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Shifting the Beveridge Curve:
What Affects Labor Market Matching?

by Elva Bova, João Tovar Jalles, and Christina Kolerus

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Shifting the Beveridge Curve: What Affects Labor Market Matching?

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Abstract

This paper explores conditions and policies that could affect the matching between labor demand and supply. We identify shifts in the Beveridge curves for 12 OECD countries between 2000Q1 and 2013Q4 using three complementary methodologies and analyze the short-run determinants of these shifts by means of limited-dependent variable models. We find that labor force growth as well as employment protection legislation reduce the likelihood of an outward shift in the Beveridge curve,. Our findings also show that the matching process is more difficult the higher the share of employees with intermediate levels of education in the labor force and when long-term unemployment is more pronounced. Policies which could facilitate labor market matching include active labor market policies, such as incentives for start-up and job sharing programs. Passive labor market policies, such as unemployment benefits, as well as labor taxation render matching signficantly more difficult.

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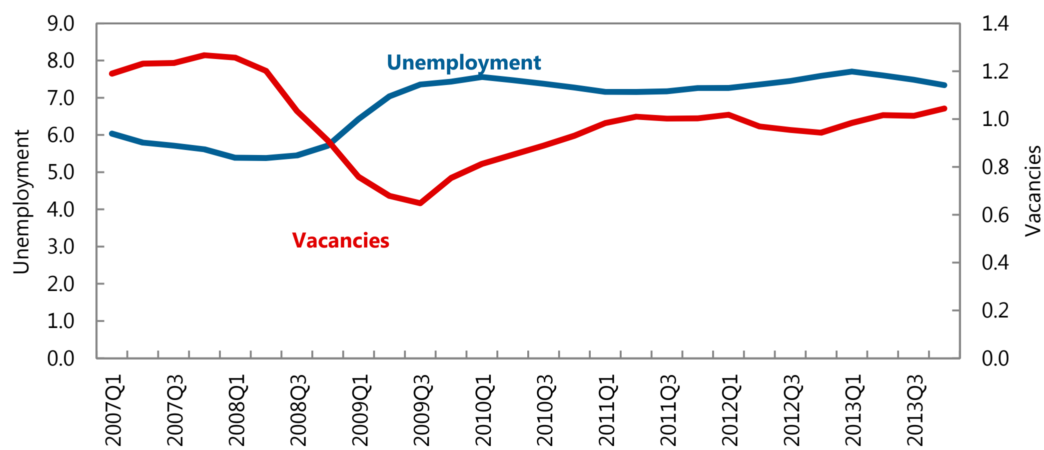
To understand the effects of policy on unemployment in Britain we would have to explain first, how policy has affected the willingness of firms to hire new workers and how it has affected the willingness of the unemployed to look for and accept new jobs.

Pissarides 1986

I. Introduction

Although much of the increase in unemployment since the global financial crisis has been attributed to cyclical factors (Kugler, 2014), mismatches between labor demand and labor supply have become more relevant in comparison with pre-crisis years. Evidence illustrates that positive signs of recovery, such as an increase in the advertised number of vacancies starting in the last quarter of 2009, coexist with stubbornly high levels of unemployment suggesting significant labor demand and labor supply mismatches (Figure 1). More importantly, long-term unemployment has increased markedly in the aftermath of the global financial crisis. As OECD data show, the number of unemployed increased by almost 50 percent between 2007 and 2013. The number of long-term unemployed increased by more than 80 percent. Given the path dependency associated with long-term unemployment, addressing labor mismatches becomes an even more urgent task.

Figure 1. OECD Average Unemployment and Vacancies in the Great Recession
(Percent of labor force)



Source: OECD.

Improving the efficiency of labor market matching requires policies beyond those aimed at stimulating aggregate demand, since frictional unemployment originates from institutional inefficiencies, skill gaps between demand and supply market forces, and from any factor that dissuades job seekers to accept a job or makes employers choosier in their job selection process.

Frictions and mismatches in the labor market can be captured by the so-called Beveridge curve, which relates vacancies to the number of unemployed. An economic slowdown, during which the job destruction process is more volatile than the job creation process (Mortensen and Pissarides, 1994), would lead to a downward movement along the curve corresponding to lower vacancies and higher unemployment. A recovery, in turn, would trigger an upward ride. Some policies, such as the short-time working scheme applied by several countries during the global financial crisis, might prevent or attenuate an increase in unemployment. Such policy could even lead to an inward shift of the curve if the number of vacancies is decreasing—due to a slowdown in economic activity—at a given unemployment level. On the contrary, during periods of jobless recoveries, for instance, the Beveridge curve would feature an outward shift as vacancies are constant and unemployment is increasing.

