Reserve Bank Report on Structural Unemployment*

R. Jason Faberman, Federal Reserve Bank of Philadelphia
Ayşegül Şahin, Federal Reserve Bank of New York

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I. Introduction

There has been speculation, both within the Federal Reserve System and outside of it, that a sizable portion of the recent increase in the unemployment rate is *structural*. The structural component of unemployment is not due to the business cycle, but instead stems from factors that have increased the long-run equilibrium level of unemployment, or what some economists call the NAIRU (the non-accelerating inflation rate of unemployment). Consequently, it is not something that is easily remedied by monetary policy.

In this memo, we examine several potential sources of the rise in the unemployment rate that could potentially be considered structural in nature. In the absence of a universally accepted definition of a change in structural unemployment, we follow the convention of considering it to be a rise in unemployment caused by changes in characteristics of the labor market (such as demographic trends, technological progress, and institutional changes) that are not easily remedied by short-run countercyclical stabilization policy. We evaluate the extent to which these factors account for the current level of unemployment. We do so guided by standard theories of labor market search and

* We benefitted greatly from the efforts of, and discussions with, numerous colleagues throughout the Federal Reserve System, including Dan Aaronson, David Andolfatto, Gadi Barlevy, Anton Cheremukhin, Mary Daly, Bruce Fallick, Chris Foote, Shigeru Fujita, Bart Hobijn, Sagiri Kitao, Bhash Mazumder, Raven Molloy, Richard Ryan, Sam Schulhofer-Wohl, Chris Smith, Murat Tasci, Giorgio Topa, and Rob Valletta.

matching. These theories are the conceptual underpinnings of the Beveridge curve (the relationship between job vacancies and unemployment over time). There is a strong negative relationship between movements in vacancies and movements in unemployment (implying a downward-sloping Beveridge curve). Recent departures from this relation have appeared in the data, as **Figure 1** shows. Since late 2009, unemployment has remained roughly constant while vacancies have been steadily rising, causing an outward "shift" of the Beveridge curve and raising concerns about the possibility of an increase in structural unemployment.[1]

After describing the basic theory and intuition behind the relationship between the Beveridge curve and structural unemployment, we will review research on several factors driving the unemployment rate, including the "mismatch" of workers' skills to the skills required to fill vacant positions (a more traditional notion of structural unemployment, although, as we argue, not its exclusive source). We then examine the evidence on the potential risk of *hysteresis* for the U.S. economy (i.e., the risk that the unemployment rate will remain permanently higher post-recession).

Research throughout the System, including our own, finds the following:

- Extended unemployment insurance (UI) benefits, changes in the recruiting intensity of firms, and skill mismatch have had measurable effects on the rise in the unemployment rate over the period 2007-10. Empirical estimates suggest that the contributions of these factors to the rise in the unemployment rate are best summarized as follows:
    - Extended UI benefits account for 0.4 to 1.7 percentage points of the increase, with the studies' preferred estimates around 1 percentage point. This is due to

[1] The vacancy rate is measured from the Job Openings and Labor Turnover Survey (JOLTS), and the unemployment rate is measured from the Current Population Survey (CPS); both are adjusted to exclude federal government workers. We refer readers to Barnichon and Figura (2010) for more details on the recent empirical behavior of the Beveridge curve. Here, we focus on the theoretical underpinnings of this behavior.

fewer moves into employment, but also fewer people dropping out of the labor force. (This is discussed in Section III.A below.)

- A decline in recruiting intensity by employers (conditional on the number of vacancies they post) accounts for about 1.4 percentage points of the rise. It is not clear if this is due to something structural, as defined above (such as a response to uncertainty), or cyclical (such as a perception of a relatively high real wage). (See Section III.B below.)

- Skill mismatch (measured across industries and occupations) accounts for between 0.8 and 1.4 percentage points of the rise. Much of this, however, appears to be cyclical, and mismatch measures have been declining recently. (See Sections IV.A and IV.B below.)

- It is important to keep in mind that these effects are not orthogonal to each other and so are not additive. Therefore, the contributions of extended UI benefits, the decline in recruiting intensity, and the increase in skill mismatch to the rise in the unemployment rate should not be considered a decomposition of the increase in the unemployment rate.

- "House lock" (the inability of people to move because their mortgage is worth more than their home) and geographic mismatch (the mismatch between the location of available workers and that of vacancies) have not had measurable effects on the unemployment rate during the recent downturn. (See Section IV.C below)

- The problems facing the U.S. labor market going forward are unlikely to be as severe as the European-style hysteresis problem of the 1980s. (See Section V.)

II. Theoretical Motivation

Theories of labor market search and matching provide a useful framework for thinking about movements in job vacancies and unemployment.[2] These theories are built upon the premise that there are frictions in the matching of workers to jobs, so that at any point in time there are both vacant jobs and unemployed workers in the economy. Factors such as the state of the economy and policies affecting the hiring and firing processes of firms, and the reservation wage of workers, affect the difficulty that firms and workers have in finding each other, as well as the wages offered to prospective employees.

Central to these theories is the notion of a *matching function*. The matching function defines the technology by which vacancies and the unemployed are matched to "produce" a hire. In this sense, it operates the same way as a standard production function, with vacancies and the unemployed being the "inputs" and hires (or matches) being the "output." The setup creates a matching function that is arguably a "black box" in nature. Nevertheless, research, such as that by Petrongolo and Pissarides (2001), finds that a matching function that uses a Cobb-Douglas specification and exhibits constant returns to scale (so that a doubling of both vacancies and unemployment doubles hiring) fits the data well. Such a formulation, which is common in the labor search literature, would be as follows:

$$H_t = \mu_t V_t^{1-\alpha} U_t^{\alpha} .$$

In the above equation, H_t represents aggregate hiring, V_t represents the aggregate number of vacancies, and U_t represents total unemployment. The α parameter, which takes a value between zero and one, represents the "input share" of the unemployed in the matching process. The most important parameter for the topic of this memo is μ_t, which is commonly referred to as the *matching efficiency parameter*. As the name suggests, the parameter governs how efficiently workers are matched to vacant

[2] Examples of seminal theories in this literature include Pissarides (1985) and Mortensen and Pissarides (1994).

positions. If μ_t rises, then efficiency goes up, and the economy can generate more hires from the same amount of vacancies and unemployed. If it falls, the opposite is true. Consequently, the effects of mismatch, defined as a disconnect between the skills of the unemployed and the skills required to fill the existing vacancies, will appear as a decline in matching efficiency. In other words, an increase in mismatch can cause an increase in unemployment, even without a decline in vacancies.

Mismatch is not the only thing that will be captured by the matching efficiency parameter, however. Using the production function analogy again, the matching efficiency parameter operates in much the same way that the Solow residual does within an aggregate production function. The Solow residual, measured as the residual difference between output produced and the estimated contributions of its inputs, is often used as a measure of total factor productivity. It is well known, however, that the Solow residual also captures anything that affects production but is not explicitly specified in the production function (e.g., changes in human capital or effort exerted by workers).

The matching efficiency parameter is no different. In addition to capturing changes in mismatch, it will also capture anything that affects the hiring process that is not explicitly specified in the matching function. From the equation above, this includes anything not observed as a vacancy or an unemployed worker in the data. For example, it includes how intensely the unemployed search for a new job, which can be affected by policies such as unemployment insurance. It can include how intensely firms try to recruit workers. If firms become more selective in hiring, it will affect the rate at which they fill their vacancies but not necessarily the actual number of vacancies they post. Changes in labor policies and the effects of uncertainty on hiring are other examples of things that could appear as a change in matching efficiency. Any change in matching efficiency, regardless of its source, will result in a shift of the Beveridge curve. Increases in efficiency will shift the curve in (so that there are fewer unemployed for a given number of vacancies). Decreases in efficiency will shift the curve out (so that there are more

unemployed for a given number of vacancies), as seen in **Figure 2**. Finally, we should also note that the Beveridge curve may shift even if there is no change in matching efficiency. For example, changes in the rate at which workers lose or leave their jobs can cause a shift in the Beveridge curve relationship, as evidenced in recent work by Barnichon and Figura (2010). This also includes changes in the pace at which workers quit one job for another. Despite the fact that these workers never become unemployed, a decline in the rate at which they quit will result in fewer hires for a given number of vacancies and unemployed. As Pissarides (2000) notes, the theory implies that one can also get what appear to be shifts in the Beveridge curve whenever the economy moves from one equilibrium to another (e.g., in response to a change in labor productivity). When making such movements, the Beveridge curve relation tends to exhibit a counterclockwise looping behavior to the new equilibrium. This is because vacancies (since they can be easily opened and closed) "jump" to the new equilibrium, while unemployment shifts sluggishly to the new equilibrium because of the frictions inherent in matching unemployed individuals to new jobs. The start of such a loop can appear in the data as a shift in the curve.

III. Changes in the Search Behavior of Workers and Firms

Variations in the intensity of search effort on the part of either workers or employers is something that is absent from the standard matching function above, although some extensions of the standard model examine the role of such variations. Consequently, analyses of the Beveridge curve that use the standard framework neglect a role for varying search intensity. If search intensity matters for movements in the unemployment rate, its effects will appear as movements in the match efficiency parameter within this framework.

We focus on two sources of variation in search intensity. The first source is the recent extensions of unemployment insurance (UI) benefits. Since June 2008, much of the U.S. labor market

has experienced an unprecedented increase in the length of time the unemployed are eligible for UI benefits, with most states allowing for up to 99 weeks of benefits. While there are several existing studies on the topic, all with differing methodologies, most conclude that extended UI benefits have added just under 1one percentage point to the current unemployment rate. The second source is variations in the recruiting intensity of employers over the business cycle. By this, we mean how much effort employers put into filling their vacancies, conditional on the number of vacancies they have posted. Recent research has highlighted an important role for recruiting channels (hiring standards, screening effort, etc.) outside of the standard posting of a job vacancy. These channels affect how quickly a vacancy is filled and, consequently, how long it takes an unemployed worker to find new work. Research suggests that a very low level of recruiting intensity has added just over one percentage point to the current unemployment rate.

III.A. The Effect of Extended Unemployment Insurance Benefits

During the recent downturn, unemployment insurance benefits have been extended to record lengths. During normal times, job losers are eligible for up to 26 weeks of benefits. These benefits usually account for just under 50 percent of their previous earnings, on average, depending on what state they live in and the level of their prior earnings, and are usually capped at a specific dollar amount for individuals who earned above some threshold. Laws existing prior to the recession could extend eligibility in most states up to 46 weeks during periods of high unemployment. Starting in June 2008 and several times since then, the federal government has enacted legislation to extend these benefits further, through the federal Emergency Unemployment Compensation program. The most recent extension came as part of the Tax Relief, Unemployment Insurance Reauthorization, and Job Creation

Act of 2010. Individuals in most states are now eligible for up to 99 weeks of UI (and, at a minimum, 60 weeks) provided that they exhaust their 26 weeks of state benefits no later than the end of 2011.[3]

In theory, receiving UI benefits for a longer period reduces the incentive of the unemployed to look for work. Similarly, it also increases their reservation wage, so that they may reject job offers that they would otherwise have accepted in the absence of these extended benefits. At the same time, it provides added liquidity to households that exhaust their assets while searching for work, as noted by Chetty (2008). Consequently, not only do these UI extensions help support an individual's consumption, they also may induce the unemployed to continue to search when they would otherwise have dropped out of the labor force. In the data, this would increase the unemployment rate but also decrease the number of "discouraged workers" (i.e., those who report that they are out of the labor force because they believe no work is available).

Several economists throughout the Federal Reserve System have examined the potential effects of these extended benefits on the unemployment rate. Their methodologies vary, but their estimates of the effect of extended UI benefits on the unemployment rate are all relatively similar. Aaronson, Mazumder, and Schecter (2010) back out the effect of these extensions on the unemployment rate using estimates of the effect of UI extensions on unemployment duration from earlier research by Katz and Meyer (1990) and Card and Levine (2000), along with the actual state-level evolution of the benefit extensions during the recent downturn. In their preferred estimation, they find that the current extensions accounted for between 10 and 25 percent (or between 0.4 and 1.1 percentage points) of the rise in the unemployment rate between June 2008 and December 2009.

