Hysteresis and Persistent Long-term Unemployment:
Lessons from the Great Depression and World War 2

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Abstract

Long-term unemployment was a problem both during the Great Depression and today. As employers view the long-term unemployed as lower-quality employees, this reduces their prospects for reemployment long after the end of a recession, a phenomenon which has been previously described as “hysteresis in unemployment”. I find that hysteresis was a significant problem during the Great Depression as the number of long-term unemployed rose, but that the essentially unlimited labor demand during the Second World War provided jobs even to the long-term unemployed. As a result, the hysteresis effect was reversed and labor market conditions in the 1950s resembled those of the 1920s prior to the Depression. The Beveridge Curve has also shifted out during the Great Recession as long-term unemployment has risen. Both of these shifts are also evident during the Great Depression. I provide some rough estimates of the costs of this hysteresis effect through a counterfactual simulation where the unemployed are matched to new jobs during the Great Recession and its aftermath just as easily as they were before the Great Recession. Without the pernicious effect of hysteresis, there could be over 12 million more employed Americans today.

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*E-mail: mathy@american.edu. Evan Kraft, Peter Diamond, Larry Ball, Bob Feinberg, Alan Isaac, Jon Faust, John Parman, Henry Hyatt, and seminar audiences at Johns Hopkins, George Mason, the College of William and Mary, the Census Bureau, the Social Science History Association, and American University all provided useful comments. A grant from the ALL-UC Economic History Association funded much appreciated data acquisition. Many thanks go to Eric DeLisle for his invaluable assistance in the Social Security Administration Archives, and to Diego Garcia and John Escobar for their research assistance.
The results are striking: the interwar United States is characterized by pure hysteresis, with a completely insignificant [unemployment] level effect.

-Gordon (1988, p. 300)

Hysteresis appears to be an important feature of American depression.

-Blanchard and Summers (1986, p. 69)

1 Introduction

The world macroeconomy experienced a massive financial and economic crisis since 2008, with the early phases seeing collapses in important macroeconomic variables that were strikingly similar to those seen during the worldwide Great Depression (Eichengreen and O'Rourke, 2009). While global policy responses have improved relative to the 1930s, complete recovery is still incomplete in the North American, European, and Japan economies. The employment situation continues to be disappointing in the United States, with low levels of job creation persisting years after the start of the crisis. Recently the matching of workers to jobs has worsened, as more job openings have co-existed with a higher unemployment rate since 2008. This can be seen in an outward shift of the Beveridge Curve, which plots the relationship between job openings and unemployment over the business cycle, and is plotted in Figure 1. One set of explanations for this elevated mismatch in labor markets include sectoral shocks to or technological changes in the labor market which make employers’ needs less well matched to workers’ skills (Kocherlakota, 2010), or “structural mismatch.”

While structural explanations are popular today (and were popular in the 1930s), another explanation for increased mismatch could be high unemployment harming the ability of the unemployment to find work leading to persistently high unemployment, which is also called hysteresis in unemployment. This theory was outlined by Blanchard and Summers (1986) as an explanation for persistently high unemployment in Europe after the 1970s. I find support for hysteresis in unemployment, as the Beveridge Curve shifts out when output is shrinking while inward shifts take place during expansions. This effect is especially prominent during the effectively unlimited labor demand of World War 2 which decisively ended the hysteresis problem. The return to normalcy can be seen in the Beveridge Curve of the 1950s, which resembles that of the 1920s. The similarity of those two decades is often attributed to the tendency of market economies to self-equilibrate.

1Similar concepts of structural mismatch are discussed in Entorf (1994) and Jackman and Roper (1987). Shifts of the Beveridge Curve are assumed to be related to non-demand factors such as “maladjustment” even in the earliest paper on the Beveridge Curve such as Dow and Dicks-Mireaux (1958). I do not stress the term structural unemployment as the long-term unemployed who are discriminated against by employers are in some sense structurally unemployed, as there are reasons other than deficient demand impeding their employment. However, with sufficient labor demand for a substantial period of times they will be hired by employers. As argued in Standing (1983), discussions of structural unemployment in this context are often muddled and unclear.
but without wartime labor demand, the problem of long-term unemployment would likely have persisted and a weak labor market would likely have persisted through the 1940s.

Ghayad and Dickens (2012) found that, when the Beveridge Curve is dissaggregated by duration of unemployment, the Beveridge curve stays in the same position for the short-term unemployed while the entire shift outward takes place among the long-term unemployed. This evidence for today is consistent with hysteresis effects, and I find that hysteresis was a problem in the Great Depression as well. While the war ended the hysteresis problem of the 1930s, the prospects for a similar surge in labor demand to address our current hysteresis problems seem unlikely, so the weak labor market will likely persist for many years to come. Using a search-and-matching framework as in Mortensen and Pissarides (1994), I estimate the implied matching efficiency of the unemployed to jobs over time, which show a marked decrease in matching efficiency during the 1930s, a major improvement during the 1940s, and a return to normalcy during the 1950s.

I conduct a counterfactual simulation in which matching efficiency does not fall during the Great Recession. When the effects of hysteresis on the labor market are removed for the 2007-2014 period, American employment is higher by over 12 million workers. The slow recovery from the Depression is consistent with hysteresis effects, confirming the result of Gordon (1989) who found that the America of 1939 faced a “low-employment equilibrium trap”. For the current situation I find that employment would have recovered to less than 4% below trend, while the actual path of employment shows little to no reversion to trend employment. These problems are tied to recent concerns about secular stagnation, as can be found in Summers (2014) and Reifschneider et al. (2013). Given the recent low investment rates (and resulting low capital stock), and the low rates of employment, the prospects for recovery are bleak. As the prospects for rapid recovery seems increasingly unlikely, the long-term unemployed will likely continue to leave the labor market Krueger et al. (2014) and the labor force will, as a result, be permanently smaller. This also means the productive capacity of the American economy and potential GDP will be permanently lower as well.

2 Theories of Persistent Joblessness

Several theories have been proposed to explain persistently high unemployment and slow labor market recoveries. One theory is that of jobless recoveries, where in the wake of the three most recent recessions of 1990-1991, 2000-2001, and 2007-2009, recoveries in output have not been seen little to no recovery in employment.\(^2\) There is no equivalent jobless recovery in the 1930s, as employment recovers at the same time as output. Other theories revolve around the importance of unemployment insurance and especially recent extensions of unemployment insurance eligibility, which have been proposed as a reason why search intensity has declined and unemployment has

\(^2\)See Groshen and Potter (2003) among many others.
persisted (Katz and Meyer, 1990). Unemployment insurance only began at the state level in Wisconsin in 1932 and at a national level starting in 1937, so unemployment insurance could have only played a role in the later phases of the Depression. Unemployment benefits were more extensive in the United Kingdom, but even so, these benefits are not enough to explain the enormous increase in unemployment in the 1920s and 1930s in Britain (Crafts, 1987), though Loungani (1991) and Benjamin and Kochin (1979) find evidence for a large negative effect of the “dole.” Financial crises tend to be followed by slow recoveries, as argued by Jordà et al. (2011) and Reinhart and Rogoff (2009), which is consistent with the experience of these two recoveries of the early 1930s and the late 2000s.