This paper assesses the role of policies and institutions in shifting the Beveridge curve for a sample of 12 OECD countries over the 2000Q1-2013Q4 period. First, we detect shifts in each country's Beveridge curve and determine their magnitude and direction by means of three methodologies: visual examination, cointegration techniques and non-linear estimation. In a second step, with a panel probit model, we assess several factors that could influence the probability of these shifts, to better understand which policies and institutions can affect the efficiency of labor market matching. Our main findings can be summarized as follows:

- **Shifts**. Out of the 12 OECD countries examined, 10 exhibit a shift of their respective Beveridge curve. We identify seven countries with outward shifts, i.e., deteriorations of labor market matching, which in many cases took place at the onset of the global financial crisis, and two countries with inward shifts. One country features both, an outward and inward shift.

- **Labor market structure**. We find strong and robust evidence that labor force growth reduces the likelihood of an outward shift of the Beveridge curve throughout our specifications. Also, higher labor market protection makes outward shifts less likely and is thus is negatively associated with frictional unemployment. Further, we find that outward shifts are more likely the higher the share of employees with intermediate education in the labor force.

- **Categories of unemployment**. We find robust evidence that frictions increase the larger the share of long-term unemployed to the total number of unemployed, possibly due to outdated skill sets or employers' bias against this group. Our preferred specification of the model also provides evidence that matching is more difficult the larger the share of female job seekers and young job seekers, while it is easier the larger the share of elderly workers, possibly due to more experience.

- **Policies**. Tax and expenditure policies can play a role in reducing frictional unemployment. We find that higher social security contributions and more generally the tax wedge are more likely to shift the Beveridge curve outward and have a detrimental impact on matching, especially at higher levels of income. As expected, a similar effect is found for higher unemployment benefits, as those lower the urgency to find a job. On the other hand, spending on active labor market programs has a positive impact on reducing frictions in particular when these are aimed at providing incentives for start-up and promoting job sharing programs.

- **Interactions**. Our results show that during the 2008 global shock the negative impact of unemployment benefits on frictional unemployment was stronger, while the role of long-term unemployment was smaller as was the impact of low and intermediate levels of education. There was no significant change in the impact of the determinants identified above, including testing for complementarities across labor market institutions, confirming the finding by Bassanini and Duval (2009).

Our study builds on the existing literature on the Beveridge curve and provides several contributions. First, this is the first cross-country study on Beveridge curves and their dynamics based on a broad sample of OECD countries (with the exception of Euro Area countries examined in Bonthuis and others, 2013; and Arpaia and Turrini, 2014); second, we provide a set of complementary methodologies for detecting shifts in the curves; third, our study introduces a fiscal policy angle to the analysis of the underlying conditions that could exacerbate the matching process; and, fourth, we test the implications of the 2008-09 shock on some of the factors that affect frictional unemployment in normal times.

The remainder of the paper is organized as follows. Section 2 presents the theoretical framework underlying the Beveridge Curve and reviews the literature. Section 3 presents the econometric methodology employed. Section 4 discusses our main findings; and the last section concludes.

II. Literature Review

A. Theoretical Framework

The Beveridge curve is an empirical regularity which relates vacancies to the number of unemployed. The underlying intuition behind the curve is that as vacancies increase the number of unemployed declines, entailing a negative slope for the Beveridge curve. First described by William Beveridge in 1958, the curve has been widely examined in the economic literature and found its most famous application in the search and matching model by Diamond and others (1994).

Beveridge curves differ markedly between countries and also change over time. Albeit downward sloping in theory, some Beveridge curves assume all different kinds of shapes, implying that economies feature very heterogeneous levels of mismatches. For instance, some countries manage to quickly reduce mismatches after economic downturns while others do not.

Beveridge curve dynamics can be distinguished between movements on the curve and movements of the curve. Assuming a stable relationship, movements along the curve occur over the business cycle as vacancies open/close, and workers exit/enter into unemployment. At times of recessions, for instance, unemployment is high and job vacancies are limited, a state which corresponds to points on the upper left branch of the curve when unemployment is set to be on the vertical axis and vacancies on the horizontal axis (Bleakley and Fuhrer, 1997). Hence, the Beveridge curve – precisely the position on the curve – can work as a tool to detect the state of the labor market, for instance whether the market is tight or not.

Movements of the curve or shifts are, instead, associated with changes in frictional unemployment, namely improvements or deteriorations in the efficiency of searching for jobs and/or applicants, i.e. in labor market matching, or simply structural changes in searching activity. Several factors can affect shifts in the Beveridge curve. The position of the curve vis-à-vis the origin can, indeed, depend on labor force characteristics, the institutional setting, and various types of mismatches. Amongst labor force characteristics, many authors have focused on the shares of young and old workers in the total labor force; female labor force participation; and the share of high-skilled to low-skilled workers. Long-term unemployment, often taken as measure of hysteresis, can shift the curve outward as it can discourage workers and render their search less effective. Also, long-term unemployment may lead to a deterioration of human capital or an 'out-dated' skill set and may stigmatize the unemployed, giving a negative signal to potential employers (Johansen, 2004). Institutional factors include employment protection legislation, active labor market policies, the generosity and duration of the unemployment benefits, and the level of real wages. As for mismatches, most papers study mismatches across skills, geographical regions and sectors.