[3] Prior to the most recent legislation, individuals who had exhausted their state UI benefits after November 30, 2010, would have no longer been eligible for the extended federal benefits (which still had a maximum span of 99 weeks at the time), but may have been eligible for an additional 20 weeks of extended state benefits, depending on their state of residence.

Valletta and Kuang (2010) use the household micro data from the Current Population Survey (CPS) to identify the effect of extended UI benefits. They distinguish the unemployed based on whether they were "job losers," "job leavers," or labor force entrants, under the premise that the latter two groups are technically ineligible for UI benefits and, therefore, should not be affected by any extensions in benefits. They compare the unemployment durations of job losers versus the other unemployed before and after the start of the recession (specifically between the 2004-07 period and the 2008-10 period). In the most recent update of their analysis, they find that the effects of extended benefits increased the unemployment rate by 0.8 percentage points, on average, during 2009 and the first half of 2010. Their estimated effects are largest during 2009 and are essentially zero in the first half of 2010 (**Figure 3**).[4] In an accompanying background paper, Foote and Ryan (2011) find increases in duration for those involuntarily unemployed that are consistent with the Valletta and Kuang results, though they do not attempt to explicitly link the rise in duration to unemployment benefits. In an additional background paper accompanying this memo, Cheremukhin (2011) shows how extended UI benefits can affect movements in a Beveridge curve based on labor search theory but does not quantify the potential effects of the current extensions on unemployment.

Fujita (2010) takes a different approach. For males, he looks at how the probability of escaping unemployment varies by unemployment duration and compares the variation during the period prior to the extended benefits to the period of the extended benefits. In doing so, he attempts to account for the potential misclassification of an individual's labor force status. In the data, the escape probabilities tend to exhibit a spike at 26 weeks of unemployment, the time when UI benefits are typically exhausted (see **Figure 4**). This is especially true of those dropping out of the labor force. Fujita shows that it is also true for the subset of unemployed who were laid off (i.e., "job losers"). Fujita uses changes in the escape probabilities at the 26-week mark between the 2004-07 and 2009-10 periods to identify the effect of

[4] For the updated results, see the accompanying background paper by Daly, Hobijn, and Valletta (2011).

extended UI benefits. In 2009-10, he finds that the usual spike in unemployment escape probabilities is substantially smaller. He estimates that the observed decline in the escape rate accounts for between 0.9 and 1.7 percentage points of the unemployment rate in 2010. These results fall at the higher end of estimates found by Reserve Bank economists. As Figure 4 implies, Fujita finds that his estimated effect is due to both a lower probability of finding a job and a lower probability of the unemployed exiting the labor force.[5]

Finally, in an accompanying background paper, Aaronson, Barlevy, and Mazumder (2011) use estimates derived from Card and Levine (2000) and elsewhere in the literature in conjunction with a standard steady-state expression of the unemployment rate. Like the Aaronson, Mazumder, and Schecter (2010) study, they are careful to document the actual evolution of UI benefit extensions at the state level over time. They estimate the difference in unemployment between the actual rate and a counterfactual rate that holds the average unemployment duration constant at its pre-recession level and find that it implies that extended UI benefits increased the unemployment rate by about 0.8 percentage points. Different scenarios for the UI take-up rate, the effect of extended benefits on duration, and other factors produce only a slightly larger range of estimates, between 0.4 and 1.2 percentage points.

Overall, although the methodologies differ, the existing System studies find that federal extensions to UI benefits likely increased the unemployment rate anywhere between 0.5 and 1.5 percentage points, with most studies' preferred estimates at just under one percentage point of the unemployment rate. The estimated effects are also in line with, though on average slightly higher than, the current Tealbook assumption that the extended benefits have increased the NAIRU by 0.6 percentage points. These effects do not fit a traditional definition of structural unemployment, but they

[5] Research into the quantification of the relative importance of the two channels is ongoing.

do conform to our preferred definition, which regards unemployment that cannot be remedied by short-term accommodative policy as structural. At the same time, one can expect the effects to dissipate once the UI benefit extensions expire.

III.B. The Effect of Changes in Employer Recruiting Effort

Recent research by Davis, Faberman, and Haltiwanger (2010) has stressed the importance of channels other than a vacancy posting when it comes to firm recruiting. That is, they argue that channels that affect how quickly firms fill those vacancies are just as important as the number of vacancies that they post. These channels can represent a variety of factors, such as variations in hiring standards, wages offered that differ from those of competitors, variations in the amount of screening effort or overall recruiting effort, and the propensity to use informal hiring methods. Davis et al. refer to the collective effect of these other channels on recruiting as "recruiting intensity." They generate an aggregate time series of their measure of recruiting intensity using a generalized version of a standard matching function and their derivation of the monthly evolution of hiring and vacancies in the Job Openings and Labor Turnover Survey (JOLTS) data.[6]

Intuitively, when aggregate recruiting intensity is above average, firms may be working relatively harder to fill their vacancies. Consequently, this will make it more likely that, for a given number of vacancies, an unemployed worker will be offered a position that she is willing to accept. Above-average recruiting intensity could reflect employers scaling back on recruiting standards, putting more effort into the search and screening process, or offering wages that are relatively higher than what would be considered competitive. When recruiting intensity is below average, firms may be putting less effort into filling vacancies or, equivalently, imposing stricter screening and hiring standards or offering a relatively

[6] In terms of the matching function representation in Section II, the Davis et al. approach breaks out the matching efficiency parameter, μ_t, into two terms. The first captures changes in aggregate recruiting intensity, while the second captures all other factors that could affect a measure of matching efficiency.

stingy wage. Consequently, this will make it less likely that, for a given number of vacancies, an unemployed worker will be offered a position that she is willing to accept. These changes in recruiting intensity can be caused by a variety of factors, both cyclical and structural in nature.

Davis, Faberman, and Haltiwanger (2010) construct their measure of aggregate recruiting intensity based on their findings for the vacancy-filling behavior of employers in the JOLTS micro data.[7] **Figure 5** shows the recruiting intensity measure over the 2001-10 period. It also shows the estimate of a matching efficiency parameter similar to the one described above implied by the Davis et al. exercise.[8] Their matching efficiency estimate captures everything that can affect matching efficiency, except variations in employer recruiting intensity. Recruiting intensity is procyclical over the period, in part because its estimation is tightly tied to aggregate hiring. It exhibits a pronounced decline during the 2008-09 recession, falling by 17 percent. Matching efficiency is also procyclical, and falls about 18 percent during the recession. The fact that matching efficiency is procyclical in the data is an important point to keep in mind when thinking about how much its decline reflects a rise in structural unemployment. Notably, the two series have diverged since the start of the recovery. Recruiting intensity has picked up slightly, while matching efficiency has continued to fall.

One can use the estimates of recruiting intensity per vacancy and matching efficiency from Figure 5 to quantify how much of the rise in the unemployment rate is accounted for by changes in the

[7] Davis, Faberman, and Haltiwanger (2010) construct the measure using the assumption that the elasticity of recruiting intensity with respect to hiring is the same in both the time series and cross-section of data. They obtain the elasticity from the cross-section of micro data by examining how vacancy-filling rates vary as a function of employer growth rates and justify using the micro data estimate through exercises that show the time-series data generate a similar elasticity estimate. Their aggregate recruiting intensity series is essentially this elasticity estimate multiplied by the log of the aggregate JOLTS hiring rate.

[8] The exercise and figures described in this section use hiring, vacancy, and unemployment data that are adjusted to exclude federal government workers, since temporary hires due to the decennial census that occurred during the period of interest can distort the results. Both series in Figure 5 are normalized so that they each have a mean of one over the sample period.

measure of recruiting intensity.[9] When we perform this exercise, we estimate that the decline in recruiting intensity observed from 2008 onward accounts for about 1.4 percentage points of the current unemployment rate, which is in stark contrast to the pre-recession period. **Figure 6** illustrates that the actual unemployment rate and the counterfactual unemployment rate, which holds recruiting intensity constant at its mean over the sample period, tracked each other very closely until late 2008. Until that time, above-average levels of recruiting intensity (relative to the rest of the sample period) acted to *lower* the unemployment rate anywhere from 0.1 to 0.4 percentage points. From late 2008 onward, recruiting intensity was relatively low and continued to fall for some time. We estimate that this increased the unemployment rate by about 0.7 percentage points per month during the recession, on average, with its contribution peaking at 1.8 percentage points in June 2009. Following the recession, recruiting intensity began to rise, but only gradually and very slowly; it remains well below pre-recession levels. Thus, its contribution to unemployment was still sizable, averaging about 1.4 percentage points from the end of the recession through the third quarter of 2010. It accounted for 1.3 percentage points of the unemployment rate as of September 2010.[10]

The effect of abnormally low recruiting intensity on unemployment is clearly non-trivial. Nevertheless, its implications for the level of structural unemployment are ambiguous because the sharp drop in recruiting intensity could come from several sources. For example, if firms were being more choosy about whom to hire because they were uncertain about the future state of policy or the

[9] This involves taking the difference between the actual unemployment rate and a counterfactual unemployment rate that holds recruiting intensity constant at its mean value over the sample period. This difference reflects the effect of changes in recruiting intensity on the unemployment rate.

[10] Most extensions of the counterfactual exercise do little to change its basic result. These include accounting for marginally attached workers, using alternative estimates of the elasticity of recruiting intensity with respect to hiring, and expanding the unemployed to include those who search while employed. The one exception is when one redefines hiring to include only those hires from non-employment (or directly from unemployment). In this case, changes in recruiting intensity have almost no effect on unemployment. This implies that nearly all of the measured effect occurs through a decline in the recruiting intensity of the hiring of those already employed and is suggestive of a "vacancy chain" effect, whereby individuals, both employed and unemployed, must wait for positions to open up before finding work (see Akerlof, Rose, and Yellen, 1988).

economy (e.g., uncertainty about the cost of a hire stemming from the new health care legislation), then there is likely little monetary policy could do to spur hiring. Under our preferred definition of structural unemployment, the effects on the unemployment rate that we estimate would be considered structural. At the same time, resolution of uncertainty in this scenario should lead to a quick return of recruiting intensity to its steady-state level, so it is also capable of quickly reversing itself. On the other hand, if firms were stringent in their hiring standards because they viewed the real wage as too high relative to the skills they require for their open positions, then monetary policy could have an effect.[11] Unfortunately, this exercise is silent on the causes of the recent decline in recruiting intensity.

IV. Mismatch

Recessions are often associated with substantial reallocation in the economy, which can lead to skill and geographic mismatch. Skill mismatch arises from the inability of job seekers to fill the skill requirements of existing vacancies. Geographic mismatch can arise from the inability of job seekers to move to where the new jobs are located. Geographic mismatch could arise when homeowners have negative equity and are thus "locked" into their current location.

There has been work within the Federal Reserve System that analyzes mismatch by comparing the experiences of different types of workers across different sectors, occupations, and locations. The basic idea motivating these studies is that if mismatch is causing the unemployment rate to be higher, certain types of workers who are more prone to mismatch are more likely to experience *relatively* worse labor market outcomes.

[11] Several economists have argued that the appropriate measure for evaluating the relationship between wage movements and hiring is the wages received by new hires (e.g., see Pissarides, 2009). Prior research Okun (1973), Bils (1985), Barlevy (2001), and others have shown that the wages of new hires are much more cyclical than an aggregate measure of the wage for all workers. Haefke, Sonntag, and van Rens (2008) show that this holds when one looks only at the hiring of the unemployed. While there is ongoing research on the behavior of these wages during the current downturn, we do not yet have enough evidence to discuss.

