the results from changes in B. In this case, changes to B have a much larger effect on equilibrium outcomes than the changes to b. In this case, changes to B have a larger effect on the total cost to the UI system, and as a result, firm responses are larger. This is most evident when the maximum benefit increases by 50%. Under this change, almost all agents collect the standard benefit, while only 6% are constrained by B. Given the relatively large increase in the cost of the UI system, firms respond by decreasing advertising intensity for agents who do collect benefits (a_1 decreases), and market tightness increases. In response to the firms' decisions, the take-up rate decreases by 31%.

That the take-up rate decreases in response to an increase in B represents a surprising result. One expects that as the generosity of the UI system increases, the take-up rate should also increase. Indeed, Blank and Card (1991) and Anderson and Meyer (1997) both find that at the *individual* level, the take-up decision is positively correlated with the benefit level. At the individual level, the same is true in our model. However, our model examines the determination of the economy-wide take-up rate. In equilibrium, there exist two opposing forces: an increase in benefit generosity makes collecting more appealing for an unemployed agent, however, it also increases the incentives for firms to reduce their UI bill. In the case of changes to B, the latter effect dominates.

Finally, we also analyze changes to the potential duration of benefits, δ, and we present these results in Table 6. Of all the UI system changes, changes in δ have a relatively large effect on equilibrium outcomes, especially the unemployment rate and average unemployment duration. Moreover, when the potential duration of benefits increases (an increase in benefit generosity), the take-up rate actually declines.

6 Quantifying the role of take-up decision

In this section we briefly describe a version of our model that abstracts from the take-up decision; i.e. all workers collect benefits when moving from employment to unemployment. This model represents the standard used in the existing literature (although we have heterogeneous workers and variable search effort, which are not commonly used), and we compare

Table 3: Calibration Results, No Take-up Model

Moment	Model	Data
Unemployment rate	5.34%	5.34%
Unemployment duration	1.4932 (19.41) weeks	1.4981 (19.48)
Take-up rate	1	0.6424
Market Tightness, θ	1.0298	0.6
Average search intensity	0.445	0.445
Replacement rate, binding benefit	0.36	0.36
Fraction with binding benefit	0.079	0.23

the results of our policy experiments to the predictions of the standard model. This comparison allows us to understand what role an endogenous take-up rate plays in how changes to UI benefits affect labor market outcomes.

This alternative model follows closely the one presented in Section 3, with the following exceptions. First, since all workers collect benefits, the firm no longer varies advertising intensity along this dimension. Thus, there only exists one job arrival rate for workers, $\theta q(S, \theta)$ and for firms, $q(S, \theta)$. Moreover, the workers' problem is now described by only three Bellman equations, described in (2), (3), and (5); furthermore, in (5) there is no longer a decision to collect benefits or not upon separation. With these changes, the optimal decision and equilibrium are determined as in Section 3. Given this alternative model, we first re-calibrate the appropriate parameters, and then perform the aforementioned policy experiments. The changes from Table 1 are to the maximum benefit amount, $B = 7.0$, non-market income $g = 0.269$, the productivity distribution $\sigma = 1/6.3$, the preference parameter $\gamma = 2.6$, and the vacancy creation cost, $k = 13$. These parameters produce the calibration results summarized in 3.

That the model with take-up rates better matches the fraction of workers with a binding benefit level is worth noting. First, in the model with a take-up decision, since higher productivity workers choose not to collect, the maximum benefit level must be higher relative to the standard no take-up model in order to match the observed average replacement rate for this group. Moreover, since the fraction of workers at the binding benefit applies to only those collecting benefits, the model with no take-up decision predicts a much lower fraction relative to the model with the take-up decisions. We also consider differences in the two models with respect to how equilibrium outcomes respond to changes in UI benefits.

Tables 4-6 also contain the results from these policy experiments. First, in Table 4 we consider changes to the basic replacement rate, b. In contrast to the model with a take-up decision, the effects of changes in b are relatively large. A 50% increase in b implies a 7.2% and 6% increase in the unemployment rate and average unemployment duration, respectively. In the no take-up model, only a small fraction of agents are bound by the maximum benefit amount (8%); therefore, changes to b affect a larger set of agents than the model with a take-up decision.

In Table 5 we consider changes to the maximum benefit level. Here, the effects on equilibrium outcomes is relatively small compared to the take-up decision model. Again, since only 8% of agents are affected by the maximum benefit amount initially, changes in this variable affect a smaller portion of the unemployed population.

Finally, in Table 6 we present the results for the no take-up model when the potential duration of benefits, δ, changes. Again, there exist differences with the model including a take-up decision, although less pronounced than the previous two experiments. Both the unemployment rate and average duration increase in both models, but less so in the model with a take-up decision. The take-up rate plays an important role here. When the potential duration of benefits increases, the take-up rate decreases; as a result, the effect on search effort is smaller in this model, relatively to the model where everyone collects. This helps explain the smaller response of the unemployment rate and duration. The results in Tables 4-6 show that including an endogenous take-up rate has important implications for the effects of changes in the UI system on labor market variables.

7 Conclusion

We developed a model to explain unemployment insurance take-up rates with endogenous application costs. The model was calibrated to U.S. data, and performed well matching observed take-up rates, which we estimate from CPS data. Specifically, we find the endogenous mechanism, driven by variable firm vacancy advertising, represents a plausible explanation for take-up rates below 100%. While the model did well explaining observed take-up rates, there exist several interesting directions for future research. One in particular is to examine more carefully the state-level variation in take-up rates, unemployment durations, and eligibility criterion. Such an analysis could also explore the relationship between these factors, i.e. how they may be jointly determined. Finally, our model of variable firm advertising intensity may have interesting applications to other problems. For example, differences between the labor market experiences of males and females could perhaps be better, or more completely analyzed in this context, as opposed to the traditional segmented markets approach.