In general, movements on the curve reflect cyclical changes while movements of the curve reflect structural changes affecting frictions in the labor market. However, some authors contest the distinction between movements of the curve and movements along the curve, and find that business cycle conditions can also affect movements of the curve (Blanchard and Diamond, 1989; Börsch-Supan, 1991; Wall and Zoega, 2002). Evidence related to the recent financial crisis has indeed re-opened the issue as the weakening of aggregate demand seems to have induced a deterioration in matching efficiency. Long-term data analysis of the U.S. labor market for the period 1951–2000 illustrates that episodes of deterioration in matching coincided with economic recessions (Diamond and Sahin 2014). This finding invalidates the long assumed orthogonality between labor market matching and aggregate demand and suggests that in bad times vacancies are not filled up as quickly as in good times in a systematic way. A major link between negative aggregate demand shocks and deterioration in the matching is the occurrence of long-term unemployment. This phenomenon typically starts during a recession and continues into the recovery period, and which is found to be an important factor behind frictional unemployment. Closely related are skill-mismatches which emerge in a process of accelerated creative destruction. Also, economic recessions and demand slowdowns are characterized by high uncertainty, which may lead to a more cautious hiring process.

B. Empirical Studies

The literature on labor market matching is vast. Many studies aim at identifying the Beveridge curve in a specific country, and then try to capture moments of shift in the curve and, finally, investigate the reasons that caused these shifts. In some cases, Beveridge curves are specified embedded in a Cobb Douglas production function with constant returns to scale on the input factors unemployment and vacancies (Blanchard and Diamond, 1989). Most studies, however, specify the curve as a negative relationship between the unemployment rate and the vacancy rate, holding the hiring rate constant (see, e.g., Börsch–Supan, 1991; Johansen, 2004; Bonthuis and others, 2013). In some instances, the vacancy rate is expanded to include a quadratic term (Wall and Zoega, 2002; Valletta, 2005), which more accurately captures the non-linear - convex shape - of the curve. In their analysis of OECD countries, Hobijn and Sahin (2012) construct fitted Beveridge curves by considering the vacancy rate at which the unemployment rate equals its turnover-steady-state value, i.e. when new hires as a fraction of employment equal the growth rate of the labor force. Groenewold (2003) uses cointegration techniques to model the relationship between vacancies and unemployment (and, in some specifications, wages). Overall, most studies seem to find a negative and statistically significant relationship between unemployment and vacancies, hence corroborating Beveridge's theoretical hypothesis. The coefficient of the relationship between unemployment and the vacancy rate usually ranges between -5 and -1.

In order to identify shifts, most authors rely on visual inspection, which they subsequently subject to statistical tests (Börsch–Supan, 1991; Wall and Zoega, 2002). Bonthuis and others (2013) identify shifts through an interaction term between the labor shortage variable (proxy for vacancy rate) and the crisis which they assume to be the turning point of the relationship between unemployment and vacancy rate. Wall and Zoega (2002) and Valletta (2005) identify shifts from the estimated coefficient of the year time dummies. To assess whether changes in the Australian Beveridge curve consist of movements on the curve or of the curve, Groenewold (2003) decomposes the variance of unemployment growth. He finds that the vacancy rate has little impact on the variance and concludes that most of the dynamics are shifts and not movements of the curve. To the best of our knowledge, this paper is the first to identify shifts, their directions and magnitudes through the interplay of three techniques: visual examination, cointegration and non-linear testing, as described below.

In terms of methodologies used to assess factors underlying the shifts, panel analysis is the most widely applied technique (Börsch-Supan, 1991; Johansen, 2004). Wall and Zoega (2002) use the estimated intercepts of the Beveridge curves as the dependent variable of a panel for the U.K. counties. Bonthuis and others (2013) use the shifts as dependent variables in a pooled probit model to examine the role of structural and institutional variables and Bonthuis and others (2015) apply the Jordà (2005) local projections method to predict determinants of shifts.

Finally, the main determinants of shifts in the Beveridge curve are documented to be:[2]

1) *Type of unemployment and labor force*: Long-term unemployment is seen as a crucial determinant of shifts (Jackman and others, 1990; Franz, 1987; Börsch-Supan, 1991; Johansen, 2004; and more recently Arpaia and Turrini, 2014). Börsch-Supan (1991) also finds that outward shifts are more common when a higher proportion of women are unemployed, and Bonthuis and others (2015) find that a higher female participation rate reduces the probability of outward shifts. Futher, Bonthuis and others (2013) show that old-age workers perform worse in terms of matching than young workers.