Overall, these studies find some evidence of skill mismatch, whether it be measured by sector, occupation, or more generally. Evidence from the behavior of workers and jobs across sectors or occupations finds that mismatch has added about 0.8 to 1.4 percentage points to the current unemployment rate. Studies that use more general measures of mismatch (e.g., unemployment durations or job-finding rates) find smaller effects, and the study in the accompanying background paper by Aaronson et al. (2011) puts an upper bound on the effect of a decline in matching efficiency (including mismatch as well as other factors) at less than 3 percentage points. The existing research within the System is consistent in finding almost no effect of house lock, or geographic mismatch, on the unemployment rate.

IV.A. General Measures of Mismatch

Several studies have examined the effect of mismatch on unemployment by examining differential patterns of unemployment, job finding, and unemployment duration across different subgroups of workers. Elsby, Hobijn, and Şahin (2010) analyze the job-finding prospects of unemployed workers in different industrial sectors. Specifically, they examine the rate of exiting from unemployment conditional on the industry in which a worker was employed at the start of his or her unemployment spell. If reallocation within the economy causes a mismatch of skills, workers formerly employed in sectors undergoing structural decline will have a harder time finding new jobs, all else equal. **Figure 7** shows a version of their calculations updated with the most recent data. As seen in this figure, industry-specific outflow rates have not diverged as the structural reallocation argument would imply. In an accompanying background paper, Cheremukhin (2011) examines sector-specific Beveridge curves and similarly finds that their behavior mimicked the behavior of the aggregate Beveridge curve during 2007-10.

Another way to examine whether there is an increase in mismatch is to look at the unemployment outcomes of different age groups. Relative to their younger counterparts, older workers have lower mobility rates, and they are more likely to experience skill obsolescence. If geographic and skill mismatch are important reasons for the persistently high unemployment rate, younger workers should perform relatively better in terms of their labor market outcomes. In their accompanying background paper, Aaronson, Barlevy, and Mazumder (2011) investigate this hypothesis by comparing the unemployment rate of workers with at least a college degree who are under age 25 with the aggregate unemployment rate. They find that the unemployment rates for both groups exhibit remarkably similar behavior in both the recession and the recovery periods (**Figure 8**), suggesting a broad-based weakness in the labor market. In a similar analysis described in another background paper accompanying this memo, Foote and Ryan (2011) examine the unemployment durations of different groups of workers and find that longer unemployment durations are ubiquitous among jobless workers in the most recent recession and recovery. They find little evidence that low job-finding rates are a particularly acute problem for specific subsets of workers, such as those with few skills, middle-aged workers, or workers who own homes in states with depressed housing markets. This evidence again favors a broad-based weakness explanation for high unemployment.

Finally, some researchers have also developed estimates of the effect of mismatch using labor search theory. Cheremukhin (2011) introduces job creation costs into the labor matching model of Mortensen and Pissarides (1994). His model predicts that when the degree of mismatch increases, firms perceive already hired workers as much more valuable and perceive good new employees as much harder to find. In response to a mismatch shock (modeled as a shock to the matching efficiency parameter described above), the model predicts that firms reduce turnover, both destroying and creating fewer jobs, but that unemployment does not change much. Cheremukhin (2011) concludes that a mismatch shock alone cannot explain the data, since it leads to some counterfactual transitional

dynamics. Aaronson, Barlevy, and Mazumder (2011) use the Pissarides (1985) matching framework to obtain an *upper bound* on how much a permanent decrease in matching efficiency (which includes mismatch but also other factors, such as those discussed elsewhere in this memo) would affect steady-state unemployment.[12] Their calculation assumes that the matching technology was constant between December 2000 and September 2008 and that matching efficiency has decreased since then. Given their assumption of a 5 percent long-run unemployment rate for the more efficient labor market, Aaronson et al. (2011) find that the implied long-run unemployment rate under the new matching technology would be at most 7 percent, based on data from October 2008 through mid-2010, or at most 7.8 percent based on data from the second half of 2010.

IV.B. Sectoral and Occupational Measures of Mismatch

Şahin, Song, Topa, and Violante (2010) develop a formal framework to conceptualize the notion of mismatch and construct some intuitive mismatch indices based directly on the behavior of vacancies and unemployment across specific sectors or occupations. They then use these indices to quantify the effect of mismatch on the unemployment rate.

Şahin et al. formalize the notion of mismatch by defining the economy as a large number of distinct labor markets segmented by industry, skill, occupation, geography, or a combination of these attributes. Each labor market is frictional, i.e., the hiring process within a labor market is governed by a matching function. To assess the existence of mismatch, they examine whether, given the distribution of vacancies observed in the economy, it would be feasible to reallocate unemployed workers across markets in a way that reduces the aggregate unemployment rate. This involves comparing the actual

[12] Their calculation provides an upper bound on the effect of mismatch because they assume that (i) all of the decline in match efficiency is due to mismatch, and (ii) the value of a job does not change as match productivity decreases. Theoretically, there are various reasons the long-run value of a job should rise as match productivity declines. The increase in value would lead to lower long-run unemployment than implied by the calculation, since it would encourage firms to increase hiring.

allocation of unemployed workers across labor markets with an optimal allocation that assumes costless worker mobility across these markets. Since the only frictions in such an environment are the ones embodied within each market-specific matching function, unemployment arising in this environment is purely *frictional*. The difference in unemployment between the observed allocation and the allocation implied by the optimal environment provides an estimate of the effect of mismatch.

Note that the optimal allocation of unemployed workers across labor markets in this environment requires that weighted vacancy-unemployment ratios be equated across labor markets.[13] In its simplest form, where all labor markets have the same productivity and market-specific matching function, this requires that the market-specific vacancy-unemployment ratios be all the same. Therefore, in the homogeneous case, any deviation of a specific market's tightness from the aggregate labor market's tightness is a sign of mismatch.[14]

The optimality condition explained above can easily be used to construct simple mismatch indices. Şahin et al. focus on two specific indices. The first, M_u, is similar to traditional measures of the extent of misallocation that have been used to measure structural imbalance in the economy. It measures the fraction of unemployed workers searching in the wrong labor market, where "wrong" is defined relative to the optimal allocation of workers across markets.[15] This index, however, cannot be used to compute a counterfactual measure of unemployment in the absence of mismatch because it does not provide any information on how the job-finding process changes across the two environments. Workers searching in the wrong labor market can still find jobs, albeit at a slower rate. At the same time, even in the optimal allocation, unemployed workers still face the frictions embodied in the within-

[13] Market-specific vacancy–unemployment ratios are weighted based on each market's productivity and matching efficiency. Şahin et al. refer to this optimality condition as the "generalized Jackman-Roper (JR) condition," following the work of Jackman and Roper (1987).
[14] This approach yields a measurement device to compare actual unemployment with an ideal benchmark and does not provide a model of mismatch that analyzes its sources and delivers mismatch as an equilibrium outcome.
[15] Note that M_u is an index that takes values between zero and one. It is equal to zero when unemployed workers are optimally allocated across labor markets.

market matching functions. Thus, to compute how equilibrium unemployment would change in the absence of mismatch, one needs to understand what happens to job finding in this case. The second index developed in Şahin et al., M_h, does just this. This index measures the fraction of hires that are lost because of the misallocation.[16] Since the presence of mismatch results in a loss of a fraction of M_h of hires (for a given level of unemployment and vacancies), it lowers matching efficiency by (1- M_h).[17]

One can then compute equilibrium unemployment in the absence of mismatch by providing the appropriate correction for the job-finding rate. Thus, this second index allows one to construct a counterfactual unemployment rate series purged of mismatch that can then be compared with the actual unemployment rate. Şahin et al. construct the counterfactual unemployment rate series by using the law of motion for the unemployment rate, which depends on the job-finding and job-separation rates:

$$u_{t+1} = u_t + s_t(1 - u_t) - f_t^* u_t .$$

The job separation rate (s_t) is estimated from data. The counterfactual job-finding rate in the absence of mismatch (f_t*) differs from the actual job-finding rate at each point in time because mismatch reduces hires. [18]

It is important to note that the effect of mismatch on the unemployment rate tends to be higher during recessions. Mismatch lowers the job-finding rate in the economy. When separations are high, the pool of unemployed is large, so the effect of the reduction in job finding induced by mismatch is amplified.

[16] Similar to M_u, the M_h index takes values between zero and one and it is equal to zero under optimal allocation. However, calculation of M_h requires an additional assumption that the market-specific matching functions are Cobb-Douglas, consistent with the matching function discussed in Section II of this memo.
[17] One can thus think of a measure of the matching efficiency parameter in this setting as containing two components: (1 – M_h), which measures the effect of mismatch, and a residual component that captures all other factors that can affect matching efficiency.
[18] The job-finding and separation rates are calculated by using the method described in Shimer (2005).

Şahin et al. construct measures of mismatch across 14 major industry sectors using vacancy data from the JOLTS and unemployment data from the CPS for January 2000 to November 2010. The left panel of **Figure 9 (a)** shows the behavior of M_u over time. The three-month moving average of M_u rose from about 0.21 in 2005-07 to about 0.32 in 2009; it declined to 0.25 in early 2010 and has since increased slightly to about 0.28. The biggest contributors to the increase in mismatch were construction, durable goods manufacturing, health, and education. For construction and durable goods manufacturing, the contribution to the increase in mismatch came from a rise in the share of unemployed relative to the share of vacancies, while for health and education, vacancy shares increased more relative to unemployment shares. Figure 9 (a) shows that M_h averaged around 0.028 before the recession started, increased to 0.075 in 2009, and has declined to around 0.05 since then, with a slight pick-up recently.

One can use these estimates to quantify how much the movements in these mismatch indices have contributed to the unemployment rate. The first step is to use M_h to calculate the number of hires that would have taken place under the optimal allocation and compute the counterfactual job-finding rate. One can then use the counterfactual job-finding rate combined with the actual separation rate to calculate a counterfactual unemployment rate series purged of its mismatch component as described above. **Figure 9 (b)** shows the actual and counterfactual unemployment rate series. Before the recession started, the difference between these series was 0.4 percentage points. This is because, as M_u shows, there is misallocation in the labor market even during expansions. By 2010, this difference had risen by 0.8 percentage points, to 1.2 percentage points, implying that sectoral mismatch accounted for around 0.8 percentage points of the increase in the unemployment rate from the start of the recession to 2010.

Şahin et al. also estimate a measure of occupational mismatch using the Help Wanted OnLine (HWOL) data from the Conference Board.[19] These are unique vacancies posted by companies on a variety of electronic job boards across the U.S. for the period from May 2005 to the present. **Figure 9 (c)** reports results for the occupational mismatch exercise at the 2-digit occupation level. Both the M_u and M_h occupational indices behave similarly to the sectoral measures, increasing from 2007 to 2009 and then declining. Occupations that contributed most to the increase in mismatch were construction, production work, health care, and sales-related occupations. For construction and production workers, the contribution to the increase in mismatch came from an increase in unemployment shares relative to vacancy shares. For health and sales-related occupations, vacancy shares increased more relative to unemployment shares. **Figure 9 (d)** shows the actual and counterfactual unemployment rates. Before the recession started, there was a 1.3-percentage-point difference between the actual and the counterfactual unemployment rates. By 2010, this difference had risen to 2.7 percentage points, implying that occupational mismatch accounted for 1.4 percentage points of the total increase in the unemployment rate. Şahin et al. also calculate a more detailed mismatch measure across 2-digit occupations and nine census divisions and find that the effect of the interaction of occupational and geographic mismatch is very similar to that of occupational mismatch only. [20]

It is important to keep in mind that the sectoral and occupational mismatch measures are not mutually exclusive, so one cannot simply add the two effects to get the joint effect of mismatch across both occupations and sectors. Further, mismatch measures rose during the recession and started to come down in 2010.[21] Thus far, the evidence suggests that mismatch has had a pronounced cyclical

[19] The HWOL data are used instead of the JOLTS data, since the latter do not have data by occupation.
[20] In interpreting these results, one should keep in mind that mismatch can occur even within an industry or occupation. For example, if unemployed workers' skills depreciate during unemployment, they might not be a good match even for the employers in their prior industries or occupations. We examine this idea of a more general mismatch that arises from skill depreciation during unemployment in Section V.
[21] There has been a slight increase in the sectoral mismatch measure based on JOLTS. However, it is too soon to tell if this is an indication of a second wave of increase in mismatch.

component, moving together with the unemployment rate. While mismatch has contributed to the increase in the unemployment rate, its current pattern suggests that it is not likely to cause a long-lasting unemployment problem for the U.S. economy.

