Delayed Collection of Unemployment Insurance during Recessions

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Abstract

Contrary to assumptions in the unemployment insurance (UI) literature, this paper argues that unemployed workers do not always lose uncollected UI benefits when they start a new job. Instead, they may postpone the collection of leftover benefits to future unemployment spells. Further, using cross-time and cross-state variations in UI policies, the paper finds empirical evidence that allowing unemployed workers to delay the collection of benefits increases their incentives to find a job during recessions when wages are low, job separation rates are high, and UI benefits are extended. I quantify the effects of the policy of allowing delayed collection of benefits on aggregate unemployment by introducing endogenous search effort, benefit eligibility, and wage-indexed benefits into a standard search-and-matching framework. The model demonstrates how the policy increases the future value of employment even though more generous UI benefits in general reduce the net value of employment. Using a calibrated model, I find that allowing delayed benefit collection raises the proportion of unemployed workers receiving benefits and reduces the unemployment rate during 2009–2012.

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1 Introduction

Two assumptions are common in the literature on unemployment insurance (UI) policy. First, only unemployed workers receive UI benefits. Second, once an unemployed worker finds a job, she loses any uncollected benefits. The first assumption is true to the extent that unemployed workers also include underemployed workers such as part-time workers who are actively seeking full-time employment.[1] The present paper examines the second assumption both empirically and quantitatively.

Empirically, this paper documents that during recessions workers in the U.S. can and do delay the collection of UI benefits to future unemployment spells ("retention policy"). In addition, there are both cross-state and cross-time differences in how easy an unemployed worker can delay collection of leftover benefits as a result of policy variations. Exploiting these differences, I find empirical evidence that making delayed benefit collection easier encourages unemployed workers to search for a job in recessions. Intuitively, because UI benefits are proportional to wage income, low-paying jobs qualify for lower benefits. As a result, an unemployed worker has less incentive to take a low-paying job because of low future benefits when she becomes unemployed again. With the retention policy, if the worker has leftover benefits when she finds a job, she can delay collecting the leftover benefits to future unemployment spells.

Motivated by the empirical evidence, this paper extends the standard search and matching model to incorporate features of the retention policy. In particular, unemployed workers actively search for jobs. Search incurs a utility cost, and job-finding probability is proportional to individual's search level. Employed workers may qualify for UI benefits through working. If qualified for benefits, an unemployed worker receives a fixed amount of benefits each period for a finite number of periods. The level of benefits received each period are proportional to the wages prior to unemployment. Without the retention policy, once an unemployed worker finds a job, any leftover benefits will be forefeited. With the retention policy, any uncollected benefits stay on the worker's record, and when she becomes unemployed again she can choose between any newly qualified UI benefits or the leftover benefits.[2] By giving the worker a choice in future benefits, the retention policy increases the expected value of employment by (weakly) increasing the value of future unemployment. As a result, the unemployed workers increase their search effort, and aggregate job-finding probability becomes higher.[3]

The effect of retention policy on workers' search depends on three factors of the economic condi-

[1] See, for example, McCall (1996) and Le Barbanchon (2014) on extending UI benefits to part-time workers.

[2] As an example, suppose a worker qualifies for 26 weeks of benefits of $200 per month. He finds a job after collecting benefits for 6 weeks. Without retention policy, he loses the 20 weeks of benefits, and whether he qualifies for benefits when he becomes unemployed again depends on how much he works between the two unemployment spells. With the retention policy, if he does not qualify new benefits when unemployed again, he can continue collecting the 20 weeks of benefits.

[3] A key assumption here is that workers do not quit into unemployment. This assumption is supported by the fact that workers who quit do not qualify UI benefits, although quits are sometimes hard to distinguish from other reasons of unemployment; see, for example, Zhang and Faig (2012).

tion. First, the effect is larger when the probability of losing a job is larger. A larger job separation probability reduces the discount on the value of future unemployment, thus raising the effect of future unemployment on current search incentives. Second, the effect of retention policy is larger when the difference in wages between previous and future jobs is (positive) larger. A positive wage difference implies that the current UI benefits are higher than the expected future benefits. The larger the wage difference, the larger the difference between current and future benefits, and the more retention policy raises the value of employment for unemployed workers. Third, the effect is larger when the benefit duration is longer such as during a recession. Longer durations give unemployed workers more benefits to carry over to future unemployment spells, thus increasing the effect of retention policy. I use a simple model to illustrate the effect of the retention policy and how it changes with the underlying economic conditions, across states and across time.

Because the three factors change with the underlying economic conditions during a recession, and because the empirical evidence is snapshots at one or more points along a recession, we need a quantitative model to evaluate the effect of retention policy on job-finding probability during a recession. For example, an unemployed worker who loses her job at the beginning of a recession is affected most by the retention policy, because (1) the gap between her past (pre-recession) and future (during recession) wages is likely high, (2) the job separation probability during her future employment is likely high, and (3) the benefit duration she qualifies is likely long because of benefit extensions during recession. To incorporate changing economic conditions, I extend the simple model to a quantitative model and analyze a transition from a pre-recession economy without UI extension to the economy between 2011 and 2012. I calibrate the model steady state to match the pre-recession economy, and feed in changing job separation probability, aggregate productivity and UI duration between 2008 and 2012. I find that while UI extensions discourage search and raise unemployment, the retention policy mitigates the adverse incentive effect of UI extensions and lowers the unemployment rate by about 0.8 during 2008–2012.

This paper contributes to the understanding of how UI policy affects unemployed workers' search behavior. Previous literature has studied how benefit level and benefit duration affect search. Empirical evidence in the literature suggests that more generous UI benefits are associated with longer spells of unemployment, with an elasticity of about 1.0; see Krueger and Meyer (2002) for a survey of the earlier literature. More recently, Krueger and Mueller (2010) use time use data to find that for a subgroup of benefit-eligible unemployed workers, more generous benefits reduce their job search time. At the same time, they find that search activity of the benefit-eligible unemployed spikes as benefit exhaustion (26 weeks) approaches, which suggests that longer UI duration is associated with less search by the unemployed workers. The present paper argues that because of the retention policy in recessions, higher benefit levels do not always mean lower search. In fact, higher expected benefits during future unemployment spells may increase search by current unemployed workers.[4]

[4] Because the effect of the retention policy requires that workers form expectation about future benefits, government commitment to these expected future benefits is implicitly assumed. A recent paper, Pei and Xie (2015b) examines

Another strand of the literature on UI policy looks at specific policy details and studies how they affect search behavior. For example, Zhang and Faig (2012) examine how endogenous UI eligibility affects search, and find that when UI benefits must be earned with employment, generous UI becomes an additional benefit to working. The current paper complements their work by incorporating both endogenous eligibility and wage-indexed wages, so that working at a high-paying job has the addition benefit of qualifying higher benefits in unemployment. And with the retention policy, this benefit may extend into future unemployment spells. McCall (1996) and Le Barbanchon (2014) look at the effect of partial benefits on unemployed workers' incentives to take part-time job. The present paper complements their works by looking at how delayed benefit collection affects another "alternative" form of employment, short-term employment.

Because the effect of retention policy is quantitatively relevant only during recessions when the maximum potential UI duration is extended, the study of the retention policy has ramifications on the optimal cyclical UI policy; see, for example, Jung and Kuester (2015), and Mitman and Rabinovich (2015). In addition, because the effect of the retention policy also changes with the scale of UI extensions, incorporating the retention policy in models evaluating the UI extensions will changes the quantitative results. In fact, quantitatively I find that the retention policy mitigates the effect of UI extensions. This paper thus contributes to the literature on the impact of UI extensions; see, for example, Fujita (2010), Rothstein (2011), Nakajima (2012a), Hagedorn, Karahan, Manovskii, and Mitman (2015), and Pei and Xie (2015a).