2) *Institutions and policies*: Johansen (2004) on Norway and Jackman and others (1990) on the United Kingdom find that active labor market policies have a very sizeable impact on reducing frictional unemployment, especially if targeted to the long-term unemployed. Similarly, Arpaia and Turrini (2014) find that active labor market policies do enhance matching efficiency, but their impact is not significant when restricting the sample to post-crisis years. The extension of unemployment benefits is found to drive outward shifts in the United States and Sweden during the Great Recession (Hobijn and Sahin, 2012). Not much evidence has been found on the role played by labor market institutions (employment protection legislation, unions, and temporary contracts) and the study by Bonthuis and others (2013) presents inconclusive results.

3) *Geography and skills:* For the United States, geographical mismatches in employment growth are found to play a role (Valletta, 2005; Abraham, 1987), while they are not found significant in driving matching efficiency in the Eurozone (Arpaia and Turrini, 2014). Educational or skill mismatches caused shifts in the Euro area, the United States and Germany (European Central

[2] Other determinants not as frequently examined include home ownership and high pre-crisis financial slack (Bonthuis and others, 2015).

Bank, 2002; Börsch-Supan, 1991; Hobijn and Sahin, 2012; Bonthuis and others, 2013; Arpaia and Turrini, 2014). In particular in Portugal, Spain and the U.K., skill mismatches were largely associated with the decline in construction employment following the housing bust (Hobijn and Sahin, 2012), a finding consistent with Bonthuis and others (2013, 2015).

III. Methodology and Data

To assess the role of policies and institutions in the matching process we begin by identifying dates and direction of such shifts for a subset of 12 OECD countries, for which sufficient quarterly data on vacancies were available for the period 2000Q1–2013Q4. We then use this information to regress the shift variables on a set of institutional, structural and policy variables of relevance.[3]

A. Identification of Shifts

To evaluate the extent to which policies and institutions affect labor market matching we first identify shifts in the Beveridge curve for each individual country. An outward shift coincides with a worsening in the matching (increasing unemployment for a given number of vacancies), while an inward shift coincides with an improvement in the matching (decreasing unemployment for a given number of vacancies).

Following most empirical studies, we begin by visually examining Beveridge curves of all countries in our sample so as to detect the presence of breaks and their direction. We plot Beveridge curves with the level of vacancies on the horizontal axis and the level of unemployment on the vertical axis over the sample period. Although telling, graphical evidence may not fully reveal the existence of a shift, especially when data points are overlapping. Hence, we complement the visual examination with two forms of econometric estimation of the Beveridge curve and its dynamics. First, following Groenewold (2003), we perform a cointegration analysis (also allowing for endogenously determined breaks in the potential long-run relationship) by country, which assumes a linear relationship between unemployment and vacancies, and test for the existence and timing of shifts of this relationship. Second, using the dates identified visually and through cointegration analysis, we test the significance and the direction of the shift non-linearly by means of the use of a hyperbolical functional form similar to Börsch-Supan (1991), which aims to reproduce a Beveridge curve convex to the origin.

Cointegration

With respect to the cointegration analysis, we follow the standard procedure and begin with a stationarity inspection by testing for the presence of unit roots for each country's series of unemployment and vacancies. In addition to standard Augmented Dickey Fuller (ADF) and Phillips-Perron (PP) unit root tests, we employ the four tests (M-tests) proposed by Ng and Perron (2001) (NP) based on modified information criteria (MIC): the modified Phillips-Perron test MZ_{α}, the modified Sargan-Bhargava test (MSB), the modified point optimal test MP_T, and the modified

[3] For a list of variables and their respective summary statistics, please see Table B1 in the Appendix.

Phillips-Perron MZ_T. These procedures improve the PP-tests both with regard to size distortions and power.[4] Furthermore, we identify the optimal lag structure in the cointegrating relationship using several information criteria (favoring the AIC as common practice in the literature).[5] Finally, the presence of cointegration is tested using the Johansen's trace test (Johansen and Juselius, 1990) and the long term coefficients are obtained through the Stock-Watson-Shin's Dynamic OLS estimation.

As emphasized by Bruggemann and others (2003), it is important to formally investigate the stability of the cointegrating vectors further, once a long-run relationship has been identified.[6] To detect the presence of shifts in the Beveridge curve, we test for breaks in the cointegrating relationship following Gregory and Hansen's (1996) approach. We apply their ADF and PP tests allowing for a break in the level or regime, to check whether the cointegrating relationship between vacancies and unemployment has been affected by a break; if the answer is positive we then indicate the timing of the break.

Non-linear estimation

The previous set of tests is complemented by estimating the Beveridge curve in its convex representation with the following hyperbolic functional form:

$$u_t = a_0 + b_0 \cdot SHIFT + \frac{1}{v_t} \qquad (1)$$

Using equation (1), we test for the validity of the breaks identified through visual specification or through the ADF and PP tests by including the breaks in the regression and examining their statistical significance. The sign of the coefficient obtained for the break allows us to distinguish between outward (positive) or inward (negative) shifts of the Beveridge and assess the magnitude of the shift. Specification (1) basically tests for an upward shift of the curve, assuming no change in the slope. Alternatively, we also test for a rightward shift and a combination of shift and change in convexity. We obtain similar results for the alternative specifications. Overall, equation (1) was found to be the most stable, and the one best reflecting the visual representation of each country's Beveridge curve.