IV.C Geographic Mismatch and House Lock

Geographical disparities in the location of workers and job openings may have contributed to the increase in the unemployment rate. Given the decline in house prices that accompanied the recession, job applicants may be more reluctant to apply for and accept jobs that are not within commuting distance from their current residence and would require them to sell their homes. This phenomenon, which is generally referred to as "house lock," appeared consistent with recent data that showed that the rate of interstate migration in the U.S. has reached a postwar low. Additionally, recent work examining the link between house prices and mobility using data from 1985 to 2005 has found that mobility was lower for owners with negative equity in their homes (Ferreira, Gyourko, and Tracy, 2010), pointing to a potentially important negative effect of housing-related problems on the labor market.

In this section, we examine the link between house prices, geographic mobility, and unemployment by reviewing the work of Aaronson et al. (2011), Foote and Ryan (2011), Kaplan and Schulhofer-Wohl (2010), Molloy, Smith, and Wozniak (2010), Şahin, Song, Topa, and Violante (2010), and Schulhofer-Wohl (2010a).[22] These studies consistently show that geographic mismatch, in the form of house lock, has had little effect—at most 0.15 percentage points—on the increase in the unemployment rate.

Kaplan and Schulhofer-Wohl (2010) show that, contrary to popular belief, interstate migration did not fall relative to the trend during the Great Recession. Had it done so, this could be viewed as

[22] The results of Kaplan and Schulhofer-Wohl (2010) and Schulhofer-Wohl (2010a) are summarized in the accompanying background paper by Schulhofer-Wohl (2010b).

consistent with house lock. However, Kaplan and Schulhofer-Wohl (2010) show that the significant drop reported in the annual interstate migration rate between the 2005 and 2006 Current Population Surveys was a statistical artifact: the Census Bureau's procedure for dealing with missing data before the 2006 survey year inflated the estimated interstate migration rate, while the correction for the 2006 and later surveys reduced the estimated migration rate. Kaplan and Schulhofer-Wohl (2010) show that this change in methods—*not* any actual change in migration patterns—turns out to be responsible for much of the recent decline in reported migration rates. In essence, the pre-2006 method spuriously imputed many interstate moves that were actually local moves. The non-imputed data show that interstate migration has been trending downward for many years, but relative to that trend, there was no additional decrease in interstate migration during the December 2007 to June 2009 period.

Molloy, Smith, and Wozniak (2010) also find that the decline in migration is not a particular feature of the past five years but has been relatively steady since the 1980s. To examine whether the housing cycle has affected the migration patterns of homeowners and renters differently, they analyze the inter-state and inter-county migration rates using the CPS and American Community Survey (ACS). They find that changes in migration rates of both homeowners and renters have been similar to their longer-run downward trends. They also investigate the house-lock hypothesis by looking at the relationship between the migration rates and the share of underwater mortgages in different locations. If the drop in migration were driven by the growing share of homeowners with negative housing equity, then we would expect to see migration fall more in locations with a larger share of underwater mortgages. They find no evidence that migration rates fell more over the recent period in states with a larger share of underwater mortgages.

In a related analysis, Aaronson, Barlevy, and Mazumder (2011) use the Survey of Income and Program Participation (SIPP) to look at whether labor reallocation has been artificially low recently as a

result of house lock. The SIPP is useful for such purposes because it follows households as they leave residences, provides relatively long household panels of up to four years, and includes a wealth of demographic covariates, labor market outcomes, and housing information. A time series of state-to-state migration rates can be computed back to 1984 and up through the end of 2009, allowing for comparisons to previous business cycles. Aaronson et al. (2011) find that state-to-state migration rates among homeowners barely budged during the recession, falling by about 0.2 percentage points on an annual basis, roughly the same size decline seen among renters and among homeowners in previous recessions. They also find little evidence that migration since 2007 has varied based on the magnitude of a state's house-price decline.

Foote and Ryan (2011) study the role of homeownership and changes in the level of house prices on unemployment duration and find little evidence for a homeowner lock-in effect driven by falling house prices. **Figure 10** illustrates this point by showing the average unemployment duration of renters (blue line) and homeowners (red line) as a function of the percentage change in state-level house prices during the previous 12 months. A striking feature of this graph is the sharp rise in unemployment duration that occurs for both owners and renters when house-price changes move into negative territory. However, the difference between the price-duration relationships of owners and renters is relatively small. Even though the house-lock mechanism operates in the right direction, its effect is quantitatively negligible.

Şahin et al. (2010) calculate their mismatch measures for 50 U.S. states using state-level vacancy data from the HWOL and state unemployment rates from the CPS. They find only a minor effect of geographic mismatch on the increase in the unemployment rate.[23] As can be seen in **Figure 9 (e)**, their M_h index (the measure of hires lost due to mismatch from earlier), measured this time across the 50

[23] Şahin et al. (2010) also calculate geographic mismatch measures for four census regions and nine census divisions and find little change in these measures as well.

states, is much lower than the corresponding indices for skill mismatch. **Figure 9 (f)** shows the actual and counterfactual unemployment rates. Only 0.15 percentage points of the increase in the unemployment rate can be attributed to geographic mismatch. Their calculations also support the view that geographic mismatch contributed very little to the increase in the unemployment rate.

Finally, Schulhofer-Wohl (2010a) follows up on the work of Ferreira, Gyourko, and Tracy (2010) and revisits the link between negative equity and mobility. He finds that homeowners with negative equity are *more* rather than *less* likely to move. While this is consistent with the work described above, it contrasts with the findings of Ferreira et al. because, as Schulhofer-Wohl argues, the initial study did not fully account for all negative-equity homeowners' moves in the data.[24]

To summarize, there is little support for the view that geographic mismatch, in the form of house-lock, has had an economically important impact on labor reallocation.

V. Long-Term Unemployment and the Risk of Hysteresis

Associated with the record rise in the unemployment rate is a surge in long-term unemployment. The average duration of unemployment rose to a record high of 34.8 weeks in June 2010. The duration of unemployment has only declined to 34.2 weeks since then. Since the end of the recession, the unemployment duration distribution in the U.S. has started to resemble that of European countries, as **Figure 11** shows. Accompanying this large increase in the duration of unemployment has been an unprecedented extension of unemployment insurance, with most states allowing up to 99 weeks of benefits as discussed in Section III.A above. These observations raise the concern that the U.S. labor market might be heading toward a European-style *hysteresis* problem with permanently high

[24] Both the Ferreira et al. and the Schulhofer-Wohl studies are currently being updated.

unemployment.[25] How likely is such a dismal outcome for the U.S. economy? In this section, we explore the effects of long-term unemployment and UI benefit extensions and examine the risk of hysteresis in the context of the U.S. labor market.

In a well-known paper, Ljungqvist and Sargent (1998) analyzed the European unemployment problem to understand why unemployment in Europe surged following the late 1970s while the U.S. continued to have low unemployment. They argued that at a time of increased economic turbulence, characterized by a rise in earnings volatility and elevated risks of human capital depreciation, generous unemployment compensation may hinder the process of restructuring the economy. An important assumption of their analysis is that workers can experience a substantial degree of skill loss when they are separated from a job in a fast-changing economic environment. Unemployment compensation systems typically award unemployed workers benefits that are linked to their earnings on their last job; those past earnings reflect workers' *past* human capital, not their current opportunities or human capital. For workers whose skills have depreciated, this can make collecting unemployment compensation the relatively more attractive option over accepting a lower wage. Laid-off workers then lack the incentive to quickly accept new job offers that would allow them to once again accumulate human capital. Consequently, when there is a rise in long-term unemployment, there can be a lengthy transition phase that plagues the economy with persistently high unemployment.

An important element of Ljungqvist and Sargent's (1998) argument is the substantial skill loss that unemployed workers experience. There is abundant evidence that long-tenured displaced workers experience large and enduring earnings losses upon reemployment (see Couch and Placzek, 2010; Jacobson, LaLonde, and Sullivan, 1993a; Neal, 1995; and Farber, 2005). Moreover, workers losing jobs in a depressed labor market experience especially large losses (Jacobson, LaLonde, and Sullivan, 1993a).

[25] We use the term hysteresis in the sense of Blanchard and Summers (1987): "to denote cases where actual unemployment affects equilibrium unemployment for a long time.''

The skill loss is likely to be exacerbated by the increase in skill mismatch that we documented earlier. If there is only limited unemployment insurance (as is the case in the U.S. in non-recessionary times), these displaced workers are likely to accept work at lower wages. However, in the presence of a generous unemployment insurance system (which is currently the case in the U.S.), laid-off workers may lack the incentives to search for and accept new jobs that will pay them less than their previous jobs, or possibly even less than the unemployment benefits they are entitled to receive.[26] Middle-aged and older workers with more experience and accumulated skills will have more to lose in such an environment, and the disincentives to search for and accept a new job are likely to be greater for them. In 2010, around 41 percent of workers who had been unemployed for more than a year were over age 45. These workers face the risk of becoming disenfranchised from the labor market.[27]

Kitao and Şahin (2011) present a quantitative model to investigate the risk of permanently high unemployment that might mimic the European unemployment situation analyzed by Ljungqvist and Sargent (1998) (see the accompanying background paper). Their model approximates the labor market conditions during the recession and quantifies the long-run effects of UI extensions and the interaction between skill loss and the policy. The study finds that as long as the UI benefits are not permanent, a European-style unemployment problem is not likely. Under the non-recessionary environment, an extension of the benefits to two years would increase the unemployment rate by 1.2 percentage points.

[26] Jacobson, LaLonde, and Sullivan (1993b) study the relationship between the duration of collecting UI benefits and the wage loss upon reemployment for displaced workers who eventually find jobs. They show that for workers who collected UI benefits for a longer period, UI benefits were a significantly larger fraction of subsequent than of previous earnings.

[27] We mainly focus on the risks that older, experienced workers are likely to face, but younger workers face risks as well. The evidence surveyed in von Wachter (2010) suggests that the consequences from entering the labor market in a recession are severe in both the short and the long run. In the short run, labor market entrants and young workers suffer from larger increases in unemployment and layoffs than the average worker. According to Oreopoulos, von Wachter, and Heisz (2008), part of the decline in earnings arises because young workers entering the labor market in a recession accept jobs that they otherwise would reject. Kahn (2010) also finds that cohorts who graduate from college in poor economic conditions find work in lower-wage occupations, which suggests that these workers find it difficult to shift into better jobs after the economy picks up. As a result, some individuals never recover from the initial shock and experience persistent negative effects.

That is, if aggregate labor market conditions were unchanged, the unemployment rate would have risen by 1.2 percentage points because of the disincentive effects of UI extensions.[28] The same policy can generate a somewhat greater impact when labor market conditions deteriorate, as represented by a greater layoff risk, a decline in the job-finding rate, or accelerated skill depreciation upon job destruction. In this case, the unemployment rate can increase by 1.4 to 1.7 percentage points. The unemployment rate, however, could become permanently above 10 percent when a more generous welfare program (such as unemployment insurance with unlimited duration) is combined with further deterioration of skills for unemployed individuals. Since the extension of benefits is temporary and likely to expire once labor market conditions improve, this does not seem to be a likely scenario for the U.S. However, we note that disability insurance might serve as a back-up safety net for some older displaced workers and may have similar effects as the permanent UI benefits for a subset of the population.