Structuralist theories argue that structural changes in the economy have increased the rate of structural (as opposed to cyclical) unemployment. One reason for this structural unemployment is technological unemployment, where workers are displaced from their previous jobs due to technological change which makes their jobs or skills obsolete. There could also be insufficient workers getting skills appropriate for the more dynamic sectors which are expanding sectors, which would make them poor matches to new job openings by firms. Geographic mismatch between workers and employers is also a possibility. In the 1930s, too many workers would be in agriculture and not enough in industry, while today, perhaps, there are too many workers in the Rust Belt and not enough in the high-tech sector in California.

The second class of theories argues that aggregate demand has remained depressed which explains why workers ability to find employment has remained depressed, even with an increase in job openings. I will refer to this theory as hysteresis in unemployment, advanced most famously in Blanchard and Summers (1986) as part of the 1980s debates over the persistent unemployment problem in Europe. Once unemployment remains high, a high unemployment situation is more likely to persist according to the hysteresis theory. In this sense, cyclical unemployment quickly becomes structural unemployment and the distinction between competing cyclical and structural explanations is replaced by clear complementarities between these two types of unemployment. This phenomenon could equally be referred to as “unemployment scarring,” as the existence of

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3Hagedorn et al. (2013) found that the shortening of unemployment insurance reduced unemployment, but Rothstein (2011) finds that this effect is small and largely driven by the unemployed exiting the labor force rather than reemployment.

4See the extensive discussion of the interwar debate in Woirol (1996). The view that technological unemployment was a significant problem in the 1930s was a view shared by some of the architects of the New Deal: “I suppose that all scientific progress is, in the long run, beneficial, yet the very speed and efficiency of scientific progress in industry has created present evils, chief among which is that of unemployment.” (Roosevelt, 1936) This credulity in technological unemployment is very persistent among top policymakers in fact: “There are some structural issues with our economy where a lot of businesses have learned to become much more efficient with a lot fewer workers. You see it when you go to a bank and you use an ATM, you don’t go to a bank teller, or you go to the airport and you’re using a kiosk instead of checking in at the gate.” (Obama, 2011)

5See Clague (1935) and Lonigan (1939) for an outline of this position in the 1930s.

6See Blanchard and Wolfers (2000) for an overview of these arguments and a strong case for the interaction between adverse shocks and inflexible labor market institutions and Ljungqvist and Sargent (1998) for an example of a structuralist view on the European unemployment problem of the 1980s.
long-term unemployment leaves persistent “scars” on the employment prospects of the unemployed. Also there could be a sectoral mismatch as certain sectors of the economy grow while other shrink or housing lock where unemployed workers with negative home equity cannot move to low unemployment areas.\(^7\) These theories vary, but all argue for structural reasons which are unrelated to current demand conditions to explain why workers are not transitioning from unemployment to employment.

There are several dimensions to hysteresis, whose origins can be traced to the physical sciences and, at its simplest, implies that there is path dependence, where previous values of a variable are important for determining present values of that variables (Isaac, 1994). Hysteresis has been applied to many other subjects like trade and investment.\(^8\) Indeed, hysteresis implies that the natural rate of unemployment consistent with stable inflation (or NAIRU (Friedman, 1968; Phelps, 1967, 1968; Ball and Mankiw, 2002)) will be dependent on how high unemployment was in the past. High unemployment will tend to persist in the form of a higher NAIRU, as shown by Layard et al. (2005) and for the Great Recession by Daly et al. (2012). The idea that “the record rise in long-term unemployment may yield a persistent residue of long-term unemployed workers with weak search effectiveness” was discussed soon after the start of the recession by Elsby et al. (2011).

While many workers who experience involuntary unemployment during prosperous periods are selected (negatively) based on their quality, a larger share of workers experience involuntary job separations due to weak demand during recessions, which should reduce the quality signal from duration during downturns as shown in Katz (1991), Biewen and Steffes (2010), and Nakamura (2008). During the 1930s, this effect was probably operative to a greater degree. However, given the large numbers of both short-term and long-term unemployed, employers could easily fill positions from the rank of the short-term unemployed and thus even a milder stigma could still greatly lengthen unemployment duration.\(^9\) The long-term unemployed, once a vanishingly small part of the workforce, became a plurality of the unemployed.

A model of stigma for the long-term unemployed is presented in Vishwanath (1989), which predicts lower exit rates from unemployment for the long-term unemployed. Layard et al. (2005, p. 258-266) discusses several reasons why employers might discriminate against the long-term unemployed, such as demotivation and demoralization among the unemployed (for which they find extensive support in the literature), which gives employers’ discrimination against the long-term unemployed some justification. They also examine the behavior of exit rates from unemployment, which tend to be lower among the long-term unemployed especially after periods of high overall unemployment, which is consistent with duration dependence, and not based on heterogeneity between various groups of workers (that the long-term unemployed differ systematically from the short-term unemployed). Experimental evidence from Oberholzer-Gee (2008) shows that fake resumes that

\(^7\)See Estevão and Tsounta (2011) and Karahan and Rhee (2013) among many others.
\(^9\)This effect can be seen in the “ranking” model of Blanchard and Diamond (1994).
are identical except for duration of unemployment result in significantly fewer callbacks. Similarly, Ghayad (2013b) sent out fake job applications that varied based on duration of unemployment and possession of relevant skills for the job postings, and found that unemployment duration was a much more important determinant than the relevance of skills.

Layard et al. (2005) also have a more striking finding, which is that the long-term unemployed have less of a downward effect on prices and tend to keep the unemployment rate high: “In other words, the long-term unemployed are much less effective inflation-fighters, since they are not part of the effective labour supply.” (Layard et al., 2005, p. 39) This result can also be found in Ball et al. (1999, p. 232). Farber (2011) find that those unemployed during the 2007-2009 period had low probabilities of reemployment and difficulty finding full-time employment. Kroft et al. (2013) and Eriksson and Rooth (2014) found similar results using similar experimental methods. However, Woytinsky discusses an additional effect which would increase stigma during downturns\(^\text{10}\), which relates to the changing composition of job separations (Woytinsky, 1942, p. 55). While during normal times a large fraction of the flows to unemployment result from voluntary separations (such as quits), during a deep downturn like the Great Depression the quit rate falls due to poor employment prospects for the unemployed at the same time as involuntary separations for economic reasons (like layoffs) increase. As generally quitting workers are seeking “better” employment prospects elsewhere they tend to be high quality workers, so the reduction in the quit rate tends to reduce the average quality of the pool of unemployed.