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8 Tables and Graphs

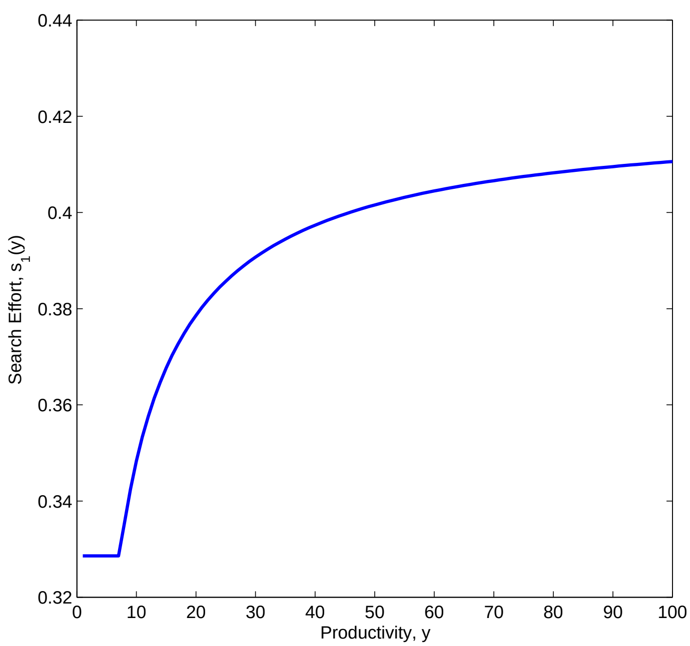

Figure 4: Search effort, collectors

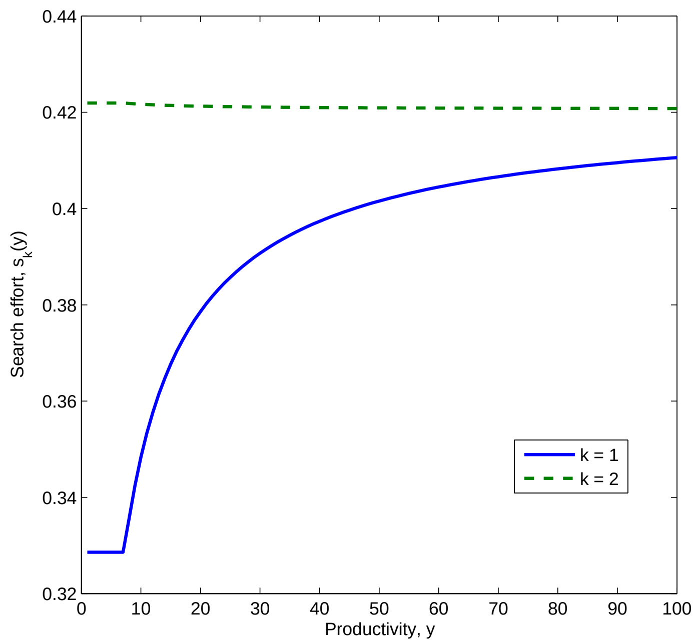

Figure 5: Search effort upon benefit expiry

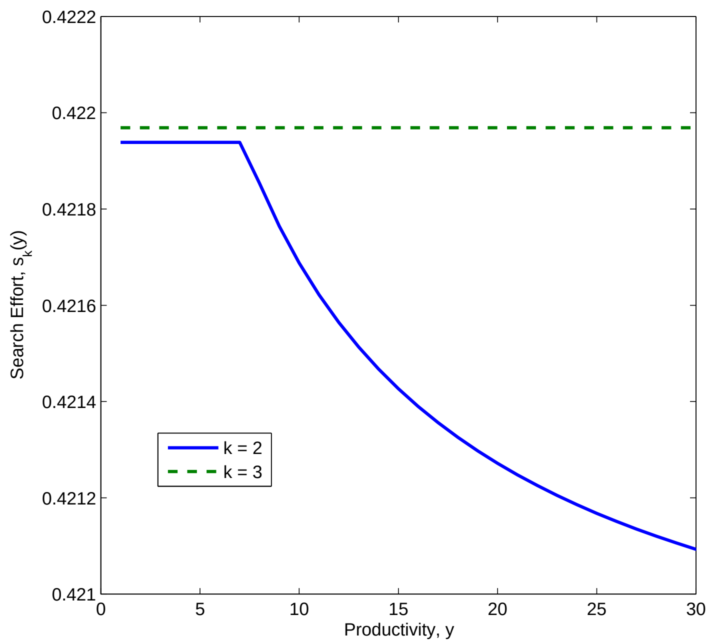

Figure 6: Search effort, $k = 2$ and $k = 3$

Table 4: Changes in replacement rate, b

% Change	10		50	
Model	Take-up	No Take-up	Take-up	No Take-up
Unemployment rate	0.32	1.63	1.23	7.20
Unemployment duration	0.25	1.31	0.96	5.96
Take-up rate	2.48	-	2.69	-

Table 5: Changes in max benefit, B

% Change	10		50	
Model	Take-up	No Take-up	Take-up	No Take-up
Unemployment rate	0.55	0.26	6.48	0.73
Unemployment duration	0.52	0.22	8.12	0.68
Take-up rate	-4.86	-	-30.93	-

Table 6: Changes in potential duration, δ

% Change	10		50	
Model	Take-up	No Take-up	Take-up	No Take-up
Unemployment rate	1.73	2.30	13.76	18.37
Unemployment duration	1.33	1.61	10.28	12.46
Take-up rate	-0.77	-	-4.92	-