Figure 12 shows the increase in disability insurance benefit applications and the unemployment rate. Disability insurance applications typically increase during periods of high unemployment (Daly, 2011). The most recent downturn also fits that pattern: disability insurance applications went up from 2.1 million in 2006 to 2.8 million in 2009. According to the Annual Statistical Report on the Social Security Disability Insurance Program, on average, 70-73 percent of disability benefits were awarded to workers older than age 45 in 2006-09. Currently, around 1.9 million workers who have been unemployed for more than a year are over 45 years old, according to the BLS data. For some of these workers, it is possible that UI acts as a transitory state between employment and non-participation with disability insurance. These factors may cause relatively high levels of disability insurance applications throughout the recovery, potentially lowering participation rates of older workers, especially among the

[28] This calculation provides another estimate of the effect of UI extensions on the unemployment rate by using a structural model. The estimated effect is consistent with the evidence surveyed in Section III.A.

low-skilled. However, we should emphasize that, thus far, we have not seen a bigger decline in labor force participation of workers over 45 years of age relative to the aggregate pattern.

Finally, we present some independent evidence on the job-finding prospects of long-term unemployed workers. As we have discussed, a major concern associated with the rise in long-term unemployment is the possibility that long-term unemployed workers become increasingly disenfranchised from the labor market, which could lead to a disproportionate change in the job-finding rates of these workers relative to others. **Figure 13** addresses this issue by presenting unemployment to employment (U to E) flow rates for workers with different unemployment durations. Consistent with the empirical studies that find negative duration dependence in U to E flow rates, the rate of flowing from unemployment into employment declines as duration rises. Up until recent months, there was little evidence that U to E flow rates had fallen disproportionately more among the long-term unemployed. However, the recent increase in the U to E flow rate is concentrated among short-term unemployed workers. Although this seems to suggest a relative worsening of the outlook for the long-term unemployed, it is actually a pattern that has been observed during previous recoveries.

Despite some of the unfavorable forces discussed above, the problems facing the U.S. labor market going forward are unlikely to be as severe as the European-style hysteresis problem of the 1980s. While the jobless in the U.S. are exiting unemployment at a historically slow rate, they are still doing so as much as four times faster than those in continental Europe did in the 1980s.

Figure 14 shows the average unemployment inflow and outflow rates for selected countries. As seen in the figure, the U.S. is an obvious outlier, with an average monthly unemployment outflow rate of nearly 60 percent and an average inflow rate of 3.5 percent. It exhibits transition rates that are at least 50 percent higher than those of other countries in the figure. The figure also shows that even the current level of the outflow rate in the U.S. is still above the flow rates observed in continental Europe.

VI. Concluding Remarks

This memo explored Federal Reserve System research on several potential sources of a rise in structural unemployment, defined as the amount of unemployment that cannot be affected by short-term countercyclical policy. The research finds that extended UI benefits, changes in the recruiting behavior of firms, and skill mismatch have had measurable effects on the unemployment rate following the end of the recession. Most studies of extended UI estimate an effect of just under one percentage point under their preferred estimation. A decline in the recruiting intensity of employers, conditional on the number of vacancies they post, is estimated to account for about 1.4 percentage points. A rise in skill mismatch may account for between 0.8 and 1.4 percentage points. It is important to keep in mind that these effects are not mutually exclusive and, thus, not additive. As discussed in Section V, these factors interact with each other. For example, an increase in skill mismatch exacerbates the disincentive effects of extended UI benefits. Similarly, the decline in recruiting intensity could cause mismatch to increase if recruiting intensity varied differentially by sectors and by skill requirements of the job openings. Consequently, it is best to treat the estimates presented here as partial equilibrium effects rather than a full decomposition.

On a related note, even though the findings presented here show that extended UI benefits, changes in the recruiting behavior of firms, and skill mismatch have contributed to the increase in the unemployment rate, they do not imply that these factors will cause unemployment to be *structurally* high, again, given our definition of structural, when aggregate demand recovers. Some of these factors, such as skill mismatch and recruiting intensity, interacted with the decline in aggregate demand and exacerbated the unemployment rate problem. The effects of other factors, such as the effect of extended UI benefits, will dissipate when the policy expires.

Finally, our review of the literature found little evidence that geographic mismatch, or house lock, has contributed significantly to the rise in the unemployment rate. Similarly, while there may be concerns about the interaction of UI benefits extensions and skill depreciation of long-term unemployed workers, a European-style hysteresis problem does not seem very likely for the U.S. economy going forward.

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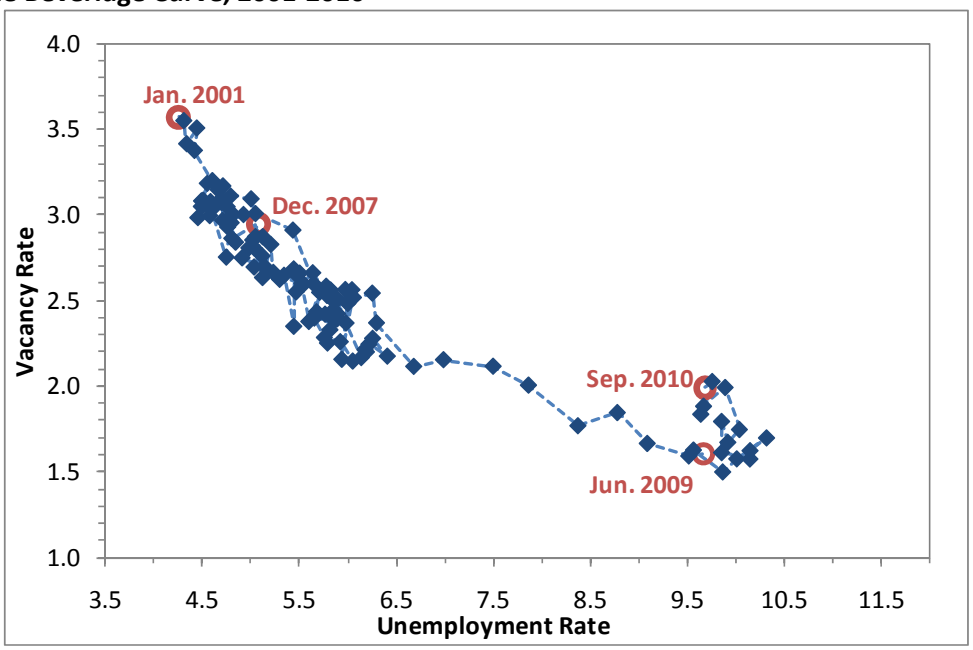
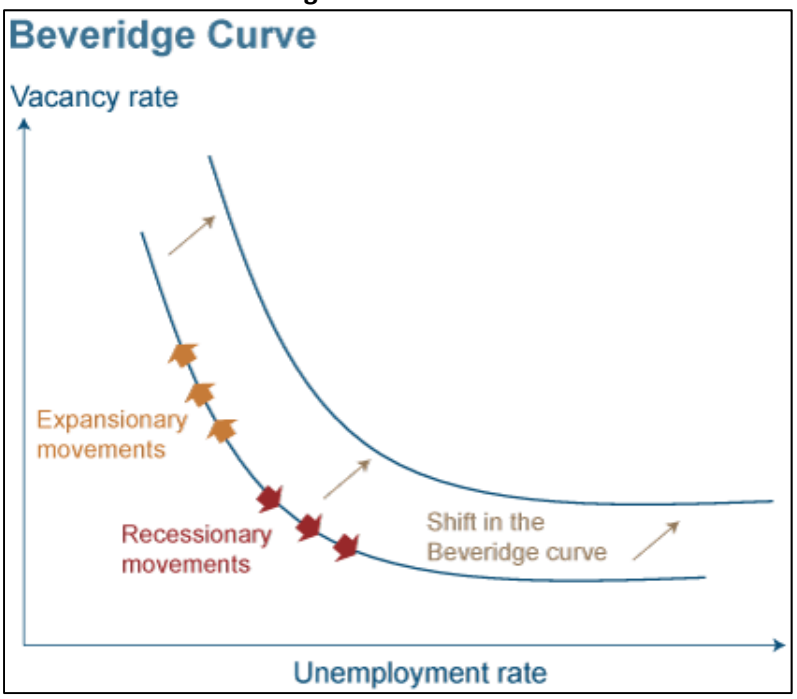
Figure 1. The Beveridge Curve, 2001-2010



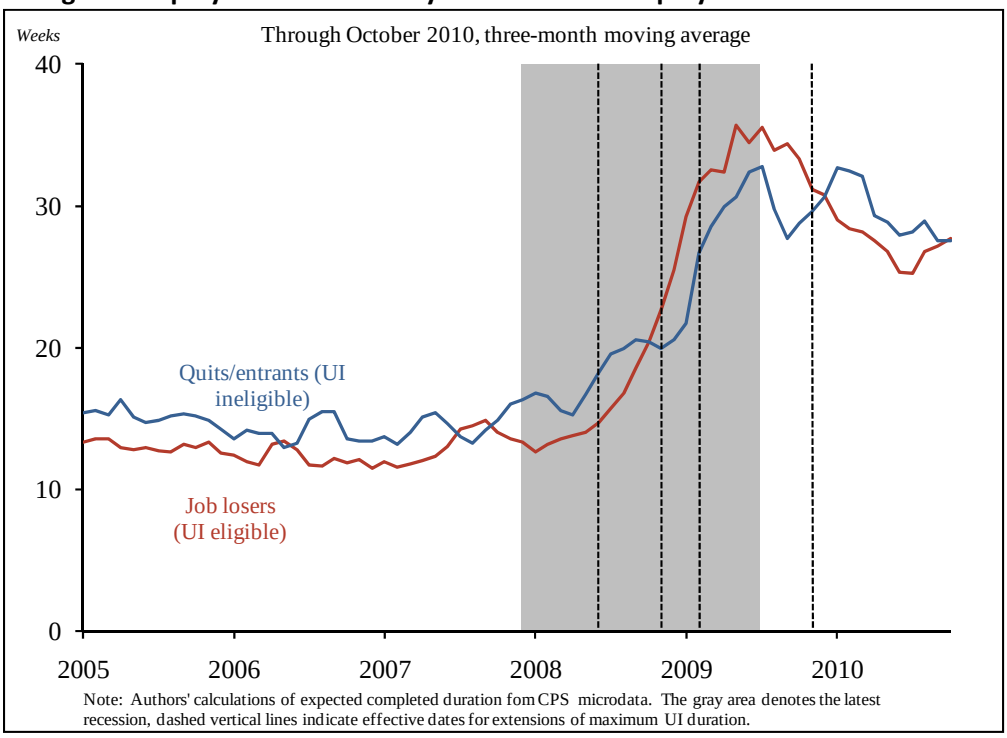
Notes: Vacancy data come from the JOLTS and unemployment data come from the CPS. Both rates are expressed as percentages of the labor force. Data are adjusted to exclude federal government employment.

Figure 2. Theoretical Movements in Beveridge Curve



Notes: Figure shows movements along a theoretical Beveridge Curve over the business cycle, as well as an outward shift that is consistent with a decline in matching efficiency. Figure from Tasci and Lindner (2010).