There are other related theories beyond these two, first mentioned by Blanchard and Summers (1987), as alternative hypothesis to explain unemployment persistence. One is that a lack of investment would then lead to decreased labor demand, which would help explain higher unemployment. However, Europe in the 1980s had a relatively large capital stock so this seems to be an unlikely problem. The capital stock did shrink during the 1930s due to the investment collapse during the Great Contraction and weak investment during the recovery,\(^\text{11}\) but this was not a bar to rapid reemployment during the Second World War in any case. Another possibility is that of insider-outsider unemployment, as discussed in Lindbeck and Snower (1988), where insiders (either the already employed or members of labor unions) push for high wages. This benefits insiders who don’t see wage cuts but harms the unemployed outsiders, who would prefer employment at lower wages to unemployment.\(^\text{12}\) Given that wages were somewhat slow to fall in the Great Depression especially in 1929-1931, and wages rose during the recovery of 1933-1937 despite double-digit unemployment (Bordo et al., 2000), this argument seems \textit{prima facie} plausible, though it would clearly interact with unemployment scarring in keeping the unemployed out of work for longer periods.

\(^\text{10}\)This effect appears, to the best knowledge of the author, to not be found anywhere in the subsequent literature.
\(^\text{11}\)See Kendrick (1961, p. 320)
\(^\text{12}\)Labor unions lobbied the Roosevelt administration to block job retraining programs for those hired on emergency job programs like the WPA as there were already too few jobs for skilled union members (Jensen, 1989, p. 577). Wartimes need for skilled labor were becoming evident by 1939 and the WPA began training programs before being liquidated in 1943 when unemployment was essentially nil.
Previous analyses have generally used empirical tests of a Phillips Curve relationship, with a relationship between the change in unemployment (as opposed to the level of unemployment) and inflation being used as evidence in support of hysteresis. The persistence of unemployment is often presented as supporting evidence of hysteresis in unemployment. Blanchard and Summers (1986), the first and most extensive of the hysteresis studies, is primarily concerned with the case of European unemployment in the 1920s and 1980s. They find evidence for hysteresis in Western Europe during this period, as well as hysteresis in unemployment during the U.S. Great Depression as the epigraph indicates. Other studies that find support for hysteresis or for persistent long-term unemployment are Blanchard and Summers (1987) and Ball (2009). In a series of papers (Gordon, 1983, 1988, 1989), Gordon finds strong support for hysteresis (as measured by Phillips Curve relationships) during the Great Depression. For the UK case, Crafts (1989) finds that the long-term unemployed did not exert downward wage pressure and led to a rise to the NAIRU there from 1925-1939. In contrast to these authors, and look at reduction in the rate of matching of unemployed workers to vacant jobs, with the long-term unemployed being slowly matched to new jobs due to the stigma of long-term unemployment. Using labor market data on job openings and unemployment, I analyze these theories for the Great Depression and show that hysteresis became a problem during the 1930s. The extraordinary demand conditions during the war ended long-term unemployment and the labor market of the 1950s resembled that of 1929.

Workers who have been unemployed for a long time have trouble being matched to job vacancies, which can arise for several reasons. As longer unemployment spells tend to occur because employers have not chosen to an employee several times, there can be a stigma effect where the long-term unemployed are seen as lower quality workers, which is formalized in Doppelt (2014). This can also be due to the human capital of the long-term unemployed degrading as the unemployed are not able to practice their skills. The stigma of being a member of the long-term unemployed makes finding new employment even more difficult, the long-term unemployment problem worsens, and the labor market remains broken. While both of the major explanations for the shift in the Beveridge Curve would result from an increased mismatch between workers and jobs, the hysteresis theory yielding the prediction that these matching problems would be primarily present among the long-term unemployed and structural unemployment theories predicting elevated mismatch across all types of workers. The importance of the long-term unemployed in these two episodes points to the importance of theories based on hysteresis to explain these shifts.

While this study is the first to use the Beveridge Curve to analyze this problem of long-term unemployment in the Great Depression, this is not the first paper to discuss the underlying problem. Jensen (1989) labels the long-term unemployed with little chance of finding employment as the “hard-core” unemployed, and estimates that they represented roughly 10% of the labor force from 1934-1939 and thus made up a plurality or majority of total unemployment, which ranged from

\[\text{See Pissarides (1992) and Acemoglu (1995).}\]
14.3% to 22% over the same period. Woytinsky (1942) also uses a similar appellation of “hard-core” unemployed for the unemployable unemployed, and finds that already by 1930 in Buffalo the long-term unemployed were 15% of the overall unemployment pool. Bakke conducted a multi-year survey to see the effects of the Depression on the unemployed in England. Both employers and employees confirmed that the long-term unemployed of the time faced much more difficulty in finding work than the recently unemployed: “[T]he longer a man was out of work, the harder it was to get work.” (Bakke, 1933, p. 50)

3 Beveridge Curve

The Beveridge Curve (Dow and Dicks-Mireaux, 1958; Blanchard and Diamond, 1990), which relates changes in job openings to unemployment, is the most useful way to examine labor market issues of this type as it allows for business cycle conditions to be separated from other factors that affect the labor market. The relationship between job openings and the unemployment over the business cycle is fairly intuitive. During a business cycle downturn, unemployment is high while employers offer relatively few job openings. Near a business cycle peak, unemployment is low and employers offer many job openings to increase production. This describes a single Beveridge curve over the business cycle.

It is possible, as well, to observe shifts in the Beveridge curve. An outward shift of the Beveridge curve, which corresponds with a worsening of job matching, will mean both more job openings and a higher unemployment rate as unemployed workers are matched to job vacancies at a slower rate at any of the business cycle. Similarly, a shifting toward the origin of the Beveridge Curve will correspond to the unemployed being matched to jobs at an increasing rate. Two sample Beveridge Curves can be seen in Figure 2 that illustrate the preceding descriptions. I use a standard Beveridge Curve formulation of a Cobb-Douglas function with the unemployment rate and job vacancies as

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14 The situation would undoubtedly worsen by later in the decade, though data is not available for Buffalo to examine this possibility.

15 "Works managers in Greenwich testified that even a short period of unemployment handicapped a man in his efforts to market his labour. There was, first of all, the preference that the employer had for the man who had just come from a job. In all probability he would be more competent than a man who had been away from his tools for some period. The handicap increased with the length of time out of work. ... [T]he complaint was made even among the labourers that the man just out of a job was given the preference. ... The general impression among the men was that the chances of getting a job were inversely proportional to the number of men who had come out since they were discharged." (Bakke, 1933, p. 50-51)

16 Why the relationship between the unemployment rate and the vacancy rate is called the Beveridge Curve is unclear, but this appellation seems to date from the 1980s (Rodenburg, 2011). Beveridge (1944) argues that British policymakers should implement full employment policies by targeting a vacancy level larger than the level of unemployment so that in principle every unemployed worker could find a job opening and become employed. However Beveridge does not plot the “Beveridge Curve” in his 1944 book, and the curve that corresponds to Beveridge’s target is the job creation curve (Pissarides, 2000, p. 20) which is defined in terms of labor market tightness (v/u) and has the opposite slope of the unemployment-vacancy curve discussed in depth by Dow and Dicks-Mireaux (1958), after whom the curve should be named. It appears the Beveridge Curve follows Stigler’s law of eponymy (Stigler, 1980) where no discovery is named after its original discoverer.
arguments following Pissarides (2000). Rather than the standard Solow Residual, a “match productivity” term is included to account for shifts in match efficiency controlling for the position of the economy in the business cycle. If workers are not matching with available jobs then match productivity will be lower and vice versa.