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[4] Moreover, these tests are especially appropriate under a certain dynamic data structure, and when their random components are not white noise.

[5] More precisely, we use the LR (sequential modified likelihood ratio test statistic), FPE (Final prediction error criterion by Lutkepohl, 1993), AIC (Akaike information criterion), SIC (Schwarz information criterion), and HQ (Hannan-Quin information criterion).

[6] Hansen and Johansen (1993) outline a procedure that formally tests the constancy of cointegrating vectors in the context of Full Information Maximum Likelihood (FIML) estimations. Any rejection of the null of cointegration stability (constancy) should emanate from a breakdown in the long-run relation, rather than from a shift in the underlying short-run dynamics (Hoffmann and others, 1995). We apply this approach to test the stability of the cointegrating relation.

Shift variables

Based on the three methodologies described above, we determine the final break date and direction of the shift by country to create a shift variable for our subsequent analysis. The variable is defined binary and captures two states, a state equal to one that corresponds to those quarters after outward shifts (or before inward shifts); and a state equal to zero corresponding to those quarters before an outward shift (or after an inward shift). With this specification, a change from zero to one of the dummy would coincide with a deterioration of the matching, while a change from one to zero would translate into an improvement.

For robustness, we also provide two alternative specifications for the shift variable. Based on the non-linear estimation results of equation (1), we replace the ones in the above described dummy with the estimated coefficients b_0 to get a sense of the magnitude of the shift across countries ("*Shift size*"). Finally, we create an additional variable to take into account the cross-country differences in matching efficiency before and after the shift. The variable "*Mismatch*" assumes the value a_0 before the shift and $a_0 + b_0$ after the shift.

B. Factors Underlying the Shifts

To assess how labor market characteristics and policy variables can influence the matching of labor demand and supply, we estimate limited dependent variable models, namely panel probit and logit models, using the previously identified shift dummy as dependent variable. Drawing from the empirical literature we distinguish two main factors affecting matching: labor market characteristics (*labmark*) and fiscal policy-related factors (*fiscal*). In each specification, we include the contemporaneous and lagged output gap to control for the cyclical position of the economy as well as the growth in the labor force. In the fiscal or policy-related analysis we also include the overall balance. We conduct estimations using a panel probit, and for robustness a logit with random as well as fixed effects. Time fixed effects are included and estimated in all model specifications. The unbalanced panel probit (logit) uses the following specification: [7]

$$\text{Prob}(\text{Shift}=1|\text{fiscal,labmark}) = \Phi(\delta gap + \text{fiscal}'\boldsymbol{\alpha} + \text{labmark}'\boldsymbol{\beta}) \tag{2}$$

The structural model can be written as:

$$\begin{aligned} &\text{Shift}^*_{\text{it}} = \delta gap + \text{fiscal}_{it}'\boldsymbol{\alpha} + \text{labmark}_{\text{it}}'\boldsymbol{\beta} + \varepsilon_{it}, \\ &\text{Shift}_{\text{it}} = 1 \ \text{ if } \ \text{Shift}^*_{\text{it}} > 0, \ \text{ and 0 otherwise.} \end{aligned} \tag{3}$$

with $i = 1, \ldots, 12$; $t = 2000{:}1, \ldots, 2013{:}4$; ε_{it} is the error term; and $\boldsymbol{\alpha}$, $\boldsymbol{\beta}$ and $\boldsymbol{\varphi}$ are the vectors of the parameters to be estimated.

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[7] For details on this binary choice model see, for example, Greene (2012, Ch. 17).

Labor market characteristics

Concerning labor market characteristics, we consider real wages, the number of temporary contracts over the labor force and the index of strictness of employment protection legislation reflecting the ease of individual and collective dismissals. To avoid endogeneity problems, real wages are included with a lag, and to avoid capturing trend behavior, we express them in growth rates. We then add variables on the composition of the unemployed population: age, gender and the share of long-term unemployed to the total number of unemployed. We also account for differences in the level of education of the labor force, distinguishing between advanced, intermediate, and basic education.

The impact of real wages on matching might be conceptually ambiguous depending on the elasticity of labor demand and labor supply. If the labor supply channel prevails, at a given reservation wage, higher real wages would, in fact, induce the unemployed to accept more jobs, possibly also outside their particular sphere of competence, which would lower both unemployment and vacancies, and therefore causing an inward shift of the curve. On the demand side, however, higher wages would make the employer 'choosier' and less reluctant to accept workers not fully matching the advertised vacancy profile thereby prolonging the hiring process. An alternative explanation for an outward shift due to wage increases has been put forward by Mehrotra and Sergeyev (2012). The authors show that productivity shocks followed by wage increases in some sectors can trigger a reallocation of labor across sectors which could lead to a—temporary—outward shift in the Beveridge curve.[8]

A large number of temporary contracts might make the advertised vacancies less desirable from a supply-side perspective; on the other hand, the existence of temporary contracts may speed up hiring procedures notably in times of great uncertainty. By increasing hiring and firing costs, stricter employment protection legislation (EPL) reduces job destruction and job creation and thus flows into and out of unemployment (Pissarides 2010). While the net impact on overall unemployment depends on which flow falls more, a lower labor turnover would reduce overall searching activity and thus affect frictional unemployment positively Also, if job seekers confer importance to secured positions, matching would be faster in more protected labor markets.