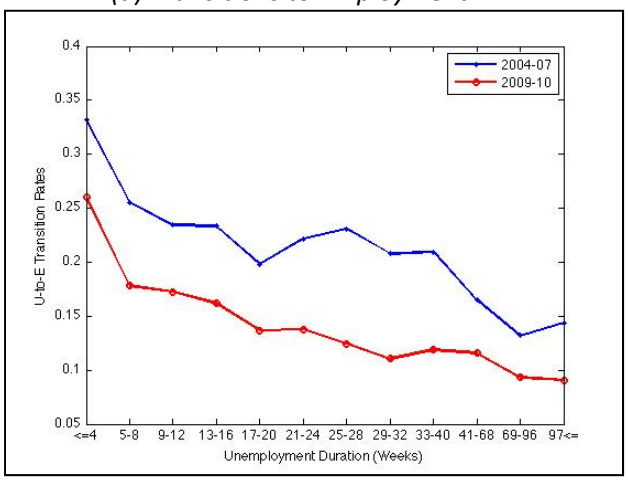
Figure 3. Average Unemployment Duration by Reason for Unemployment



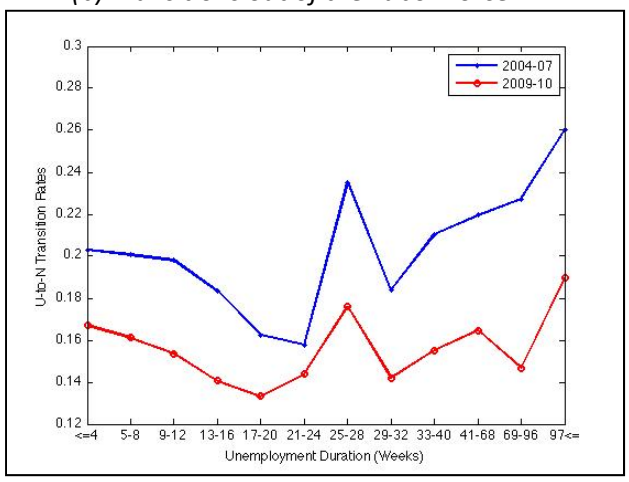
Notes: Results are from the accompanying background paper by Daly, Hobijn, and Valletta (2011), based on CPS data

Figure 4. Unemployment Escape Rates to Employment and Out of the Labor Force, All Males

(a) Transitions to Employment

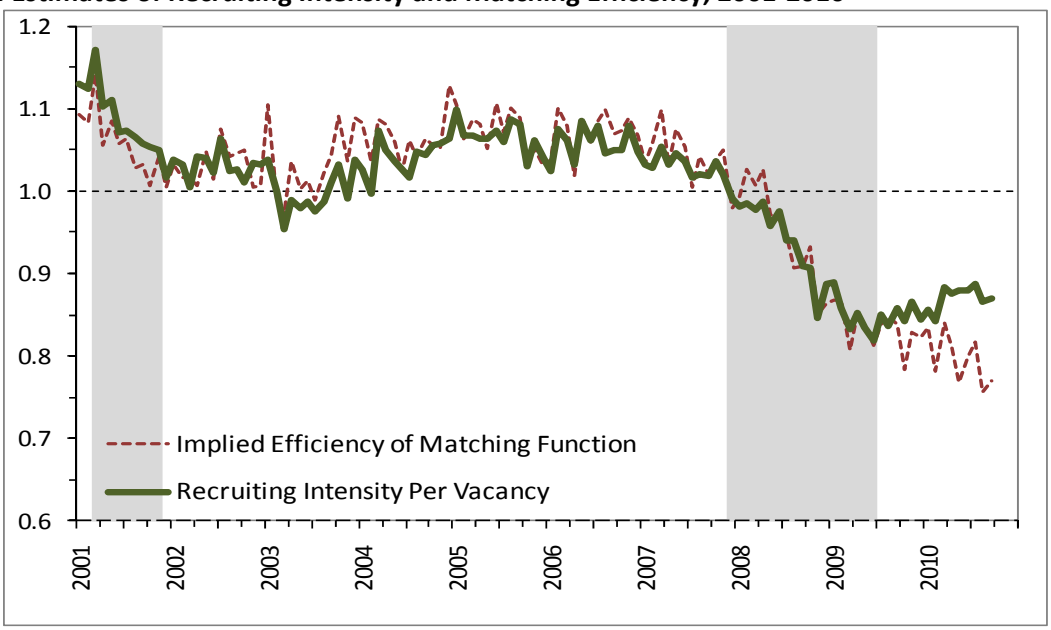


(b) Transitions out of the Labor Force



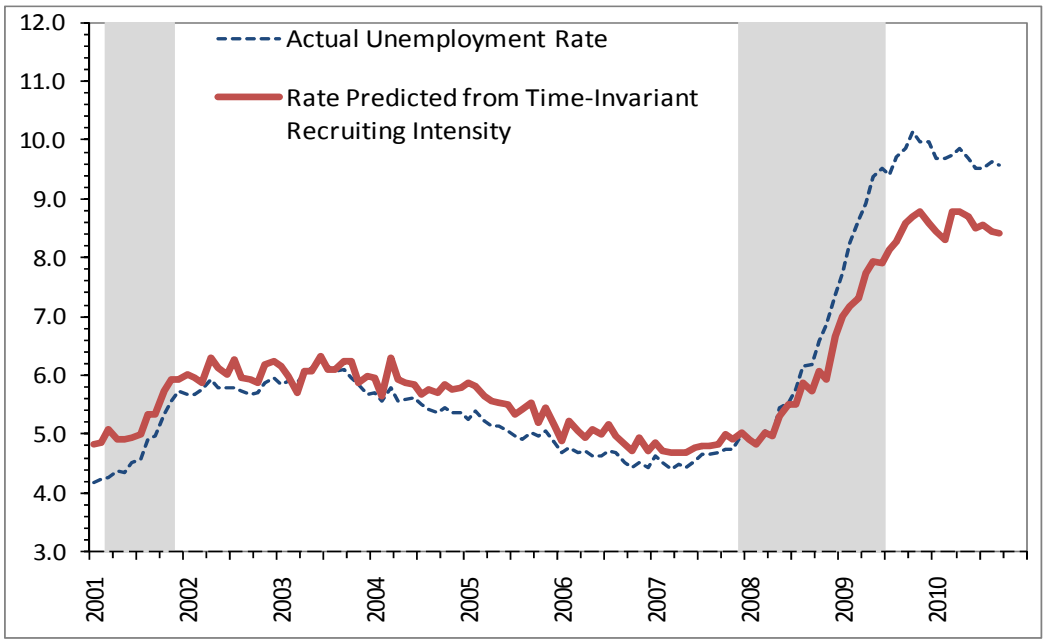
Notes: Figure replicated from Fujita (2010) and is based on estimates from CPS micro data. Figures show the monthly probability of exiting unemployment to employment (left panel) or out of the labor force (right panel) as a function of an individual's current duration of unemployment (in weeks).

Figure 5. Estimates of Recruiting Intensity and Matching Efficiency, 2001-2010



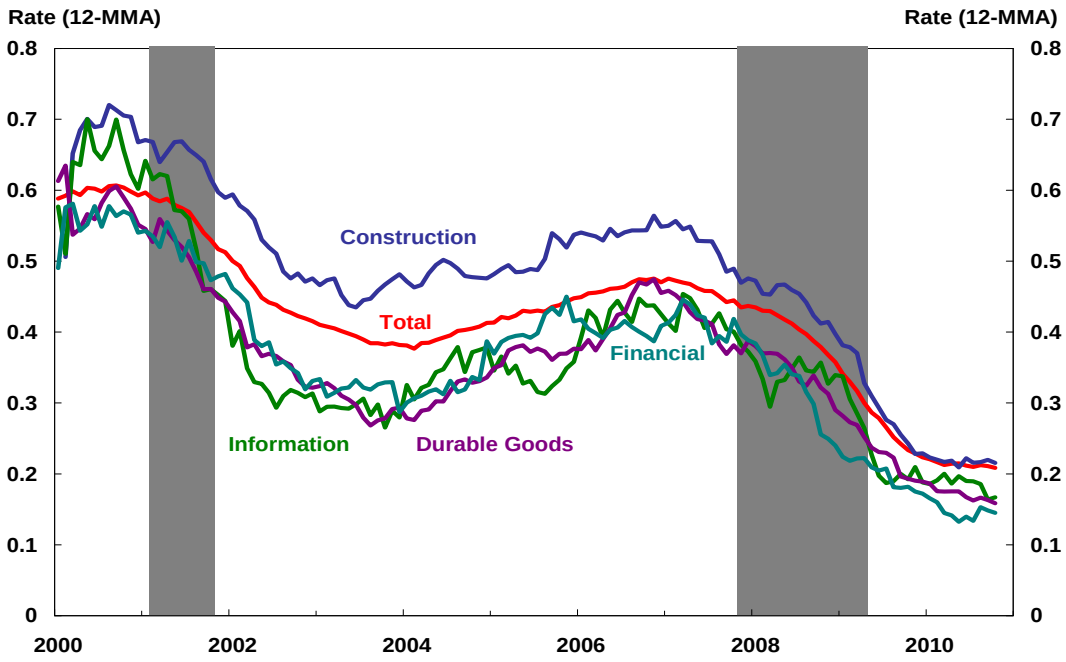
Notes: Estimates based on methodology of Davis, Faberman, and Haltiwanger (2010). Estimates use hiring and vacancy data from the JOLTS and unemployment data from CPS. Data are adjusted to exclude federal government employment.

Figure 6. Actual and Counterfactual Unemployment Rates, Holding Recruiting Intensity Constant, 2001-2010



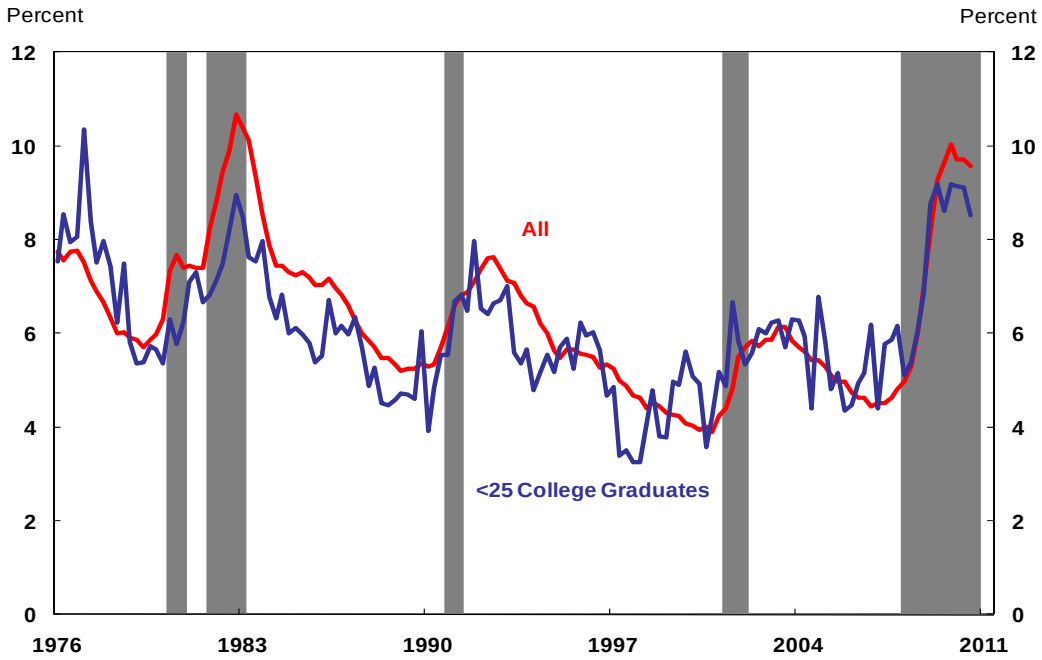
Notes: Estimates based on methodology of Davis, Faberman, and Haltiwanger (2010). Estimates use hiring and vacancy data from the JOLTS and unemployment data from CPS. Data are adjusted to exclude federal government employment.

Figure 7. Unemployment Outflow Rates by Selected Industry



Notes: From Elsby, Hobijn, Şahin (2010), using CPS data.