4 Beveridge Curve Data

I construct a Beveridge curve for the 1930s using existing data on job openings and a monthly series on unemployment from the National Industrial Conference Board. Using a Cobb-Douglas form for the Beveridge curve allows me to separately identify movements along the Beveridge Curve and shifts of the Beveridge Curve. For a given change in unemployment and vacancies I show that mismatch increased during the recession periods of the 1930s and shrank during economic expansions, especially during World War 2, as can be seen in Figure 3. This is consistent with the predictions of the hysteresis theory. The immediate postwar is the only period where structural mismatch is evident as the demobilization from the wartime economy and the shift from a command economy to a market economy required significant structural change in the American economy. However, by the early 1950s the Beveridge curve had returned to a similar position as in the 1920s and the economy had returned to normalcy. The damage to the labor market that occurred during Great Depression, while significant, was reversible, as can be seen in Figure 4.

The job opening data are drawn from the work of Zagorsky (1998), who constructs a job vacancy rate from 1923-1944 using a help-wanted index from the Metropolitan Life Insurance Company. Zagorsky carefully accounts for geographic representation, controls for changes in the number of newspaper pages, and benchmarks his help-wanted index to other job openings measures from the BLS to ensure their accuracy. These vacancy figures are available back to 1923 at a monthly frequency. While currently the Lebergott figures (unemployment figures used by the BLS for this period) are available at an annual frequency for 1929-1940, similar methods as used by Lebergott can be used to construct monthly series based on employment and labor force data collected by governmental agencies.

While I examined several series, the series from the National Industrial Conference Board conformed most closely to the annual estimates of Lebergott. These estimates were published in National Industrial Conference Board (1940) and other issues of the Conference Board’s Economic Record publication. All estimates follow roughly the same procedure. Non-agricultural employment figures are available from the BLS at a monthly frequency back to 1929. Agricultural employment is available from the Department of Agriculture monthly, and the sum of these two series makes up total employment. The labor force is derived from interpolated estimates of decennial censuses. Unemployment is then the difference between employment and the labor force and the unemploy-

17Microfoundations for the Cobb-Douglas form of the matching function can be found in Stevens (2007).
ment rate is the ratio of unemployment to the labor force. The Conference Board figures can be used to calculate two estimates of unemployment. One includes emergency workers hired by New Deal Agencies like the New Deal as unemployed workers (in keeping with the method of Lebergott (1964)), and another which counts these emergency workers as employed (in keeping with the method of Darby (1975)). These annual unemployment rates can be seen in Figure 5, and the monthly series are displayed in Figure 6. 1940 sees the beginning of the Current Population Survey (CPS), which was initially under the control of the Work Projects Administration (WPA) but was soon transferred to BLS administration. While the definitions of unemployment, employment, and the labor force are not identical to those of the current BLS definition post-1948, the two series conform closely for the months in 1948 when they overlap. Official unemployment rate data begin in 1948 and are used to examine the condition of the labor market in the immediate postwar for comparison.

Woytinsky (1940) is the first to propose the “added-worker” effect. This effect arises when a male head-of-household becomes unemployed and other members of his household will enter the labor force and search for employment to replace his lost income. Woytinsky compared labor force participation for families of differing sizes in Philadelphia, and found that larger families had larger labor supply, with unemployed male breadwinners sending their wives and children to work to replace their income. As this makes the interpolated labor force estimates lower-bounds, this would, if anything make actual unemployment larger than the above estimates as unemployment is the difference between employment and the labor force. This also implies that the outward shift of the Beveridge Curve is more pronounced than described above if unemployment is higher than estimated.

5 Measuring Mismatch

A Beveridge Curve is defined by the plotting of data points for the job vacancy rate and unemployment over a business cycle for a given matching efficiency, such that higher unemployment and lower job vacancies correspond to a downturn as few workers are quitting and demand for firms’ products is low so that few job openings are needed to produce to meet demand. During a boom, unemployment declines and job vacancies are high as more workers quit and firms ramp up production as aggregate demand increases. However, this implicitly assumes a given matching efficiency between workers and job vacancies. If this matching efficiency decreases (increases), then the Beveridge Curve will shift outward (inward). However the observed data can contain either shifts along a given Beveridge Curve, or shifts of an existing one, or likely both. To separate these two effects, I will assume a given functional form for the Beveridge Curve based on labor search-

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18 Note that there are no discouraged workers here, and any non-employed “gainful” worker counts as unemployed even if they are not seeking employment actively.
19 To complicate things further, the Census Bureau does the physical work of conducting the survey.
and-matching models of the Beveridge Curve as pioneered in Mortensen and Pissarides (1994). Extensive empirical evidence support a Cobb-Douglas functional form for the matching function as shown in Petrongolo and Pissarides (2001). The Beveridge Curve is defined as a Cobb-Douglas functional form over match productivity $\lambda_t$, the number of unemployed $U_t$, and the number of job vacancies $V_t$, which jointly determine the number of new matches $M_t$,

$$M_t = \lambda_t U_t^\alpha V_t^{1-\alpha}. \quad (1)$$

As the matching function is assumed to have constant returns to scale\(^{20}\), we can express the matching function in intensive form with lower-case variables representing per labor force units as in

$$m_t = \lambda_t u_t^\alpha v_t^{1-\alpha}. \quad (2)$$

As the fraction of the long-term unemployed rises, this causes a reduction in match efficiency. As more unemployed are coexisting with more vacancies, the Beveridge Curve shifts outward. For the modern period since 2000, there is data from the Job Opening and Labor Turnover Survey (JOLTS) for the hire rate so that an exact estimate for $\lambda_t$ can be constructed, while for the historical period there is no corresponding data. For the historical period, I estimate $\lambda_t$ as an ordinal variable that represents the ordinal position of the Beveridge Curve, with $m_t$ normalized to one for convenience so that

$$\lambda_t = u_t^{-\alpha} v_t^\alpha -1.$$

All that remains is to calibrate the coefficients for $\alpha$ which is explained further in Section B of the Appendix. I use the estimates of unemployment that count emergency workers hired by government agencies like the WPA as unemployed, as these workers were largely drawn from the long-term unemployed and had few prospects for employment outside of government work.