Finally, the composition of the unemployed population can also play a role in case the employer has a stigma or bias towards young or old unemployed, long-term unemployed or female unemployed; or in case these groups feature out-dated and/or lower skills. Looking at the educational level of the labor force in more detail, we explore the existence of skill mismatches between labor demand and labor supply, which could arise in the context of technological changes and/or creative destruction possibly accompanying economic crises.

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[8] An overall, across-the-board, productivity shift would not shift the Beveridge curve.

Fiscal and labor market policies

Concerning labor market policies, we examine the role played by the tax wedge and its components (employer and employee social security contributions) considered by different types of earners.[9] We then look at active labor market policies and unemployment benefits, all expressed as government spending as a share of GDP. Components of active labor market policies include incentives for start-ups, job creation, job rehabilitation, general employment, job rotation and training.

Any policy that pushes up the take home pay is expected to have the same effect for the supply side as an increase in nominal wages, such as decreases in the tax wedge due to lower employee social security contributions. Reductions in employer social security contributions could lead to more hiring, or, if passed on to the employee, increase the take home pay but without increasing the employers' wage costs. Spending on active labor market policies would improve matching as it is intended to address skill-gaps or other labor supply deficiencies. On the contrary, large unemployment benefits may constitute a limitation for matching as they increase the reservation wage and reduce incentives for active job seeking of the unemployed.

Interaction analysis between some of these factors could provide relevant insights regarding the role of institutions under shocks or under certain policies. This hypothesis is explored in an interaction analysis where we found no significant complementaries among policies and institutions but found significant effects of the 2008 shocks on unemployment benefits and education.

C. Data

Our sample covers 12 OECD countries between 2000Q1 and 2013Q4, chosen on the basis of data availability for the vacancy series.[10] We use several sources of data.

- IMF data from the WEO and IFS databases are used for the quarterly series of GDP, the output gap and the fiscal balance. The output gap is obtained as the ratio of the difference between nominal and potential output to potential output, where potential output is calculated through HP-filtering.

- OECD quarterly data are used for wages (proxied by wages in manufacturing and expressed as an index with base 2010) and for unemployment groups (female, long-term, youth and elderly unemployment). OECD annual data are used for (i) employer and employee social security contributions and the tax wedge per household of a single person with no children at 100, 67 and 167 percent of average earnings; (ii) for spending (as percent of GDP) on components of passive and active labor market policies; (iii) for employment protection legislation and temporary contracts.

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[9] The rationale behind distinguishing between employer and employee social security contributions is given by the possible presence of nominal rigidities for employer social security contributions as those contracts are specified net of contributions (De Mooji and Keen, 2012).

[10] We choose the starting year 2000 for the entire sample for comparability reasons. Several countries have longer series and most related single country studies use longer series of data.

- ILO provides annual data on the labor force and its education structure.

As quarterly movements matter, we convert data which are only available on an annual basis to a quarterly series, using the Denton procedure. As indicated by Di Fonzo and Marini (2012), the procedure entails shaping the quarterly distribution of an annual variable using the distribution of a benchmark quarterly variable. For all labor-related variables and unemployment benefits we use the quarterly series of unemployment as benchmark. For active labor market policies we use quarterly spending as a share of GDP.

IV. Empirical Analysis

A. Timing and Direction of Shifts

Visual examination

Figure 2 displays the Beveridge curves for all 12 countries in our sample based on the number of job vacancies and unemployed.[11] For most countries, surprisingly, there is a clear pattern of shifts and two parallel or displaced curves. This is very nicely illustrated for Australia or Hungary, for instance. In some countries, however, such as Finland and Norway, there seems to be only one curve—irrespective of the use of seasonally adjusted or non-seasonally adjusted data.