The rest of the paper proceeds as follows. Section 2 describes the policy background and empirical evidence pertaining to policy variations. In Section 3 I introduce a simply version of the model to illustrate the effect of policy variation. Section 4 presents a quantitative model and analysis based on calibrated parameters. Section 5 concludes.

2 Policy Background and Empirical Evidence

The retention policy allows unemployed workers to delay collection of UI benefits to future unemployment spells.[5] Two important ingredient here are that workers *qualify* benefits through work—so not all unemployed workers receive benefits—and the monthly benefit payout amount ("benefit level") is proportional to wages received during the most recent employment. The retention policy changes over the business cycle. In addition, while the majority of states have the retention policy, states differ in how easy it is for unemployed workers to take advantage of the retention policy.

the effects of government commitment to UI policies on the optimal cyclical UI benefits and and on the labor market.

[5] This section focuses on explaining the cross-time and cross-state variations of the retention policy and abstracts from the variations in UI extensions. While UI extensions also vary over time in recessions, it does not affect the cross-sectional empirical analysis. The variations across states are controlled for in the empirical analysis by taking data from a time when states in the sample implemented roughly the same length of UI extensions.

2.1 Cross-time policy variations

During normal times, when the maximum potential UI duration is 26 weeks, an unemployed worker has up to one year ("benefit collection window") to use all 26 weeks. As an example, an unemployed worker who qualifies 26 weeks of benefits and starts collecting on January 1, 2005 may collect during anytime before January 1, 2006. During this time, if she finds a job after collecting benefits for 13 weeks, then she may collect the other 13 weeks if she loses her job again before January 1, 2006. A complication arises if the employment during this one-year period qualifies he with a new UI segment. When this happens, the worker may choose whether to continue collecting the 13 weeks left over from before, or start the new UI segment. However, she may not keep both UI segments.

The impact of the retention policy is small during normal times for two reasons. First, because the benefit collection window is one year for a typical 26 weeks of benefits, any job taken has to last less than six months for the workers to keep the leftover UI segment. During normal times, when long-term employment opportunities are relatively abundant, the probability of having a job lasting for less than six months is low. Second, the opportunity to choose between leftover benefits and new UI segment makes a difference if the benefit level is high enough on the leftover benefits that the workers will choose the leftover benefits. During normal times, because wage scarring is relatively low, it is unlikely that unemployment will create a big wage gap that will lead to large differences in benefit levels.

The retention policy plays a more important role in recessions for two reasons. First, the benefit collection window is extended with UI benefit extensions such as during the Great Recession when the UI benefits were extended from 26 to over 90 weeks. With these extensions, the benefit collection window is also extended from one year to as long as extensions are in effect. For example, during the Great Recession, extensions were in effect for four years (from 2008 to the end of 2013). In addition, long-term jobs are harder to find in a recession. With short-term employment, it is more likely that at the end of a job the worker is still within the collection window of the benefit that she started before taking the job.

Second, the benefits that a worker qualifies from jobs before the start of the recession are likely higher than the benefits from working during the recessions. This is true with wage scarring or if during the recession she is forced to take a job that pays much less than the job before the recession. With wage scarring, the wages she gets after being unemployed are lower than wages before unemployment. As an example of different types of job, suppose a worker laid off from a regular, long-term job at General Electric cannot find similar type job during the recession and is forced to work a temporary job at McDonald's. The two jobs potentially differ in two dimensions—wages and job security. Wages are likely higher at General Electric even without wage scarring. Job security is likely worse at McDonald's especially if the job is temporary. Because of lower wages, if the worker qualifies new UI benefits at McDonald's, the new benefit level is lower than her benefits qualified from working at General Electric. At the same time, because of lower job security, the job

at McDonald's may not qualify for new UI benefits, in which case being able to continue collecting any leftover benefits will be even more valuable.

It is worth noting that unlike during normal times when the worker can *choose* between leftover benefits and new qualified benefits, in recessions, the retention policy is more restrictive. In particular, once the worker qualifies new benefits, she may not continue collecting any leftover benefits from before.[6] This restriction was in place until July 2011, when a federal legislation awarded the choice of UI segments to the unemployed worker.

Because the effect of the retention policy differs substantially over the business cycle, I will treat the policy as time dependent. For tractability, I assume that the retention policy has negligible effect during normal times, and only plays a role in recessions.

2.2 Cross-state policy variations

In addition to variations across time, the retention policy also differs across states. Because the policy effect is small during normal times, in what follows I focus on the policy differences in recessions.

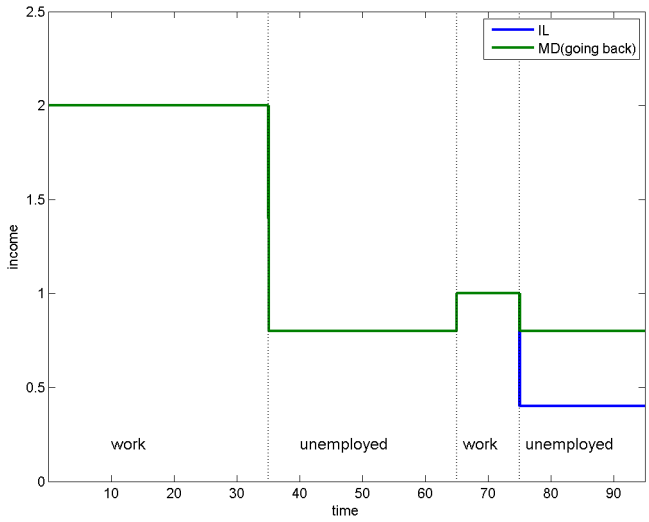
States differ in how hard it is to take advantage of the retention policy. More specifically, states differ in how much work is needed to qualify for a new UI segment. As noted in the previous subsection, the restriction on retention policy before July 2011 means that when an unemployed worker qualifies a new UI segment, she has to start collecting the new segment. Given this restriction, it is *easier* for an unemployed worker to collect leftover benefits in states where it is *harder* to qualify new UI benefits.

Figure 1 illustrates the cross-state difference for a worker who becomes unemployed twice within a 90-week period. Because benefit level is dependent on wages, the income she gets during unemployment is proportional to the income from work. For illustration purpose, suppose Illinois does not allow delayed collection of benefits (or that the worker qualifies a new UI segment in Illinois from the short period of work). In Illinois (blue line), the worker has to start collecting new benefits which are lower than the benefits before. In contrast, in Maryland (green line) where delayed collection of benefits is possible (or that the wages from the short period of work do not qualify new UI in Maryland), she can continue collecting the leftover benefits from the first unemployment spell.

Because of the difference in benefit levels, when searching for jobs during the first unemployment spell, the worker will anticipate the difference in consumption level during the second unemployment spell. In Maryland, where the expected consumption during the second unemployment spell is relatively high, the worker has more incentives to find any job (especially a job with lower wages and/or shorter expected duration) during the first unemployment spell, knowing that life won't be

[6] The reason for this feature is that extended benefits in recessions come from federal funding, whereas the first 26 weeks of benefits are funded through states. Under the UI regulation prior to July 2011, benefits funded by states must be collected first before collecting federal benefits, and in cases where more than one benefit segments are open, state-funded benefits take precedence.

Figure 1: Illustration of cross-state difference in retention policy.



too hard if she gets unemployed again soon. Following this logic, the probability that an average worker finds a job within a set period of time will be higher in Maryland than in Illinois.[7]

2.3 Evidence of policy effects on individual choice

An important question is whether the unemployed workers are knowledgeable and rational enough to take into account such complicated policy structures and anticipate consumption changes during future unemployment spells? On the Unemployment forum of the web site City-Data,[8] a popular forum site for U.S. city information with alleged 1.5 million members, many unemployed workers discussed the how taking a temp job or part-time job would impact their UI benefit receipts. Figure 2 presents two examples of questions asked on the forum that are related to the retention policy. These two posts illustrate that the unemployed workers do indeed consider how taking a job, especially a temp or part-time job impact the benefits they will get when the job ends.