### 5.1 Duration and Matching

Recessions both reduce vacancies and increase the duration of the unemployed, an intuition which is shown formally in Barron (1975) and Feinberg (1977). Kroft et al. (2014) find that negative duration dependence in job finding rates among the long-term unemployed helps explain the shift outward of the Beveridge Curve from 2008-2013, and this section provides an alternative model negative duration dependence. The aggregate matching efficiency masks heterogeneity among different types of unemployed. When the long-term unemployed are viewed as lower-quality workers by employers, the hazard rate for exiting from unemployment is higher the longer one is unem-

\(^{20}\)This is a feature that is well supported by most empirical studies as shown in Petrongolo and Pissarides (2001).
ployed. For simplicity, I will consider two types of unemployed, long-term $u_l$ and short-term $u_s$, though in reality one could imagine a continuum of unemployed indexed by their unemployment duration. The overall unemployment rate is simply the sum of the short-term unemployment rate and the long-term unemployment rate so that

$$u = u_l + u_s.$$  (3)

There is a lower probability of a successful match for the longer duration workers due to the stigma of being long-term unemployed, which makes the matching parameter for the long-term unemployed $m_l$ smaller than that of the short-term unemployed $m_s$, as the hazard rate of exit from unemployment is inversely related to matching efficiency. This can be seen through the lens of the Blanchard and Diamond (1994) “ranking” model, where employers hire the unemployed worker with the shortest duration spell. The overall hire rate can be decomposed into hires of short and long duration

$$h = h_s + h_l.$$  

While we can subdivide the unemployed by duration, vacancies are not intended for workers of a specific duration, so vacancies $v$ are common to all of the unemployed. We can also generalize the matching function to any duration of unemployed $j \in [s, l]$ such that

$$h_j = m_j u_j^\alpha v^{1-\alpha}.$$  

This formulation does not permit any interaction between the number of the short-term unemployed and the prospects for the long-term unemployed for simplicity, though this would be a useful feature in a future model. This allows us to obtain the following expression for hires:

$$h = \left[ m_l \left( \frac{u_l}{u} \right)^\alpha + m_s \left( \frac{u_s}{u} \right)^\alpha \right] u^\alpha v^{1-\alpha}.$$  (4)

Combining equations 2, 3, and 4 we obtain

$$m = \left[ m_l \left( \frac{u_l}{u} \right)^\alpha + m_s \left( 1 - \frac{u_l}{u} \right)^\alpha \right].$$  

For simplicity, call $\theta = \frac{u_l}{u}$. Taking the derivative of matching efficiency with respect to the share of long-term unemployed in the population, we obtain

$$\frac{dm}{d\theta} = \left[ \alpha m_l \left( \frac{u_l}{u} \right)^{\alpha-1} - \alpha m_s \left( 1 - \frac{u_l}{u} \right)^{\alpha-1} \right].$$  (5)

The condition required to ensure that an increasing share of the long-term unemployed decrease
matching efficiency \((\frac{dm}{df} < 0)\) and shift out the Beveridge Curve is:

\[
m_s \left( \frac{u_l}{u_s} \right)^{1-\alpha} > m_l.
\]  \(6\)

While it may seem intuitive that \(m_s > m_l\) is sufficient to ensure a decline in matching efficiency when the Beveridge Curve shifts out, the changes in the aggregate match rate is larger as the share of the long-term unemployed rises as this weights the lower matching efficiency of the long-term unemployed more strongly.

6 Results

I examine the structural mismatch and hysteresis theories by examining the behavior of match efficiency over the business cycle. This is essentially the framework used in Gordon (1988) which examines these two types of theories (“structuralist” versus “hysteresis”) for the European unemployment experience of the 1980s.\(^\text{21}\) One can also see a similar tests used to in the debate over sectoral shocks versus aggregate shocks as the primary driver of the business cycle including the seminal papers of Lilien (1982) and Abraham and Katz (1986). The hysteresis hypothesis would predict that matching efficiency should worsen during a downturn as long-term unemployment rise. Matching efficiency should also improve if the economy recovers as the long-term unemployed will then transition into employment. Structural mismatch theories do not predict any relation between matching efficiency and the business cycle. Any changes in matching efficiency should happen as structural issues develop or are resolved. Once we control for the movements of the business cycle, we can see clearly the massive deterioration in matching in Figure 7 which occurs during the 1929-1933 collapse in output that began the Great Depression. Recovery begins in 1933, but it is too feeble to reemploy the long-term unemployed and unemployment stays high. The evolution of the match productivity parameter shows clear evidence for the hysteresis theory and is not supportive of a structural mismatch. Match productivity falls during the 1929-1933 Great Collapse, rises somewhat during the 1933-1941 recovery period\(^\text{22}\), and falls massively during the wartime boom, as can be seen in Figure 8. Only the start of American mobilization for the Second World War and the massive labor demand it engendered shifted the Beveridge Curve inward and improved matching.

As anyone, even minorities, women, and the long-term unemployed could and did get a job during the war, the labor market was cleared out after the war.\(^\text{23}\) This is consistent with the

\(^{21}\)There have also been some other explanations for a weak employment recovery recently, such as uncertainty (Leduc and Liu, 2013) and weak recruiting intensity on open vacancies (Davis et al., 2012).

\(^{22}\)1937-1938 was a sharp but brief recessionary period which does not seem to have lasted long enough to have had a hysteretic effect.

\(^{23}\)The shift in priorities from creating more employment to deal with a surplus a unemployed workers, which was the problem of the 1930s, to the priority of creating more war material given a rapidly diminishing pool of surplus or unemployed workers in the early 1940s, makes for a stark contrast. The possibilities for increasing war production
evidence in Eriksson and Rooth (2014), who found that previous long-term unemployment did not affect later employment prospects, which seems to be the case for the long-term unemployed of the 1930s. This is also consistent with the evidence in Diamond and Şahin (2014), who find that the Beveridge Curve shifts out after recessions and shifts in during recoveries in the postwar.\(^\text{24}\) That an increase in demand can reverse hysteresis is also consistent with evidence presented in Ball et al. (1999), where persistent increases in demand can undo the effects of hysteresis. While Ball could find this effect even among the relatively small changes in demand during the postwar, the demand increase during the Second World War is an order of magnitude larger than any change seen in postwar data, and thus the effect can be even more clearly identified during the 1940s. Sample Beveridge Curves for each period’s average matching efficiency are shown in Figure 9. While the Beveridge Curve had shifted outward somewhat during the recovery, the war completed this shift and returned the Beveridge Curve to a position of normalcy after the war.

Figure 10 shows a 7-month moving average of match productivity to smooth out seasonal variation graphed with estimates of the output gap, which shows a close connection between changes in output relative to trend and matching efficiency with the exception of the immediate postwar. This divergence can be attributed to structural factors, as mismatch increases while output is also high. After the war, demobilization was quick and relatively painless, but former soldiers had to return to their jobs, married women returned to their households, and workers in munitions production had to shift to jobs in other sectors. This appears as a brief period of what Shimer (2007) would call “mismatch.”\(^\text{25}\) By the early 1950s the American economy returned to normalcy and the Beveridge Curve had returned to its position during the 1920s, which can be seen in Figure 4. The war, despite its great cost and the sacrifice involved, had cleared out the lingering problems in the American labor market resulting from the Great Depression and allowed a fresh start after the war. While I cannot rule out the structural hypothesis decisively, it seems unlikely that structural problems would only present themselves coincidentally during a period of low demand. Furthermore, it seems implausible that the command economy of the 1940s would effectively eliminate severe structural misallocation.