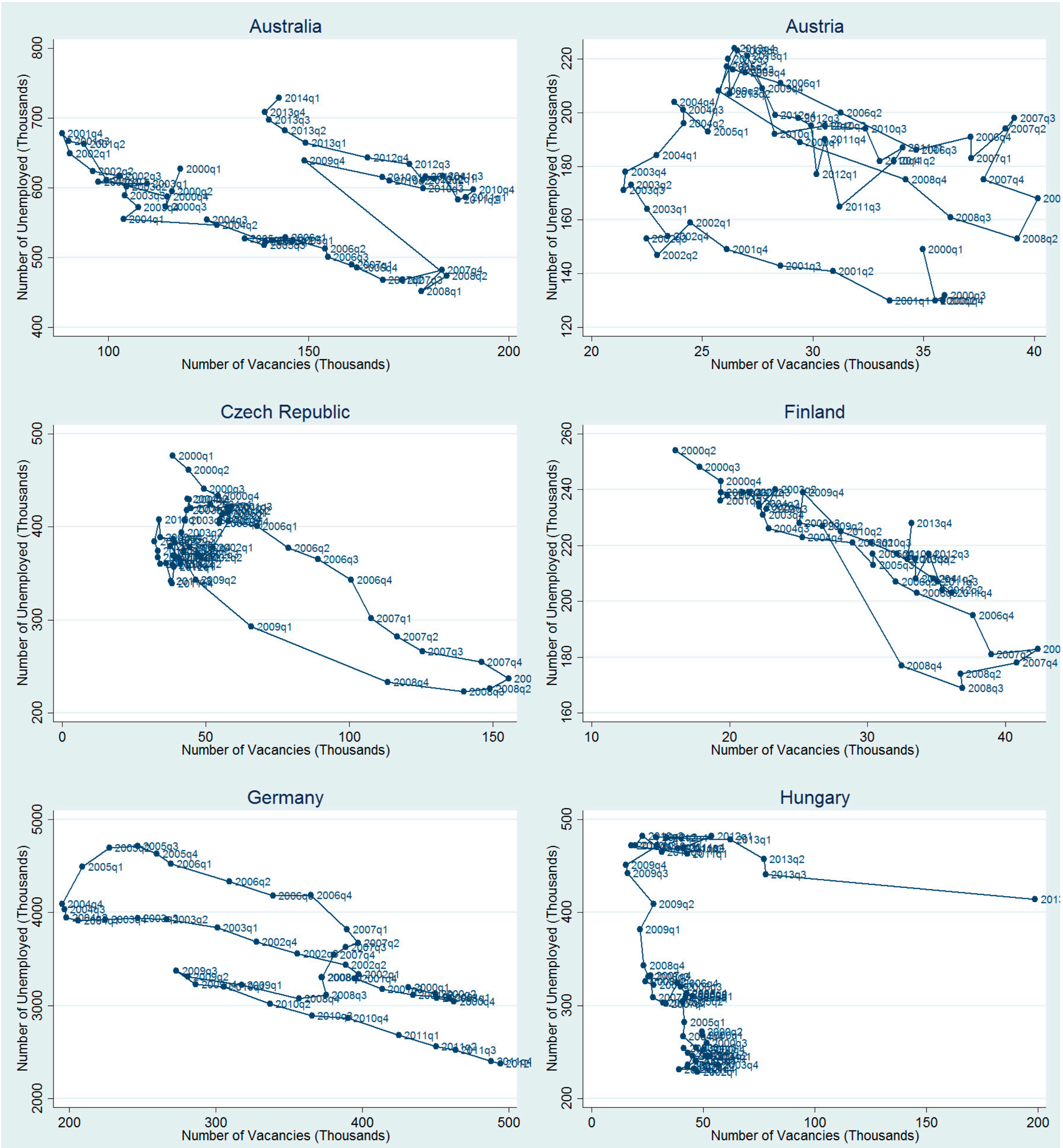
Cointegration analysis

At a one percent significance level the unemployment series have a unit root for all countries. For vacancies, the hypothesis of a unit root is rejected for the United States in both the ADF and PP tests and for Finland and Sweden in the PP test, while the ADF test statistics is very close to the critical value (Table 1). Overall, these results provide a basis for testing the existence of an underlying cointegration relationship.[12] The underlying specification—including a constant and/or trend—was chosen based on graphical inspection.

[11] Plotting the curves in levels is in line with our cointegration analysis. When plotting Beveridge curves in ratios, we observe a very similar picture with breaks matching the visually identified years. Only Australia's Beveridge curve displays a slightly different pattern. Moreover, we control for change in the labor force in the panel analysis.