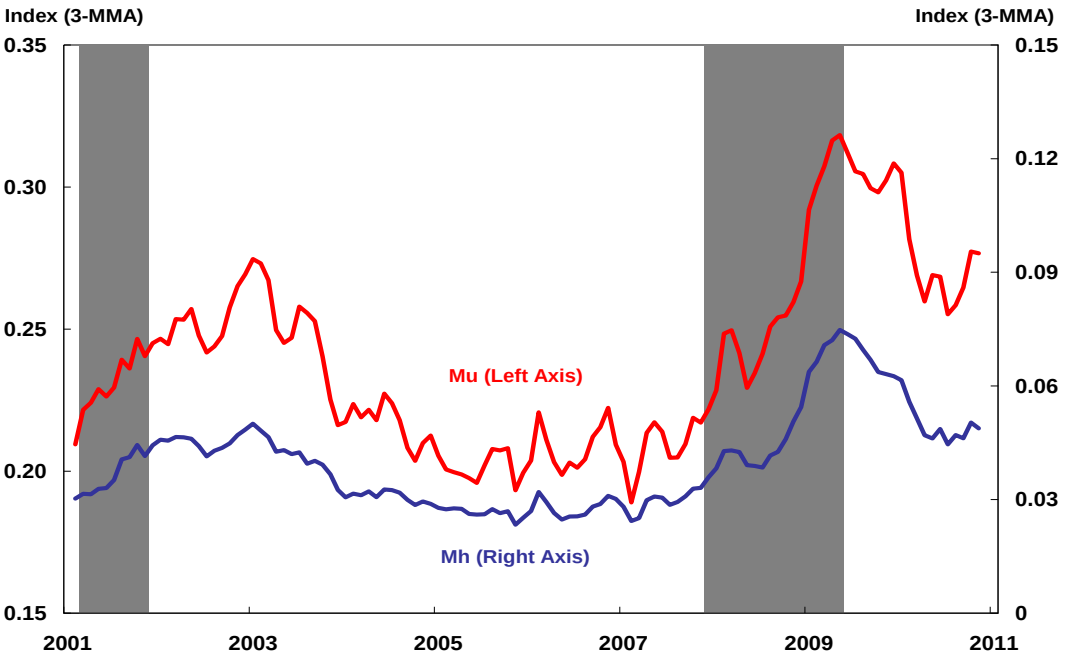
Figure 8. Unemployment Rate – Recent College Graduates



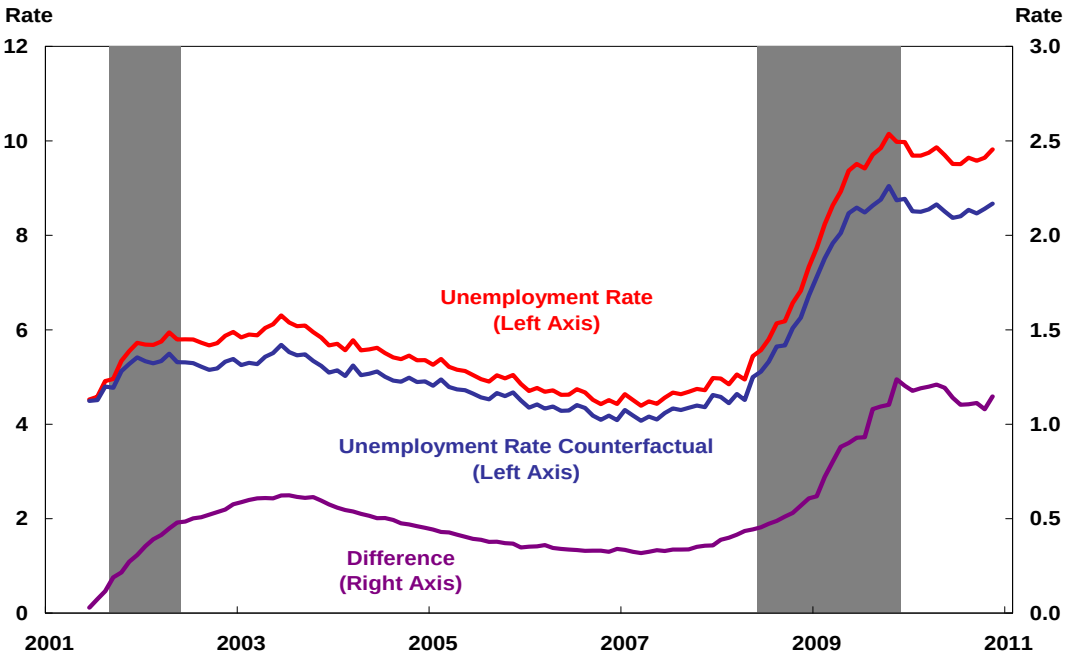
Notes: From Aaronson et al. (2010), using CPS data.

Figure 9 (a) – (b). Mismatch Indices and Counterfactual Unemployment Rates

(a) JOLTS 15 Industry Sectors: M^u and M^h



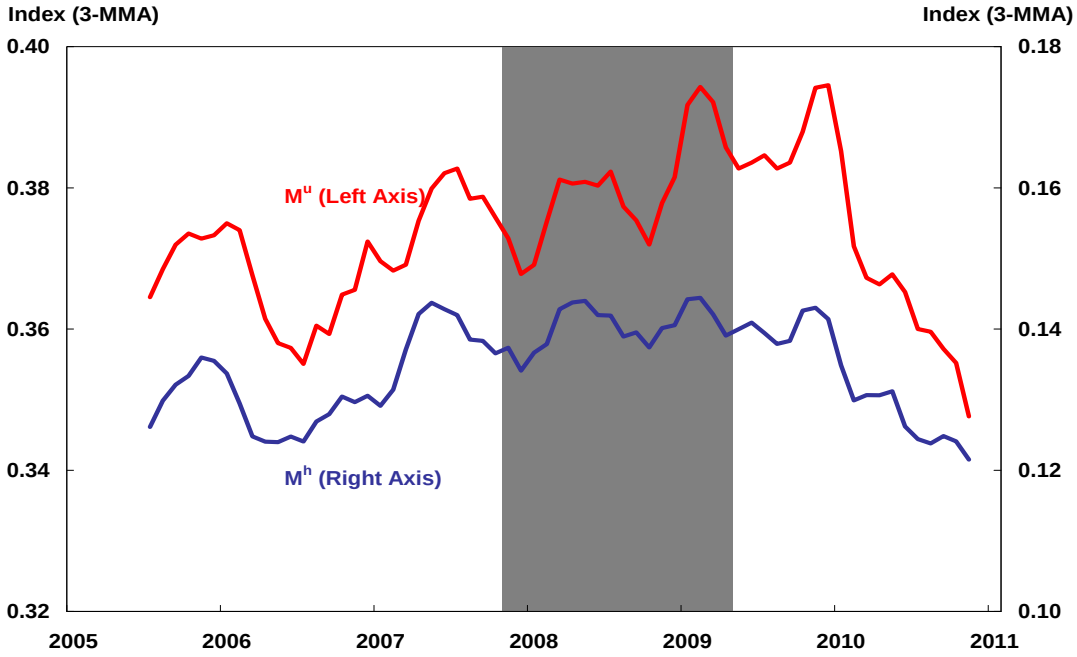
(b) Counterfactual



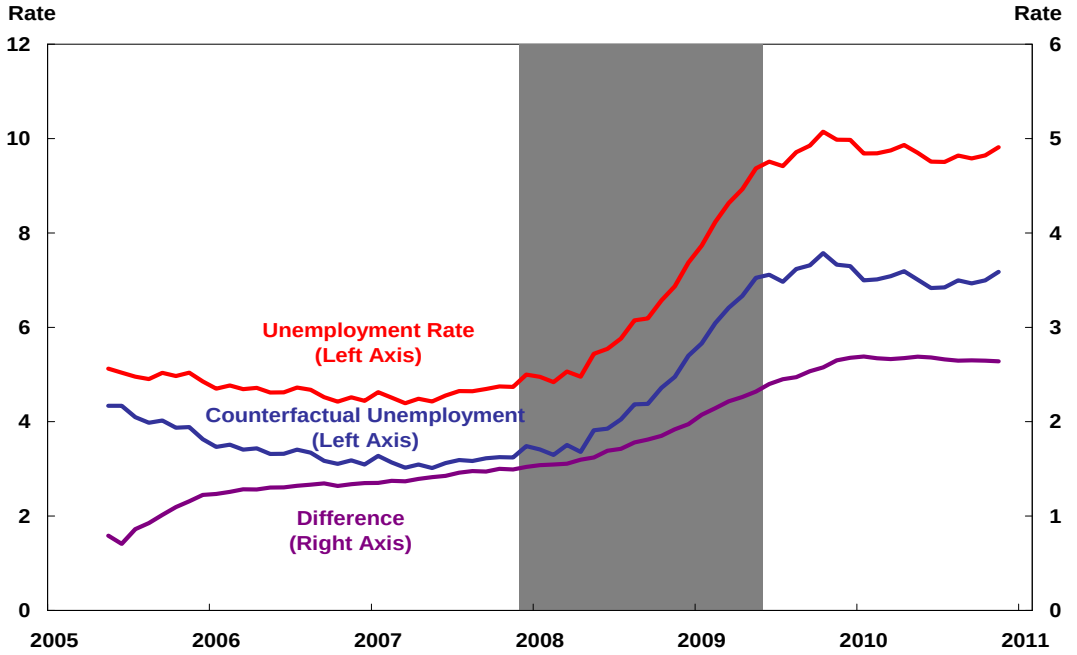
Notes: Şahin, Song, Topa, Violante (2010), The Conference Board Help Wanted OnLine Data Series, JOLTS, CPS

Figure 9 (c) – (d). Mismatch Indices and Counterfactual Unemployment Rates

(c) 2 Digit Occupation: M^u and M^h



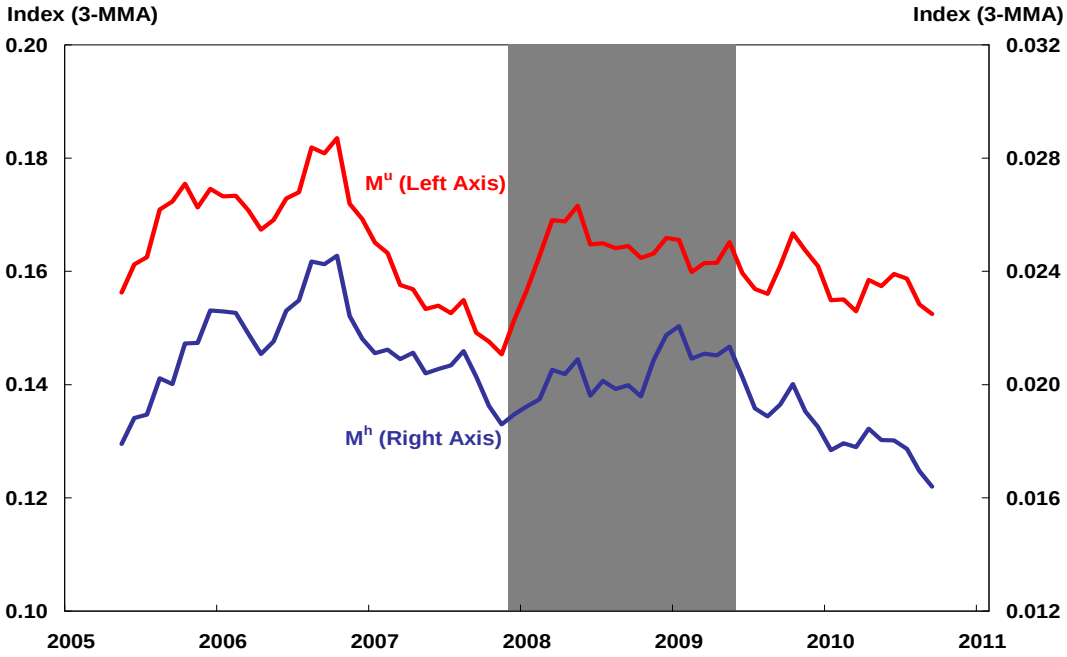
(d) Counterfactual



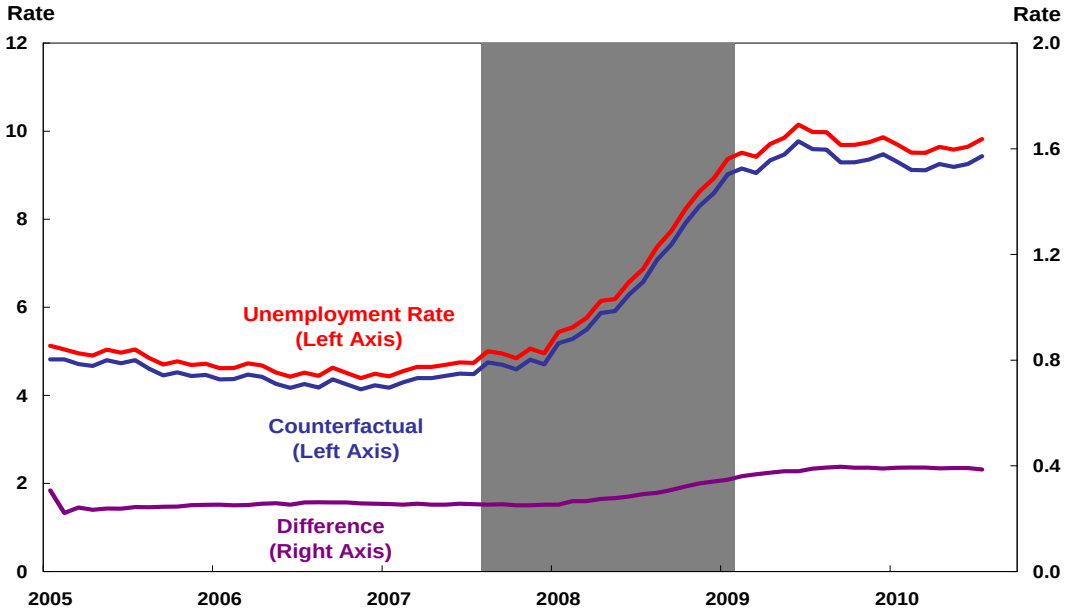
Notes: Şahin, Song, Topa, Violante (2010), The Conference Board Help Wanted OnLine Data Series, JOLTS, CPS