I estimate the matching TFP using JOLTS vacancy data from the BLS and the unemployment rate from the BLS and the same coefficients on the matching function as before. Matching worsens and the Beveridge Curve shifts out exactly as the economy enters recession, again consistent with hysteresis and strikingly similar to the early phases of the Great Depression. Matching efficiency is relatively high during the 2000s, so no structural problems in the labor market are evident prior to

\(^{24}\)Diamond and Şahin (2014) argue that this means that shifts in the Beveridge Curve are not very informative about structural changes in the economy in terms of a natural rate of unemployment, but these regular shifts related to the business cycle can be adequately explained by a hysteresis-based explanation such as the one presented in this paper.

\(^{25}\)Recall that I term “structural mismatch” to distinguish it from a decline in matching efficiency due to hysteresis. However, structural does not mean permanent, as structural problems in the labor market can be eliminated.
the recession which began in 2007, confirming Rothstein (2012)'s skepticism about the important of structural factors in explaining persistently high unemployment. As in the 1930s, we are seeing persistent mismatch due to the weak recovery and the effects of hysteresis.

7 Evidence on Duration

The Social Security Administration collected several estimates of unemployment duration from unemployment insurance records (Winslow, 1938), which are displayed in Figure 11. The share of the long-term unemployed rises steadily, even after recovery is underway starting in 1933. An additional source for evidence on the inability of the long-term to exit joblessness is from several city-level studies published in a series of WPA reports which are reproduced in Woytinsky (1942). The first series chronologically is from Buffalo, where the unemployed were surveyed by year from 1929-1933. This period coincides with the NBER recession dates during the downturn phase of the Depression, and can be seen in Figure 12. The short-term unemployment rate remains low as overall unemployment rose, which meant that those unemployed for more than one year quickly became the vast majority of the unemployed and about 20% of all gainful workers were unemployed. The city with the longest series is Philadelphia (Palmer, 1937) which surveyed the unemployed from 1932-1938 with the exception of 1934. The evidence on duration can be seen in Figure 13, with long-term unemployment staying very high even after unemployment began falling in 1933.

To confirm the importance of long-term unemployment as a driver of the hysteresis effect, a separate Beveridge Curve is constructed for unemployment by duration. If hysteresis is largely driven by long-term unemployment, then the Beveridge curve should shift out for long-term unemployed while no shift should be apparent for short-term unemployment. On the other hand, if structural factors are dominant, mismatch should increase for workers across all durations. The evidence regarding shifts in the Beveridge Curve of Ghayad (2013a) for the 2000s is reproduced in Figures 14 and 15. The Beveridge curve for the short-term unemployed is unchanged, while the outward shifts of the Beveridge Curve can be clearly seen uniquely among the long-term unemployed, showing the importance of long-term unemployment in explaining these shifts.26

Similar evidence is presented for the Depression using data from Philadelphia, where the WPA commissioned a report on labor market conditions in that city which provided evidence on unemployment by duration for the later 1930s (Palmer, 1937). While a local vacancy rate series is not available, national vacancies are used instead. The Beveridge Curve for the long-term unemployed in Philadelphia shifts outward while the Beveridge Curve for the short-term unemployed actually shifts inward during this period as can be seen in Figures 16, 17, and 18. The importance of a reduction in matching efficiency among the long-term unemployed is confirmed for the Great Depression, which provides further support for the importance of hysteresis in unemployment and

26Ghayad and Dickens (2012) use JOLTS data, which only begins in December 2000, and BLS unemployment rate data.
again little evidence in support of structural mismatch.

While these Philadelphia unemployment data do not track individuals and instead sample the unemployed in various years, the data on duration is broken down by number of years unemployed in subsequent years. This allows Woytinsky to calculate the transition probabilities of unemployed workers by duration, as the pool of workers unemployed for at least 2 but not more than 3 years in 1938 must necessarily be drawn from the pool of workers who were unemployed at least 1 year but not more than 2 years in 1937, and these must be drawn from the pool of workers who were unemployed less than 1 year in 1936, and so on. These results are presented in Table 1, and show the probability of the unemployed exiting to employment is lower as unemployment duration increases, consistent with the Beveridge Curve evidence shown above. For the Great Depression, the evidence supports a strong relationship between the unemployment rate and unemployment duration, as found for modern data (Dynarski and Sheffrin, 1990).

8 Counterfactual Simulation

Match productivity is fairly constant during the 1920s and after the Second World War, falls significantly during the output collapse of 1929-1933, and then remains depressed during the recovery after 1933 despite record peacetime output growth. This can be seen in Figure 7. Similarly, match productivity is essentially constant from 2000 to the business peak of 2007, before falling during the recession through 2009, with no tendency to return to the levels of the 2000s in the ensuing recovery, as shown in Figure 19. To see how debilitating the effects of hysteresis are, I construct a counterfactual simulation of the employment experience during the recent recovery, assuming that match productivity does not decline, in other words, assuming that the hysteresis effect is not operative.

As the number of matches will be lower in cases when matching efficiency is reduced, this will result in a reduction in new hires and thus in new employment. As obviously other broader economic factors matter for labor demand as well, I calculate a baseline match efficiency for a “normal” period, in this case the period before the Great Recession which has stable match efficiency. I then calculate the percent decline in matching efficiency relative to this baseline. The next step is to remove the decline in match efficiency from the decline in gross hires to create a counterfactual series with a smaller decline in gross hires without the effect of hysteresis. Implicitly, this decomposes the decline in matches to a decline in matching efficiency and a decline in labor demand, which is taken as exogeneous as it remains unchanged in the simulation. For this reason, there is still a decline in employment during the Great Recession as the other factors driving labor demand down are still present, but the decline in matching efficiency is now stripped out, which means that employment falls less than before. As job separations are relatively acyclical, no changes are made to the separation series.

Net accessions is the difference between new hires and job separations (jobs destroyed), and
should in theory equal the change in employment. I use data on gross hires, net hires, gross
accessions, and total separations from the JOLTS dataset from the BLS from 2000-2014. The
baseline employment figures are drawn from BLS data for non-farm employment for the same
period. Matching efficiency is constructed using the same methods as in previous sections.\textsuperscript{27}

The average matching efficiency for the “pre” period before the Great Recession is the average
match efficiency from the start of the JOLTS series in 12/2000 through the business cycle peak of
12/2007. The counterfactual path of employment has increased gross employment due to no decline
in matching efficiency, which increases gross hires. Separations is assumed to be unchanged, and
when subtracted from the new gross hire series a net hires series is constructed. Actual changes in
employment do not exactly equal implied changes in employment from net hires due to rounding
and measurement errors, but these two series are fairly close. To make a meaningful comparison, I
construct an “actual” path for employment implied by the actual net hire series and compare this
to the counterfactual employment series generated by the steps outlined above. Note that this is a
static simulation which does not consider other dynamic considerations like changes in investment,
changing in total output or hours worked, and many other factors and thus the results should not
be overstated. However, these simulations are informative to give a quantitative sense of the costs
of hysteresis in reducing employment slowing the recoveries from the Great Depression and the
Great Recession.