2.4 Empirical evidence on aggregate effect of retention policy

To empirically document the effect of the retention policy on job search, the ideal dataset is microdata with administrative details on UI recipients including benefit receipts and employment history. In

[7] In addition to benefit level, the duration of benefits is also a factor in worker's choice. Because newly qualified benefits start from week 1 of benefits, the duration on the new UI segment is most likely longer than any leftover benefits. But from the empirical patterns, duration of benefits does not seem to be as important as benefit level. One possible reason is that in recessions unemployed workers are credit constrained and value liquidity more than total expected income. See Chetty (2008) for a discussion of how liquidity effect affects workers' search incentives.

[8] http://www.city-data.com/forum/unemployment.

Figure 2: Example discussions on the retention policy and short-term job on City-Data.

the absence of such data, I exploit policy variations across states before July 2011 to capture the aggregate effect of retention policy.

As explained in the previous subsection, the state policy on how much a worker needs to earn to qualify a second UI segment determines the probability that an unemployed worker can delay collection of benefits. Because most states require a worker to earn over a one-year period a multiple (from 3 to 10) of the benefit amount to qualify a new UI segment, I place states according to the multiple into three groups. A higher multiple represents a state where it is harder to qualify new benefits and thus easier to delay collection of benefits.[9] One issue is that the effect of the retention policy potentially depends on the expected duration of benefits and states implement different UI extensions in recession. I exclude states that did not implement the second tier of extension before November 2009 in the sample created from survey data of 2010. This restriction drops North Dakota, Nebraska, South Dakota, and Utah out of the sample. Table 1 presents summary statistics of sample of workers from the the Current Population Survey (CPS) Displaced Worker Supplement by state group.

I use data from the CPS Displaced Worker Supplement to compute a state-level average job-finding probability among unemployed workers who lost job in the previous year. The CPS is a representative sample of U.S. households, but does not contain information about UI eligibility or receipt. The Displaced Worker Supplement of the CPS contains this information but is limited by its

[9] I group states as follows. Group I: multiple equal to 3 or 4, Group II: 5 or 6, and Group II: 8 or 10. No states have a multiple 7 or 9. While this way or grouping is somewhat arbitrary, it balances the number of states in each group.

Table 1: Summary Statistics of State Groups.

	Group I	Group II	Group III
Number of States	8	16	22
Workers in sample	258	613	558
In-sample UI recipients	76	217	204

Note: CPS Displaced Worker Supplement 2010, restricted to workers who lost job in the year prior to survey and are in labor force at time of survey. Sample restricted to states implementing similar benefit extension tiers: states with no EUC 2 before Nov 2009 ND, NE, SD, UT) are excluded; state with no retention policy (VA) is excluded.

biennial frequency. I use the 2010 survey because it contains information on workers who lost their jobs at the starts of the recession (2008 and 2009). I also use the 2012 survey because the surveys happened after the July 2011 federal law took effect.

I use the individual responses to questions about UI benefit receipt, labor force status at the time of survey, and the timing of unemployment to create a sample of workers who lost job in the year prior to the survey year and are still in the labor force at the time of survey. I then separate the sample into UI recipients and non-recipients. I then use responses to questions about job finding to construct the measure of aggregate job-finding probability for the two groups of workers. Table 2 shows the aggregate job-finding probability measure for each state group and by UI recipient status.

Table 2: Cross-State Difference in Aggregate Job-Finding Probability Measure.

	Group I (8 states)	Group II (16 states)	Group III (22 states)
		Easier to collect previous benefits $\longrightarrow$	
UI recipients	0.29	0.34	0.37
Non-recipients	0.59	0.59	0.61
	After July 2011: No cross-state difference in retention policy		
UI recipients	0.41	0.40	0.42

Note: CPS Displaced Worker Supplement 2010 and 2012, restricted to workers who lost job in the year prior to survey and are in labor force at time of survey. Sample restricted to states implementing similar benefit extension tiers: states with no EUC 2 before Nov 2009 ND, NE, SD, UT) are excluded; state with no retention policy (VA) is excluded.

Consistent with the intuition for how cross-state policy differences affect workers' job finding incentives, the first panel of Figure 2 shows that among UI recipients, the aggregate job-finding probability is *higher* in states where it is *easier* to collect previous benefits. Among the control group of non-recipients, the job-finding probability does not differ consistently across state groups. The pattern in the non-recipient group controls for conditions that may differ consistent across state

groups (for example, firm-side conditions, aggregate shocks). As a second control group, I look at the aggregate job-finding probability among UI recipients after July 2011, when a federal law removed the effect of cross-state policy difference on benefit collection. The second panel of Figure 2 shows that in this group, again, there is no consistent pattern across state groups.

To the extent that the two control groups capture any economic conditions that vary consistently across state groups, the pattern among UI recipients prior to 2011 shows that the retention policy, by allowing unemployed workers to collect previous benefits (or equivalently, delay collection of benefits), increases workers' job search incentives in a recession. Several assumptions are made here. First, I have assumed that most of the cross-state difference in aggregate job-finding probability is driven by unemployed workers' decisions to take short-term jobs. Second, I have assumed that for these workers, the benefit level of their first UI segment is higher than subsequent benefit levels. While these assumptions are hard to verify without information on the type of jobs taken and detailed wage or benefit history, the evidence provided in the previous subsection should demonstrate that these assumptions are not far from reality.

Because the empirical evidence is cross-sectional, the numbers are hard to interpret especially due to the presence of business cycle variations and endogeneity. Thus, in the two two sections I develop a structural model that incorporates the necessary elements of the retention policy.

3 A Simple Model

This section uses a simple model to illustrate the effect of the retention policy on the job-finding incentives of unemployed workers. The model extends the standard Mortensen-Pissarides framework to include endogenous search, UI eligibility, and wage-indexed benefits. For simplicity, I only model two types of jobs, which is enough for the simple illustration. Because the effect of the retention policy should be small without duration extensions such as during normal times, to best illustrate the effect of the policy I assume the economy is in a state of recession with UI extensions.[10]

3.1 Model setup

Environment Time is discrete and infinite. The economy consists of a mass of infinitely lived workers. The measure of workers is normalized to one. In any given period, a worker can be either employed or unemployed. Some unemployed workers receive UI benefits. For simplicity, I assume risk-neutral workers here. Workers maximize expected lifetime utility given by

$$\mathbb{E}_0 \sum_{t=0}^{\infty} \beta^t \left[c_t - v(s_t) \right]$$

[10] For the analysis in this section, I assume the recession is long enough to reach a near steady state.

where $\mathbb{E}_0$ is the period 0 expectation factor, and β is the time discount factor. Period utility comprises of utility from consumption of goods c and disutility from job search activity $v(s)$, which is an increasing, convex function with $v(0) = 0$. Utility is increasing in c and decreasing in s. Only unemployed workers choose positive search intensity; that is, there is no on-the-job search. Each period, an employed worker gets paid wages w, which depend on type of job. With an exogenous job separation probability δ each period, the worker becomes unemployed. An unemployed worker get h from non-monetary benefits such as leisure and home production. If on unemployment benefits, she also receives b which is a function of previous wages w^-. In addition, all unemployed workers search at the utility cost $v(s)$, and finds a job with probability $\alpha(s)$, where $\alpha(\cdot)$ is an increasing and concave function. There are no private insurance markets and workers cannot save or borrow.

UI policy structure Not all unemployed workers receive benefits. With probability λ a newly unemployed worker qualifies new benefits. UI benefits are indexed on wages of previous employment through $\gamma\omega$, where γ has the interpretation of the monetary replacement ratio, and ω denotes wages at the previous job. Wages depend on type of jobs, which differ in two dimensions: wages and job separation probability. The good jobs pay higher wages and have better job security than bad jobs, or $w_g > w_b$ and $\delta_g < \delta_b$ The proportion ρ of all job openings are bad jobs. Benefits expire with an exogenous probability e each period. This is a simple way to capture the fact that benefits do not last forever.