Figure 9 (e) – (f). Mismatch Indices and Counterfactual Unemployment Rates

(e) U.S. States: M^u and M^h



(f) Counterfactual

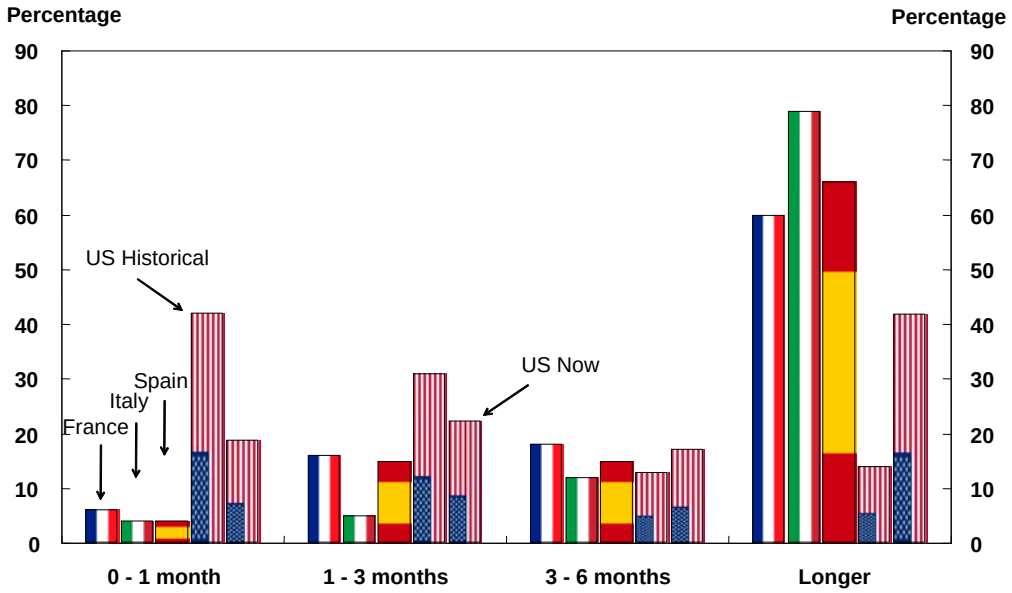


Notes: Şahin, Song, Topa, Violante (2010), The Conference Board Help Wanted OnLine Data Series, JOLTS, CPS

Figure 10: Average Unemployment Duration by 12-Month Change in State-Level House Prices

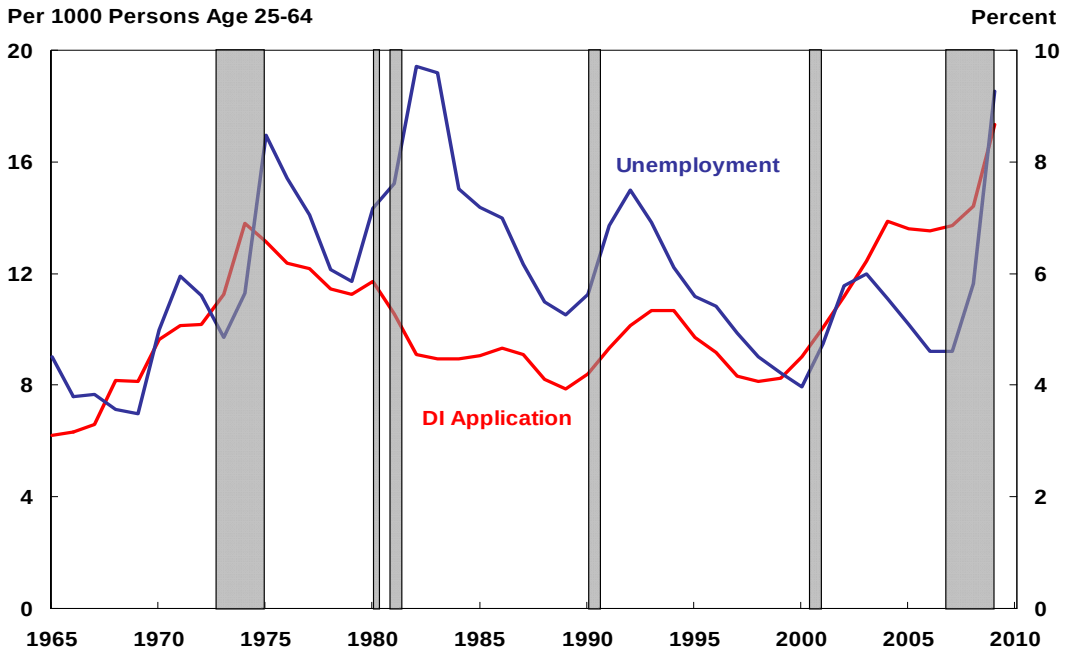
Notes: From Foote and Ryan (2011). The horizontal axis measures the 12-month percentage change in state-level house prices, as indicated by monthly interpolations of the quarterly, seasonally adjusted purchase-only price series from the Federal Housing Finance Agency.

Figure 11. Distribution of Unemployment Duration Across Countries



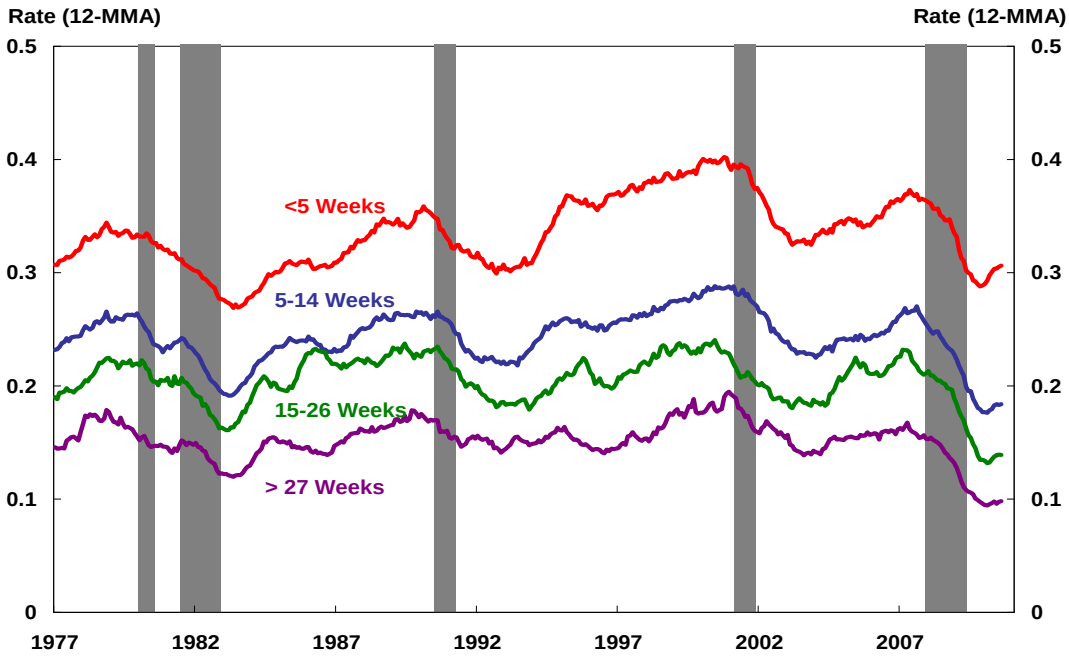
Notes: From Hobijn and Şahin (2009), using CPS and OECD data. Start dates vary between 1968 and 1983 and end dates (save for the recent U.S. data) are 2004.

Figure 12: Disability Insurance Application Rate and the Unemployment Rate



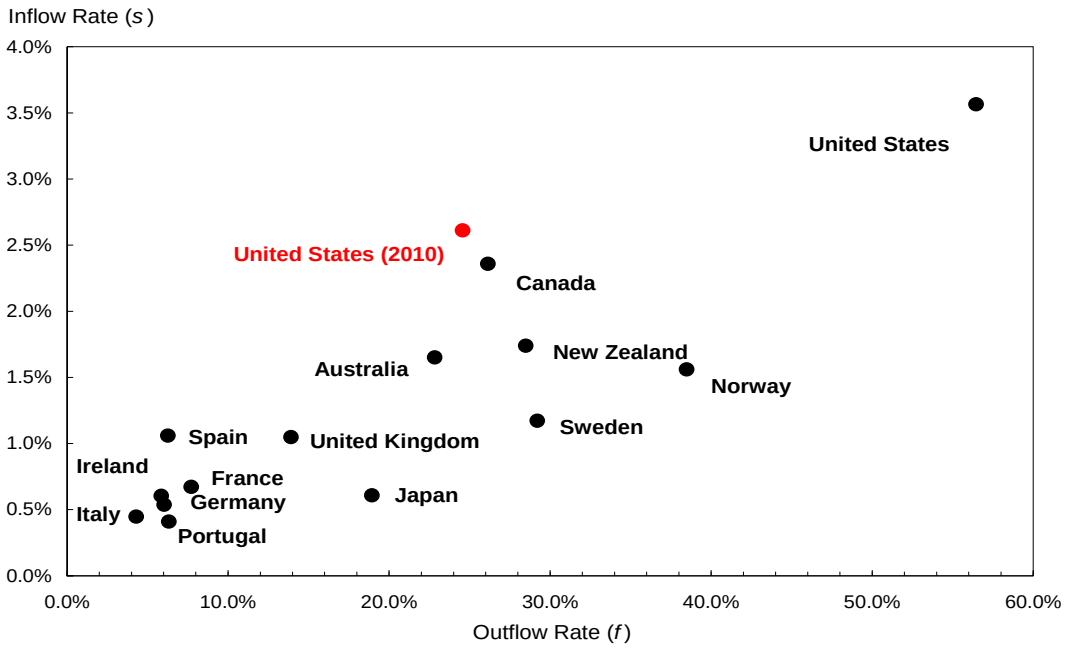
Notes: From Daly (2011), using Social Security Administration, Census Bureau, BLS data.

Figure 13. Unemployment to Employment Flow Rates by Unemployment Duration



Notes: From Elsby, Hobijn, and Şahin (2010), using CPS data.

Figure 14. Average Unemployment Inflow and Outflow Rates across OECD Countries



Notes: From Elsby, Hobijn, and Şahin (2009), using OECD data. Start dates vary between 1968 and 1986 and end dates (save for the recent U.S. data) are 2009.