The results for the counterfactual simulation are shown in Figure 20, which show a much faster
recovery without the effects of hysteresis. Figure 21 shows the percent deviation from trend for the
actual and counterfactual series. For the actual series, employment is 10\% below trend after 2009
and employment continues to fall behind trend. The counterfactual series, on the other hand, never
falls below 7\% and recovers to under 4\% below trend by the current time. Without the segmentation
of the long-term unemployed from labor markets, the American labor market would have seen a
much more robust recovery which would more strongly resemble other post-war recessions. The
Great Depression and the Great Recession resemble each other both because both episodes were
severe recessions, but also because both episodes had slow recoveries due to the lasting scars of
hysteresis on the labor market.

9 \ Conclusion

During the Great Depression the social safety net was much weaker than it was today. As shown in
Woytinsky (1940), this induced additional family members to work if the primary (generally male)
breadwinner was unemployed. Currently the social safety net is much more established and aver-
age income are much higher than subsistence than in the 1930s, which means that the long-term
unemployed are much more likely to exit the labor force, which explains the divergence between

\footnote{Match efficiency ($\lambda_t$) is calculated using the formula $m_t = \lambda_t u_t^\alpha e_t^{1-\alpha}$ as in Equation 2.}
the stagnant employment-to-population ratio and the declining unemployment rate. While there are obviously demographic reasons why labor force participation is falling, much of the falling unemployment rate has been due to declining labor force participation among prime-aged Americans, as can be seen in Figure 22. Once the unemployment rate declines sufficiently, monetary stimulus will be withdrawn and the American economy will end up in a situation with a permanently lower labor force and the productive capacity of the economy will be permanently reduced. Unless radical changes are made, we appear to be headed towards a situation similar to that described recently by Summers (2014), and during the Depression by Hansen (1938), where a permanent stagnation takes hold and economic growth remains sluggish for the foreseeable future.

While we can not at present foretell when we will return to economic normalcy, we can look to the past for inference about what type of recovery can be expected in the wake of a serious crisis. The American unemployment rate during the Great Depression rose from a few percent to almost a quarter of the population and, while declining generally after 1933, remained above double digits in almost every year until the start of the Second World War in 1941 as can be seen in Figure 5. The wartime emergency brought output to record levels and the problem of insufficient labor demand quickly reversed itself as manpower needs brought all available labor into productive use. However, there does not appear to be any such increase in the demand on the horizon. While the hysteresis in unemployment that developed in the 1930s was decisively ended by the wartime boom of the 1940s, the hysteresis of the late 2000s and early 2010s will likely persist barring a similar national emergency. It is abundantly clear that the long-term unemployed face similar problems in the 2010s as they faced in the 1930s (Krueger et al., 2014).

The policy responses of the 1930s, which included massive monetary stimulus through the devaluation of the dollar, and large government employment relief programs, helped to begin to reduce unemployment. If the problems facing the long-term unemployed are to be adequately addressed today, similar policies should be implemented or continued today. During the Great Depression the social safety net was much weaker than it is today, and so unemployment by the head of household likely meant that a spouse or children needed to work to compensate for the lost income. This would swell the labor force and increased the number of frustrated job-seekers competing for already scarce jobs. The extensive safety net that has developed in the post-New Deal America has reversed this phenomenon, with many workers becoming discouraged and leaving the labor market rather than continuing with a frustrating and fruitless job search. This can be seen in Figure 22, which plots an adjusted unemployment rate if labor force projections from 2007 has held true through 2014, instead of the more rapid shrinking of the labor force which has resulted from the Great Recession and its aftermath. If the labor force had not shrunk, unemployment would be at 9% in January 2015, rather than at 5.7% which is the current rate. This reduction of the labor force will eventually mean that the unemployment rate will eventually settle in its new

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28If emergency workers are excluded, the U.S. unemployment rate fell to under ten percent in 1936 using the figures of Darby (1976) figures.
natural rate of unemployment (if it has not reached that level already), thus leaving the labor force, and the productive capacity of the economy, permanently lower (Reifschneider et al., 2013).

Indeed, Haltmaier (2013) finds that increases in the length and depth of recessions generates declines in potential GDP across the OECD. This is also the case for the United States in particular, as can be seen in Figure 23. This findings suggests that the United States of today may suffer from hysteresis induced secular stagnation as outlined by Summers and Hansen.\textsuperscript{29}. The damage done by of the Great Recession will persist for decades potentially. Unlike the position of Schumpeter (1939), who argued that recession were beneficial as they cleansed inefficient firms from the economy, the paper suggests that full employment and prosperity is the ideal arrangement to ensure macroeconomic efficiency. While the U.S. economy was able to return to normalcy during the 1950s after the crisis of the 1930s, persistent joblessness will leave the United States of the present permanently poorer and will leave far too many Americans permanently separated from gainful employment.

\textsuperscript{29}This quote seems to have relevance for today: “This is the essence of secular stagnation- sick recoveries which die in their infancy and depressions which feed on themselves and leave a hard and seemingly immovable core of unemployment.” (Hansen, 1941, p. 353)
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A Figures

Figure 1: Beveridge Curve since 2000

Figure 2: Sample Beveridge Curve

Unemployment Rate vs. Job Vacancy Rate

- Boom
- Recession

Worse matching vs. Better matching
Figure 3: Annual Unemployment and Vacancy Rate: 1923-1954

Note: Vacancy rate from Zagorsky (1997) and unemployment rate from Lebergott (1957)
Figure 4: Beveridge Curve: 1920s and 1950s

Source: Vacancy rate from Zagorsky (1997) and unemployment rate from Lebergott (1957)
Figure 5: Great Depression Unemployment Rate, with and without Emergency Workers

Note: Lebergott counts WPA workers as unemployed in his unemployment rate, while Darby counts WPA workers as employed in his unemployment rate. Source: Lebergott (1964) and Darby (1975).
Figure 6: Monthly Unemployment Rates for 1930s

Source: Author’s calculations, Output Gap calculated as percent difference between Real GDP and Real Potential GDP in Gordon and Krenn (2010).
Figure 8: Match productivity: 1929-1953

The graph illustrates the productivity of matching over the years 1930 to 1952. The productivity is measured on the y-axis, ranging from 0.25 to 0.5. The x-axis represents the years from 1930 to 1952.