Worker's problem An unemployed worker has individual state ω, which equals the wages at her previous employment $\{w_g, w_b\}$ if she has benefits, or 0 if no benefits. The unemployed worker chooses how much to search s. Her problem can be written recursively as follows for $\omega = \{w_g, w_b, 0\}$,

$$\begin{aligned} U(\omega) &= \max_s \quad \gamma\omega + h - v(s) + \beta \underbrace{(1-\alpha(s))\Big[eU(0) + (1-e)U(\omega)\Big]}_{\text{doesn't find a job}} \\ &\quad + \beta \underbrace{\alpha(s)\Big[\rho W_b(\omega) + (1-\rho)W_g(\omega)\Big]}_{\text{finds a job}}, \end{aligned} \tag{1}$$

where U is the unemployed worker's value function, and W_k is the value function of an employed worker at job type $k = \{g, b\}$ and is given by

$$W_k(\omega) = w_k + \beta \underbrace{(1-\delta_k)W_k(\omega)}_{\text{keeps job}} + \beta \underbrace{\delta_k\Big[\lambda U(w_k) + (1-\lambda)U(\omega)\Big]}_{\text{loses job}}. \tag{2}$$

In the above unemployed worker's problem, her current consumption consists of base consumption h and benefits $\gamma\omega$ (if no benefits then $\omega = 0$). Search incurs a utility cost $v(s)$, and the probability of finding a job in the current period is given by $\alpha(s)$. If she doesn't find a job, then with probability

e she loses benefits next period. If she finds a job, with probability ρ it is a bad job (b), otherwise it is a good job (g). A workers at job type k gets paid wages w_k. With the type-specific job separation probability δ_k she loses her job. With probability λ the newly unemployed worker qualifies new benefits with benefit level γw_k, otherwise she can collect any leftover benefits from when she was last unemployed at the benefit level $\gamma\omega$.

It is important that an employed worker inherits the individual state ω from when she was last unemployed. This is to keep track of her previous benefit status the difference between past and current benefits is important to the retention policy. In particular, $\omega = 0$ means she did not have benefits (or benefits ran out) during her previous unemployment spell, and so when she becomes unemployed again she either gets new benefits if her current job qualifies new benefits or no benefits.

3.2 Retention policy and search incentives

From the unemployed worker's problem we can derive a condition for the optimal level of search s of an unemployed worker with benefits $\gamma\omega$

$$\frac{v_s(s)}{\beta\alpha_s(s)} = \underbrace{[\rho W_b(\omega) + (1-\rho)W_g(\omega)]}_{\text{future value of finding a job}} - \underbrace{[eU(0) + (1-e)U(\omega)]}_{\text{future value of not finding a job}}, \tag{3}$$

where the left-hand side is the marginal cost of search weighted by the marginal probability of job finding and expressed in future terms (divided by time discount β), and the right-hand side expresses the marginal gain from additional search as the net value of finding a job versus not finding a job.

To understand how the retention policy affects search incentives we can write (3) more explicitly:

$$\begin{aligned}\frac{v_s(s)}{\beta\alpha_s(s)} = {} & \rho w_b + (1-\rho)w_g - e\Big[h - v(s_0')\Big] - (1-e)\Big[\gamma\omega + h - v(s')\Big] \\ & + \big[1 - \delta_g - \alpha(s')\big]\frac{v_s(s')}{\alpha_s(s')} + e\left[\alpha(s')\frac{v_s(s')}{\alpha_s(s')} - \alpha(s_0')\frac{v_s(s_0')}{\alpha_s(s_0')}\right] \\ & \underbrace{+\beta\rho(\delta_g - \delta_b)\Big\{W_b(\omega) - U(\omega)\Big\}}_{\text{job security effect}} \underbrace{+\beta e(1 + \delta_g - e)\Big\{U(\omega) - U(0)\Big\}}_{\text{benefit eligibility effect}} \\ & \underbrace{+\beta\lambda\Big\{\rho\delta_b\Big[U(w_b) - U(\omega)\Big] + (1-\rho)\delta_g\Big[U(w_g) - U(\omega)\Big]\Big\}}_{\text{retention effect}}.\end{aligned} \tag{4}$$

The first two lines on the right-hand side are standard conditions for optimal search: the first line represents the marginal gain of employment from higher utility next period, and the second line represents the marginal gain of employment from not having to search next period. The last part on the second line represents the marginal gain (loss) from future search if benefits expire in the next

period. Here, s_0 is the search level by an unemployed worker without benefits.

There are three other effects in addition to the standard gains from employment. All three effects take place in the periods after the next period (thus discounted by β). First, the *job security effect* represents the marginal gain (loss) of having a bad job relative to a good job. This effect disappears if two job types have the same job security ($\delta_g = \delta_b$). Second, the *benefit eligibility effect* represents the marginal gain from having benefits, which disappears when all unemployed workers get benefits ($e = 0$) or if the unemployed worker does not have benefits today ($\omega = 0$). Third, the *retention effect* comes from the difference between the current ($\gamma\omega$) and future (γw_b or γw_g) benefit levels and is affected by the retention policy.

For easy interpretation, the retention effect can be equivalently written as

$$\beta\lambda\Big\{\mathbb{1}_{\omega=w_g}(-\rho)\delta_b + \mathbb{1}_{\omega=w_b}(1-\rho)\delta_g\Big\}\Big[U(w_g) - U(w_b)\Big]. \tag{5}$$

The effect is negative if the current benefit effect is high ($\omega = w_g$), and it is positive if the current benefit level is low ($\omega = w_b$). In a recession when good jobs are scarce (ρ is large)[11] or bad jobs are even less secure (δ_b is large), the negative effect on unemployed workers receiving high benefits is amplified. The size of the effect is larger when it is easier to qualify new benefits (λ is larger).

The retention effect here reflects the effect of allowing delayed collection of benefits without giving workers a choice between old and new benefits. More specifically, the unemployed worker receiving high benefits today is discouraged from searching for jobs because of the prospect of lower benefits in future unemployment spells, whereas someone receiving low benefits now is encouraged to search today because of potentially higher benefits when she is unemployed again. The variable λ here captures the cross-state difference in policy explained in the previous section. A larger λ corresponds to states where it is easier to qualify new benefits. Because of the restriction that once qualified new benefits the unemployed worker must collect new benefits, the negative incentives on search by high-benefit unemployed workers are also larger in these states.

The retention effect is larger for higher job separation rates δ_b and δ_g. Higher separation rates reduce the discount on the difference in future value of unemployment, and making the policy effects on search more pronounced. The effect is also larger for larger wage gap, $w_g - w_b$, and hence larger utility difference $U(w_g) - U(w_b)$. The larger the wage difference, the more the retention policy matters for the expected value of future unemployment. The effect of the retention policy should also depend on how long the unemployed worker can collect benefits, because the longer she can collect, the more benefits she can potentially carry over to future unemployment spells. But because all unemployed workers fact the same benefit exhaustion probability e, this effect is not present in the simple model. For the quantitative model in the next section, unemployed workers have maximum UI entitlements, and so workers at different point in their unemployment spell face different benefit

[11] In the quantitative section, I endogenous ρ as an outcome of firm-side decisions, and find rising ρ in recessions.

exhaustion probabilities.

After July 2011 Consider the policy after July 2011, when a federal law removed the cross-state differences in retention policy by giving workers a choice between new and old benefits. Now the retention effect becomes

$$\beta\lambda\Big\{\rho\delta_b\Big[\max\big\{U(w_b)-U(\omega),\ 0\big\}\Big]+(1-\rho)\delta_g\Big[U(w_g)-U(\omega)\Big]\Big\} \tag{6}$$

$$\equiv \begin{cases} 0 & \omega = w_g \\ \beta\lambda(1-\rho)\delta_g\Big[U(w_g)-U(w_b)\Big] & \omega = w_b \end{cases}$$

In this case, because the unemployed worker can choose between the leftover benefits ($\gamma\omega$) and new benefits, the retention effect is nonnegative. The retention policy does not have any additional incentive effects on the worker with higher benefits ($\omega = w_g$), and it increases the search incentives of workers with low benefits now ($\omega = w_b$).

4 Quantitative Model

This section extends the simple model in the previous section to include discrete UI duration, human capital of workers and firm-side decision. Allowing discrete UI duration means an unemployed worker collecting her first week of benefits will make different decision from someone at her last week of benefits. This difference is both consistent with empirical findings in the literature and relevant for the choice between new and old benefits. Human capital depreciation from unemployment reduces wage income from future work, and as a result, unemployed workers have an additional incentive to find a job sooner rather than later. Firm-side decision allows differences in unemployed worker's job-finding decision to affect the overall job creation through firms' job posting.

The purpose of this section is to quantify the effect of the retention policy during a recession. The empirical evidence presented in Section 2 motivates provides directions for modeling choice, but because the evidence is cross-section, it does not reflect the effect of changing economic conditions. A structural model allows for analyses over a transitional path.

4.1 Model

Model environment Instead of risk-neutral workers assumed in the simple model, the workers here are risk averse with utility from consumption at time t given by $u(c_t)$. Unemployed workers with benefits qualify for entitlement of benefits, which is the length that an unemployed worker can receive benefits while unemployed. As with the simple model, benefit levels are proportional to wages to most recent employment.

In addition to employment and UI status, workers also differ by the level of skills. In particular, there are finite levels of skill $h \in \{h_1, h_2, \ldots, h_N\}$ with $h_1 < h_2 < \cdots < h_N$. A worker accumulates skill from work with probability h_{up}, and loses skill from unemployment with probability h_{down}.

As with the simple model, there are two types of jobs, regular job (indexed by g) and temp job (indexed by b),[12] operated by regular and temp firms, respectively. That is, the labor market on the firm-side is segregated by type, and a firm may only post one type of jobs.[13] Regular firms are more productive, pay higher wages and lower exogenous job separation rates. In particular, the productivity of regular firms varies over the cycle and depends on the worker's skill level, whereas the productivity of temp firms is fixed and skill-independent. Given the time-varying labor productivity z_t and a lower-bound productivity level $\underline{z}$, the output of a match between a worker with skill h and a position is $p_g(z_t, h)$ for a regular job and p_b for a temp job, where

$$p_g(z_t, h) = hz_t > p_b = \underline{z}.$$

Firms are risk neutral and maximize the expected discounted sum of profits, with the same discount factor β. A firm can be either matched to a worker and producing or vacant. A vacant firm posting a vacancy incurs a flow cost κ which is assumed independent of job type.

Unemployed workers and vacancies are randomly matched according to the matching function $M(S,V)$, where S is the aggregate search effort of all unemployed workers, and V is the aggregate vacancy posting by all firms, both regular and temp. The matching function is assumed strictly increasing and strictly concave in both arguments, and is bounded above the number of expected matches: $M(S,V) \leq \min\{S,V\}$. The job-finding probability per efficiency unit of search, f, and the job-filling probability per vacancy, q, are functions of labor market tightness $\theta = V/S$. More specifically,

$$\begin{aligned} f(\theta) &= \frac{M(S,V)}{S} = M(1,\theta) \\ q(\theta) &= \frac{M(S,V)}{V} = M\left(\frac{1}{\theta}, 1\right). \end{aligned}$$

Following the assumptions on M, $f(\theta)$ is increasing in θ and $q(\theta)$ is decreasing in θ. The job-finding probability for an unemployed worker searching with intensity s is then $sf(\theta)$. The job-filling probability of a temp vacancy is $\rho q(\theta)$, where ρ is the proportion of all vacancies posted by temp firms. As with the simple model, existing jobs are destroyed exogenously with constant and job type-dependent probability δ_k for job type k.

The wages of regular jobs are determined through a bargaining process to be specified later, and

[12] "b" stands for bad jobs and "g" for good jobs. These are to be consistent with the analyses in the previous section.

[13] Although many establishments in reality hire both long-term and temp workers, certain type of jobs are only filled by temp workers, for example, seasonal jobs, lower-ranking sales jobs. As such, an establishment does not choose whether these positions are filled by long-term or temp workers. In the setup here, a firm can be viewed as a collection of positions, some filled and others vacant.

so they depend on the workers' skill levels and outside options. In contrast, wages of temp jobs are fixed and independent of worker characteristics. The different wage determination processes mirror the reality: temp jobs often have fixed wages around minimum wage levels, whereas regular jobs involve wage bargains that take into account the worker's skills and outside options.

In this model, changes in productivity z drives the business cycle. Job separation rate δ, output of positions p, and the maximum UI entitlement J potentially vary with productivity over the cycle.

Worker's problem The worker's problem is similar to before. An unemployed worker has individual state (ω, j, h), where ω is her previous wages, j is her UI entitlement for the period, and h is her current skills level. While ω does not change during the same unemployment spell, j changes with probability 1 each period, and h follows a Markov process. UI entitlement $j \in \{1, 2, \ldots, J\}$, where J is the maximum potential duration of benefits that an unemployed worker can get. J is larger in recessions than during normal times because of benefit extensions. Each period, the unemployed worker chooses how much to search for a job. Her problem can be written as

$$\begin{aligned} U_t(\omega, j, h) &= \max_s \quad u(\gamma\omega + h) - v(s) + \beta(1 - f(\theta_t)s)\mathbb{E}^-{}_{h'|h}\Big[\mathbb{1}_{j=1}U_{t+1}(0,0,h') + \mathbb{1}_{j>1}U_{t+1}(\omega, j-1, h')\Big] \\ &\quad + \beta f(\theta_t)s\mathbb{E}^-{}_{h'|h}[\rho_t W_{b,t+1}(\omega, j-1, h') + (1-\rho_t)W_{g,t+1}(\omega, j-1, h')], \end{aligned} \tag{7}$$

where $\mathbb{E}^-_{h'|h}$ is the expectation of future skill level conditional on today's skill level in unemployment ($^-$ denotes loss of skill from unemployment). As long as the worker still collects benefits ($j \geq 1$), her entitlement decreases by 1 each period in her unemployment. When she is at her last period of UI benefits ($j = 1$), her benefits expire next period ($\omega = 0$ and $j = 0$).