The graph shows four lines:
- Blue line: Conference Board
- Red line: Modern
- Green line: WPA
- Orange dashed line: Mean of 1948-1952

The productivity values appear to fluctuate significantly over the years, with a notable increase around 1944 and a decrease around 1946.
Figure 9: Estimated Beveridge Curves: Depression to War to Postwar

Note: Author’s calculations outlined in text. Estimated match productivity is combined with generated unemployment rates to generate these sample Beveridge Curves.
Note: Author’s calculations outlined in text. Estimated match productivity is smoothed with a 7-month moving average. Output gap is percent difference between actual and potential GDP from Gordon and Krenn (2010).
Figure 11: US Unemployment Rate by Duration: 1930-1934

Note: Estimates are from Social Security Administration (Winslow, 1938) based on insured unemployed.
Figure 12: Unemployment Rate for Buffalo: 1929-1933

Source: Woytinsky (1942)
Figure 13: Philadelphia Unemployment Rate by Duration for the 1930s

Note: Short-term unemployed are unemployed for less than one year, medium-term unemployed are unemployed between one and five years, and long-term unemployed are unemployed for more than 5-years. Source: Woytinsky (1942).
Table 1: “Estimated Chance of Being Hired During a 12-month Period After the Specified Duration of Unemployment” (1930s Philadelphia)

<table>
<thead>
<tr>
<th>Duration of unemployment</th>
<th>1932</th>
<th>1933</th>
<th>1934</th>
<th>1935</th>
<th>1936</th>
<th>1937</th>
<th>1938</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Under 1 year</td>
<td>0.41</td>
<td>0.39</td>
<td>0.48</td>
<td>0.48</td>
<td>0.54</td>
<td>0.70</td>
<td>0.40</td>
</tr>
<tr>
<td>1 but less than 2 years</td>
<td>0.22</td>
<td>0.23</td>
<td>0.46</td>
<td>0.46</td>
<td>0.42</td>
<td>0.50</td>
<td>0.13</td>
</tr>
<tr>
<td>2 but less than 3 years</td>
<td>0</td>
<td>0.28</td>
<td>0.44</td>
<td>0.46</td>
<td>0.42</td>
<td>0.46</td>
<td>0.12</td>
</tr>
<tr>
<td>3 but less than 4 years</td>
<td>0</td>
<td>0</td>
<td>0.20</td>
<td>0.25</td>
<td>0.43</td>
<td>0.41</td>
<td>0.23</td>
</tr>
<tr>
<td>4 years and over</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0.26</td>
</tr>
<tr>
<td>Female</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Under 1 year</td>
<td>0.61</td>
<td>0.66</td>
<td>0.60</td>
<td>0.60</td>
<td>0.62</td>
<td>0.74</td>
<td>0.48</td>
</tr>
<tr>
<td>1 but less than 2 years</td>
<td>0.40</td>
<td>0.40</td>
<td>0.50</td>
<td>0.50</td>
<td>0.51</td>
<td>0.57</td>
<td>0.12</td>
</tr>
<tr>
<td>2 but less than 3 years</td>
<td>0</td>
<td>0.38</td>
<td>0.50</td>
<td>0.50</td>
<td>0.51</td>
<td>0.50</td>
<td>0.16</td>
</tr>
<tr>
<td>3 but less than 4 years</td>
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<td>0</td>
<td>0.10</td>
<td>0.25</td>
<td>0.32</td>
<td>0.42</td>
<td>0.17</td>
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<tr>
<td>4 years and over</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0.50</td>
<td>0.40</td>
<td>0.24</td>
</tr>
</tbody>
</table>

Note: Table reproduced from (Woytinsky, 1942, p. 103). Zeroes, especially for longer durations, may be the result of insufficient data and not a precisely measured zero. 1934 and 1935 values interpolated due to a missing year (1934). Columns refer to the 12-month period ending in May.
Figure 14: Beveridge Curve for Short-term Unemployed: 2000-2014

Source: Reproduction of chart in Ghayad (2013a), based on BLS JOLTS data.
Figure 15: Beveridge Curve for Long-term Unemployed: 2000-2014

Source: Reproduction of chart in Ghayad (2013a), based on BLS JOLTS data.
Figure 16: Beveridge Curve for Short-Term Unemployed in 1930s

Source: Woytinsky (1942)
Figure 17: Beveridge Curve for Medium-Term Unemployed in 1930s

Source: Woytinsky (1942)
Figure 18: Beveridge Curve for Long-Term Unemployed in 1930s

Source: Woytinsky (1942)
Figure 19: Matching Efficiency and the Output Gap: 2000-2013

Note: Match productivity calculations outlined in body of paper. Output Gap is calculated as the percent difference between Real GDP and the CBO estimate of Real Potential GDP in 2009 Chained Dollars.
Figure 20: Trend, Actual, and Counterfactual Series for Non-Farm Employment, 2008-2014

Source: Author’s calculations, based on BLS JOLTS and Current Population Survey.
Figure 21: Actual and Counterfactual Series for Non-Farm Employment, Percent Deviation from Trend, 2008-2014

Source: Author’s calculations, based on BLS JOLTS and Current Population Survey.
Source: BLS and Economic Policy Institute analysis of Toossi (2007). Counterfactual Unemployment Rate is unemployment rate with labor force projections from Toossi (2007) instead of actual labor force which is smaller due to long-term unemployed leaving the labor force.
Figure 23: Real GDP and Real Trend GDP

Note: Real GDP calculated using 2009 Chained Dollars. The log trend was calculated using quarterly Real GDP from 1948-2014. Source: Bureau of Economic Analysis.
B  Calibration

I calibrate these coefficients in two stages. First I estimate the coefficients for the Beveridge Curve using postwar data. Data on unemployment are drawn from the BLS. Data on vacancies are drawn from Zagorsky (1998). For simplicity, I will simply assume for this first stage that a Beveridge Curve is defined as following a Cobb-Douglas form as follows:

$$B = u_t^\alpha v_t^{1-\alpha} \quad (7)$$

As labor markets do not show scale effects, it is a reasonable assumption that Beveridge Curve relationships would not vary with scale and thus the coefficients on unemployment and vacancies would sum to one. As B is simply a constant that represents the position of the Beveridge Curve, this is assumed to be a time-invariant, which implies that there is a single Beveridge Curve. Next I take logarithms and changes, which results in the following expression,

$$0 = \alpha \Delta \ln(u_t) + (1 - \alpha) \Delta \ln(v_t), \quad (8)$$

which can be rewritten as

$$\frac{\Delta \ln(v_t)}{\Delta \ln(u_t)} = \frac{\alpha_t}{1 - \alpha} \quad (9)$$

Letting $\psi_t$ represent the ratio on the left-hand side, we obtain the following

$$\alpha_t = \frac{\psi_t}{\psi_t - 1} \quad (10)$$

Using a difference of 12-months yields an estimate of $\alpha$ of 0.5016561, and for a 24 month difference I obtain .5185415. As these are very close to the 0.5 generally used in the literature, I will use coefficients of 0.5 and 0.5 on the unemployment rate and the vacancy rate.