The Bellman equation of of an employed worker at job $k = \{g, b\}$ is given by

$$\begin{aligned} W_{k,t}(\omega, j, h) &= u(w_{k,t}) + \beta(1 - \delta_{k,t})\mathbb{E}^+{}_{h'|h}W_{k,t+1}(\omega, j, h') \\ &+ \begin{cases} \text{(recession, before July 2011)} \\ \beta\delta_{k,t}\mathbb{E}^+{}_{h'|h}\Big[\lambda_{k,s,t}(\omega)U_{t+1}(\gamma w_k, J_t, h') + (1 - \lambda_{k,s,t}(\omega))U_{t+1}(\omega, j-1, h')\Big] \\ \text{(recession, after July 2011)} \\ \beta\delta_{k,t}\mathbb{E}^+{}_{h'|h}\Big[\lambda_{k,s,t}(\omega)\max\Big\{U_{t+1}(\gamma w_k, J_t, h'), U_{t+1}(\omega, j-1, h')\Big\} + (1 - \lambda_{k,s,t}(\omega))U_{t+1}(\omega, j-1, h')\Big] \\ \text{(non-recession)} \\ \beta\delta_{k,t}\mathbb{E}^+{}_{h'|h}\Big[\lambda_{k,s,t}(\omega)U_{t+1}(\gamma w_k, J_t, h') + (1 - \lambda_{k,s,t}(\omega))U_{t+1}(0, 0, h')\Big] \end{cases} \end{aligned} \tag{8}$$

where $\mathbb{E}^+_{h'|h}$ is the expectation of future skill level conditional on today's skill level at work ($^+$ denotes accumulation of skill from work). During work, any leftover benefit entitlement j stays the same. Once the job is exogenously destroyed, the probability of qualifying new benefits is given by a function of previous benefit level $\lambda_{k,s}(\omega)$ and depends on type of job (k), and state (s). More specifically,

$$\lambda_{k,s,t}(\omega) = (1 - \delta_{k,t})^{X_s\gamma\omega/w_k},$$

where X_s is the multiple that differs across U.S. states and used to group states in the empirical section. In a recession, when the retention policy has the most impact, a newly unemployed worker who does not qualify new benefits can use any leftover benefits from previous unemployment spells. Before July 2011, if she qualifies new benefits, she has to start the new UI segment; after July 2011, she can choose whether to start new UI segment or to continue collecting leftover benefits. During normal times, the retention policy does not apply, and thus if a newly unemployed worker does not qualify new benefits, she becomes unemployed without benefits.

Newly qualified UI benefits have the maximum potential entitlement J_t which varies over time according to the legislation. To reduce computational complexity, I assume that the government can commit to previous entitlements. In other words, if a worker qualified for an entitlement longer than the current maximum entitlement, $J_{t-1} > J_t$, she can potentially collect all J_{t-1} periods of benefits even though the current maximum benefit period lower than her entitlement.

Firm's problem To be matched with a worker, a firm posts a vacancy at a flow cost κ. A temp job and a regular job is filled with probability q_b and q_g, respectively, where

$$q_b = \rho q(\theta), \quad q_g = (1-\rho)q(\theta).$$

Production takes place the following period. The Bellman equation of a vacant firm of type $k = \{b, g\}$ is

$$V_{k,t} = -\kappa + \beta \underbrace{(1-q_{k,t})V_{k,t+1}}_{\text{vacancy not filled}} + \underbrace{\beta\, q_{k,t} \frac{1}{\mu_t^u} \sum_{(\omega,j,h)} \left[\mu_t^u(\omega,j,h)\mathbb{E}^-_{h'|h} F_{k,t+1}(\omega,j,h')\right]}_{\text{vacancy filled}}, \tag{9}$$

where given the distribution of workers μ_t, μ_t^u is the total measure of unemployed workers and $\mu_t^u(\omega,j,h)$ is the measure of type-(ω,j,h) unemployed workers. If the vacancy is filled, then the firm's future value is the expected value of a position filled by a worker with skill h, weighted by the unemployed worker's type distribution. The ratio $\mu_t^u(\omega,j,h)/\sum \mu_t^u$ represents the proportion of type-(ω,j,h) unemployed workers among all unemployed workers. It therefore gives the probability that a vacancy is filled by an unemployed worker of type (ω,j,h). Under free-entry conditions for each type of firms, the value of a vacancy is zero,

$$V_{k,t} = 0. \tag{10}$$

Given the gree=entry condtion, the Bellman equation of a type-k position filled by a worker of type (ω,j,h) is

$$F_{k,t}(\omega,j,h) = p_k(z_t,h) - w_{k,t} + \beta(1-\delta_{k,t})\mathbb{E}^+_{h'|h} F_{k,t+1}(\omega,j,h'), \tag{11}$$

where $p_b = \underline{z}$ and $p_g(z_t, h) = z_t h$ are the firm's productivity. Wages of a temp job are fixed, $w_{b,t} = \bar{w}$, and wages of a regular position, $w_{g,t}$, is the outcome of wage bargaining.

Wage determination Vacant jobs and unemployed workers are randomly matched each period according to the aggregate matching function $M(S,V)$. A realized match produces some economic rent shared between the firm and worker in a way that is job type-dependent. Temp jobs have fixed wages, $w_b = \bar{w}$, while wages of regular jobs come from a Nash bargaining process. I assume that wages of regular jobs are set every period, so the equilibrium wages respond to the aggregate productivity and worker's skill level.

More specifically, worker's surplus from working on a regular job is the difference between the values of working at wage w and being unemployed without benefits. This specification of the outside option follows the rules of UI that workers who quit do not qualify benefits. Firm's surplus is the difference between the values of a filled position and running a vacancy. In particular, wages are chosen to maximize the weighted product of the worker's surplus and the firm's surplus when the aggregate productivity of the economy is z and the worker's individual state (ω, j, h)

$$\Big(W_{g,t}(\omega,j,h) - U_t(0,0,h)\Big)^{\zeta}\Big(F_{g,t}(\omega,j,h) - V_{g,t}\Big)^{1-\zeta}, \tag{12}$$

where $\zeta \in (0,1)$ is the bargaining power of the worker, $W_{g,t}(\omega,j,h) - U_t(0,0,h)$ is the worker's surplus, and $F_{g,t}(\omega,j,h) - V_{g,t}$ is the firm's surplus from the match. The solution to this bargaining problem, denoted w_t, varies over times and by worker's individual states.

Competitive equilibrium Given an initial condition for worker type distribution μ_0 and a sequence of time-varying parameters $\{z_t, \delta_{k,t}, J_t\}_{t,k}$ a competitive equilibrium consists of a sequence of regular job wages $w_{g,t}$, labor market tightness θ_t, job type distribution ρ_t, worker's optimal decision rules of search $s_t(\omega,j,h)$, worker type distribution μ_t, and value functions $U_t(\omega,j,h)$, $W_{k,t}(\omega,j,h)$, $F_{k,t}(\omega,j,h)$ such that:

- The value functions satisfy the worker's and firm's Bellman equations (7), (8), (9), and (11).
- The search intensity $s_t(\omega,j,h)$ solves the type-(ω,j,h) unemployed worker's maximization problem in (7).
- The market tightness θ_t and job type distribution ρ_t are consistent with the free-entry conditions of both types of firms in (10).
- The wage of regular jobs $w_{g,t}$ maximizes the Nash product of (12).
- The law of motion associated with worker distribution μ_t is consistent with worker's optimal choices of search and stochastic processes.

4.2 Parametrization

This section provides a description of the parametrization strategy. Table 3 summarizes the values of parameters. The model period is one week. I calibrate the steady-state competitive equilibrium to match key statistics of the U.S. labor market.

The utility of consumption takes the following functional form

$$u(c) = \frac{c^{1-\sigma}}{1-\sigma}.$$

I assume the search cost function is non-negative, strictly increasing, and convex, with the property that $v(0)$ is bounded and $v(0) \geq 0$. I specify the search cost function to be consistent with the literature:

$$v(s) = \xi \frac{s^{1+\phi}}{1+\phi}.$$

For any $\xi > 0$, $v(\cdot)$ exhibits positive and increasing marginal cost, $v_s(s) > 0$ and $v_{ss}(s) > 0$, and $v(0) = v_s(0) = 0$. The matching function takes the Cobb-Couglas form of

$$M(S, V) = \eta S^{\alpha} V^{1-\alpha},$$

where S is the aggregate job search and V is the aggregate vacancy posting in the economy.

I pick two parameters related to preferences. The discount factor β is set to give a quarterly discount factor of 0.99. The coefficient of relative risk aversion σ is set to 1 (log utility). Following Nakajima (2012a) I calibrate the level parameter of the search cost function (ξ) to match the average time an unemployed person spends on job search. The curvature parameter of search (ϕ) is calibrated to match a 50% of unemployed workers receiving benefits in the steady state.

I normalize the steady-state aggregate productivity ($\bar{z}$) to 1. The temp job productivity ($\underline{z}$) is set relative to the steady-state aggregate productivity at 0.6. The level parameter of matching function (η) is calibrated to match a steady-state unemployment rate of 4.5%, and this gives $\eta = 0.207$. I follow Shimer (2005)'s estimate of the elasticity of matching function to set $\alpha = 0.72$. Following the Hosios efficiency condition, the worker's bargaining power is set to equal the elasticity of matching function, $\zeta = \alpha = 0.72$. Temp job wages are set to 0.6, according the estimate of average temp job wages in a 2004 BLS study. Because the job separation rates are potentially time varying, I calibrate the steady-state job separation rate from regular jobs to match the transition probability from employment to unemployment between 2005 to 2007, which gives $\bar{\delta}_g = 0.003$. The steady-state job separation rate from temp jobs ($\bar{\delta}_b$) is calibrated to the average length of temp jobs of about one quarter.

The UI replacement ratio (γ), the ratio of benefits and wages, is set at 0.4 following Shimer (2005). The value of non-monetary benefits (h) is set at 0.3 following Nakajima (2012b)'s estimate.

Table 3: Summary of Parametrization.

Parameter	Description	Value
	Preferences	
β	Time discount factor	$0.99^{1/13}$
σ	Coefficient of relative risk aversion	1
ξ	Level parameter of search cost	2.134
ϕ	Curvature parameter of search cost	0.98
	Labor Market	
$\bar{z}$	Steady-state aggregate productivity	1
$\underline{z}$	Temp job productivity	0.6
η	Level parameter of matching function	0.207
α	Elasticity of matching function	0.72
ζ	Worker's bargaining power	0.72
w_b	Wages on temp job	0.6
$\bar{\delta}_g$	Steady-state regular job separation rate	0.003
$\bar{\delta}_b$	Steady-state temp job separation rate	1/13
	UI-Related	
γ	UI replacement ratio	0.4
h	Value of non-monetary benefits	0.3
	Workers' Skills	
N	Number of skill levels	3
Δh	Step size in skill levels	0.15
$\pi^{-}_{h'\|h}$	Probability of skill loss during unemployment	1/12
$\pi^{+}_{h'\|h}$	Probability of skill accumulation during employment	1/250

I choose three skill levels ($N = 3$) to capture the skill losses from average unemployment and from long-term unemployment. The step size in skill (Δh) is set at 0.15 to reflect estimates by Farber (2010) that job losers experience about 15% of real weekly earnings loss on average. The probability of skill loss during unemployment ($\pi^{-}_{h'|h}$) is set at 1/12 based on the average unemployment duration of around 3 months. The probability of skill accumulation during employment ($\pi^{+}_{h'|h}$) is set at 1/250, according Kambourov and Manovskii (2009)'s estimates of a 12-20% increase in wages during the first 5 years of occupational tenure.

4.3 Policy experiment over transition path

I compute a transition path between two steady states. The initial steady state resembles the pre-recession economy of 2005-2007 without UI extensions, and the end steady state is the economy of 2011-2012 when both the job separation rates and UI extensions stayed roughly unchanged and thus

can be approximated as a steady state.

Exogenous processes Over the transition path between the two steady states, the aggregate productivity, z_t, the separation rate, $\delta_{k,t}$, and the maximum potential UI entitlement, J_t, change over times. When computing the transition path, I assume that these paths are revealed at the beginning of the transition path. In other words, it is a perfect foresight equilibrium with respect to the exogenous shocks. The assumption of perfect foresight makes the solving the equilibrium computationally manageable.

Figure 3: Paths of exogenous processes 2008-2012: Data and smoothed.

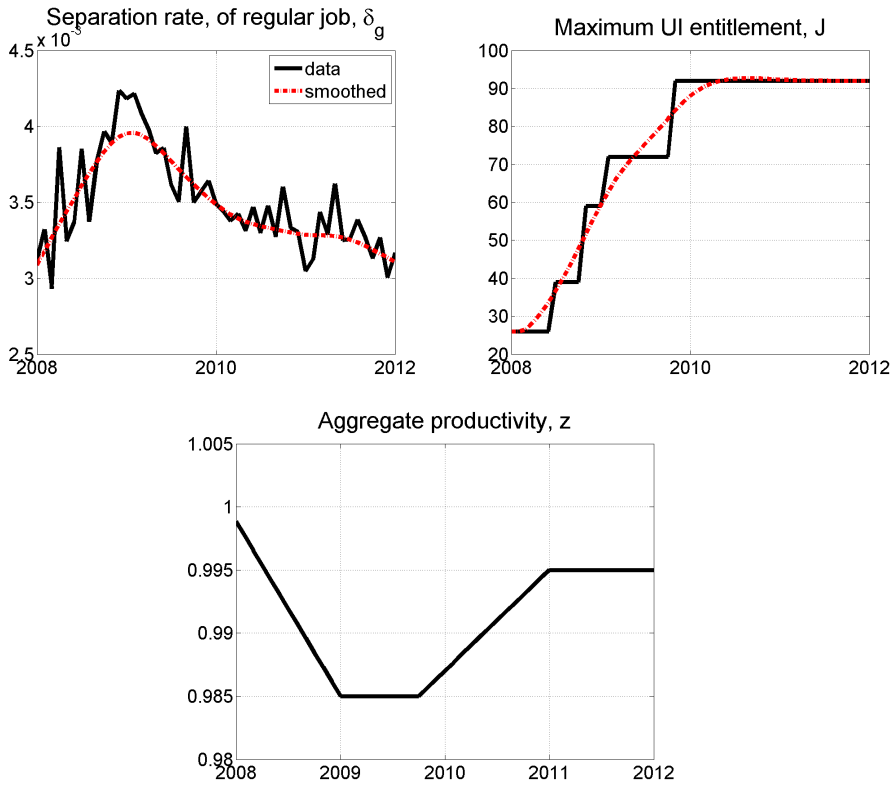


Figure 3 shows the paths of the exogenous processes calculated from the data and smoothed as model inputs from 2008 to 2012. I compute the job separation rates following the methodology outlined in Shimer (2005) and using the aggregate-level monthly CPS data, and then convert it to weekly values. The path for the maximum UI entitlement is take directly from the U.S. Department of Labor Employment and Training Administration (DOLETA) website. I smooth the job separation and UI entitlement series before feeding them into the model to compute the transition path. The rationale for using the smoothed series is to make the assumption of a transition path with perfect

foresight more reasonable.[14]

The path of aggregate productivity is calibrated so that the unemployment rate reaches around 10% in the second half of 2009. This requires a drop of 1.5% from the beginning of 2008 to 2009 and stays low until late 2009 before recovering to 0.5% below the pre-recession level. Note that the three exogenous paths correspond to the three economic conditions that affect the effect of the retention policy. Higher separation rates and longer UI entitlement both amplify the effect of the retention policy in reducing search disincentive. Lower aggregate productivity, in contrast, leads to lower regular wages and hence smaller wage gap between regular and temp jobs. Smaller wage gap in turn reduces the effect of the retention policy.

Policy experiments The purpose of computing the transition path is to find out the aggregate effect of having the retention policy. To this end, I assume the restriction on delaying the collection of benefits has been removed. In other words, the federal law of July 2011 is implemented from the start of the recession. In addition, I take the median probability of the qualifying new benefits across all states ($X_s = 5$).

Figure 4 compares the transition paths of the economy with retention to two alternative economies.[15] In the first alternative economy, there is no retention policy and any newly unemployed worker who does not qualify new benefits are unemployed without benefits. Because in reality the use of the retention policy is restricted before July 2011, the U.S. economy is between the baseline and first alternative economies. In the second alternative economy, I assume that there is no UI extension, and so the maximum UI entitlement stays at 26 weeks. All three economies are otherwise identical with the same shock processes. The comparison between the economies with and without retention tells us the effect of the retention policy over the transition, while the comparison between the no-retention economy and the no-extension economy highlights the effect of UI extensions.

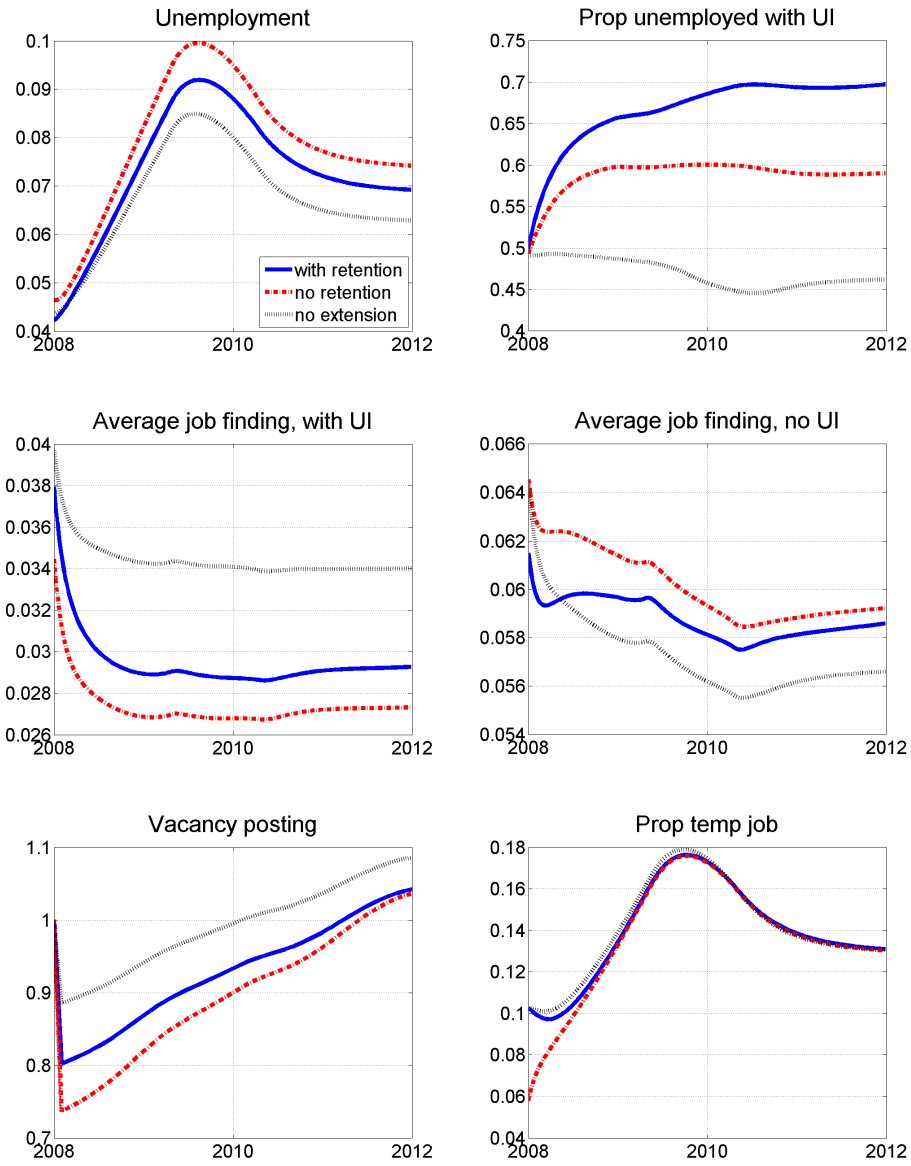
The Unemployment rate peaks in the second half of 2009. Unemployment is lower by about 0.8% in the economy with the retention policy than without. The economy without UI extensions has the lowest unemployment, with an unemployment gap of about 1.5% with respect to the economy without retention policy but with UI extensions. With UI extensions, the proportion of unemployed workers receiving benefits increases over the transition path, partly because of the gradually increasing maximum UI entitlement as shown in Figure 3. The proportion is highest on the transition in the economy with retention policy, because some unemployed workers who don't work enough to qualify new UI can use leftover benefits from before.

Average search and hence the average job-finding rate among unemployed workers with benefits falls in all economies mainly because of falling aggregate productivity which reduces the return from search activity. The fall is more substantial in the two economies with UI extensions because of rising

[14] It would be hard to imagine that the workers and firms perfectly foresee the timing of changes in UI entitlement which resulted in the zigzag pattern in Figure 3 or the short-term fluctuations in the job separation rates.

[15] Vacancy posting is normalized to 1 at the end of 2007.

Figure 4: Simulated paths of labor market 2008-2012: Retention policy and UI extension.



maximum entitlements further reduce the incentives to search. Because workers on the transition paths have perfect foresight about the maximum entitlements in the future, they reduce search effort very early on the transition and both search and job-finding rate stay low over the entire transition path. Consistent with intuition, the unemployed workers with benefits reduce search less in the economy with retention policy, because being able to delay collection of leftover benefits increases

their expected future value of employment. In contrast, search by unemployed workers without benefits fall the most in the economy without UI extensions. This is because while falling aggregate productivity reduces the incentives to search in all three economies, the larger fall in benefit-search as a result of UI extensions increases the return to search through a general equilibrium effect, and thus unemployed workers without benefits have slightly higher search and job-finding rates with UI extensions.[16]

Turning to the firm side, vacancy posting is normalized to 1 in the initial steady-state economy. Because firms have perfect foresight about the shock processes, vacancy postings fall when the shock paths are revealed at the beginning of the transition paths. Because of lower expected search in the economies with UI extensions, vacancy postings fall more in these economies. Because the retention policy creates incentives to search, it mitigates the negative incentive effects of UI extensions. The expected higher search with retention policy raises vacancy posting relative to the economy without retention policy. The proportion of vacancies posted by temp firms rises initially in response to falling aggregate productivity. While the marginal product of regular firms is linked to the aggregate productivity, the marginal product of temp firms stay unchanged over the business cycle. As a result, the drop in vacancy posting by regular firms is larger than by temp firms, leading to rising proportion of temp job postings.[17] Finally, the proportions differ very little across the economies, because worker's search is random and not directed.

5 Conclusion

This paper examines an assumption used in the modeling of UI in the literature that an unemployed worker forfeits any uncollected benefits at the time she finds a job. The paper first documents that during recessions workers in the U.S. can and do delay the collection of benefits to future unemployment spells. Exploiting cross-state and cross-time policy differences, this paper then provides empirically support that the allowing workers to delay benefit collection can may quantitatively relevant aggregate effects. I then extend a standard search and matching model to incorporate elements necessary to study the impact of such policies, and use a simple framework to illustrate how the policy can create incentives for unemployed workers to search for jobs. Using a quantitative version of the model, I then study a transition path that resembles the U.S. economy from 2008 to 2012. The policy to allow delayed benefit collection lowers the unemployment rate during the period by mitigating the negative incentive effects of UI extensions.

An interesting future direction for research is to allow workers to save. Because savings provide

[16] But because of rising benefit proportion and the small changes in no-benefit search relative to benefit search, average search across all unemployed workers falls more in the economy without retention, followed by with retention, and the least in the economy without UI extensions.

[17] This pattern is broadly consistent with empirical studies that document a rise in temp agency hirings during the Great Recession.

self-insurance to workers, introducing savings decision will reduce the response of unemployed workers to changes in UI policy. Nakajima (2012a) incorporates borrowing and savings choices in the evaluation of UI extensions, and finds that the job-finding rate of borrowing-constrained unemployed workers are higher and more responsive to changes in UI generosity. Because wages in my model are determined through a bargaining process, incorporating borrowing and savings choices considerably complicates computation.[18]

[18] A version of the model with savings choice and endogenous wage determination can be solved using method outlined in Krusell, Mukoyama, and Sahin (2010).

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