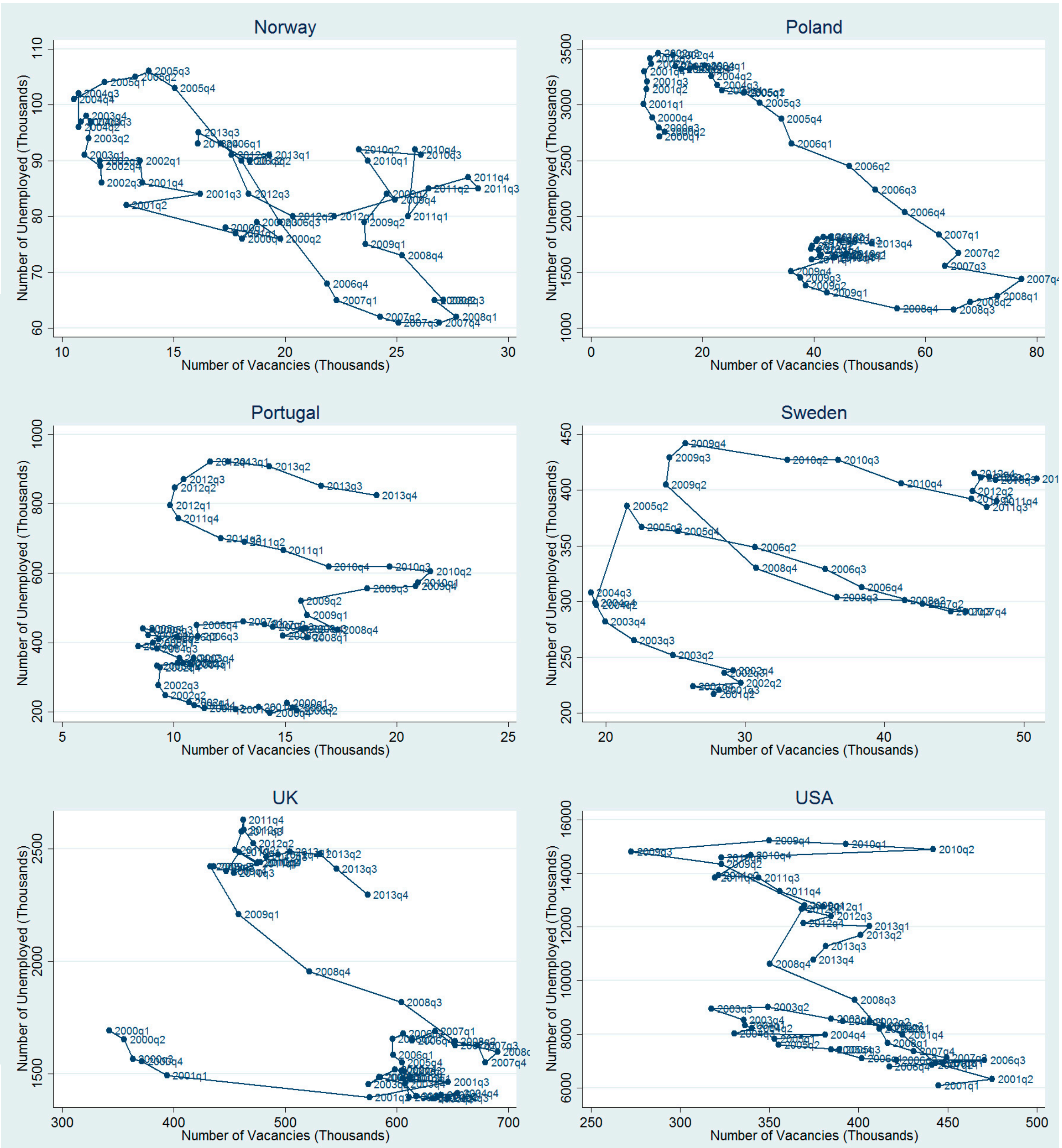
[12] Results on the unit root M-tests proposed by Ng and Perron (2001) (NP) are not reported for reasons of parsimony but available from the authors upon request. Results from these tests are consistent with the results of the ADF and PP tests.

Figure 2. Beveridge Curves (I)



Source: OECD data.

Figure 2. Beveridge Curves (II)



Source: OECD data.

Table 1. Unit Root Tests

	Unemployment			Vacancies		
	Specification Constant or Trend	**ADF**	**PP**	**Specification** Constant or Trend	**ADF**	**PP**
Australia	C	-1.45*	-1.32*	C & T	-0.61*	-1.27*
Austria	C&T	-2.10*	-2.29*	C	-2.81*	-2.54*
Czech Republic	C	-2.73*	-2.16*	C	-2.05*	-1.78*
Finland	C&T	-1.44*	-1.92*	C&T	-3.44*	-6.72
Germany	C&T	-1.74*	-1.33*	C	-1.22*	-1.38*
Hungary	C&T	-2.42*	-2.20*	C&T	1.12*	-0.46*
Norway	C	-2.37*	-1.87*	C&T	-2.35*	-2.87*
Poland	C&T	-2.12*	-1.57*	C&T	-1.94*	-2.62*
Portugal	C&T	-2.03*	-2.28*	C	-3.11*	-1.96*
Sweden	C&T	-1.65*	-2.12*	C&T	-3.52*	-5.35
United Kingdom	C&T	-2.33*	-2.37*	C	-1.19*	-2.55*
United States	C&T	-2.15*	-1.64*	C&T	-3.64	-3.67

Note: critical values for 1% confidence for constant and no trend: ADF -3.55; PP -3.55; for constant and trend ADF -4.137; PP -4.133;

Cointegration analysis *à la* Johansen-Juselius indicates that unemployment and vacancies display a long run relationship for most countries, except Australia, Finland, Germany, Hungary, and the United States. For the Czech Republic, cointegration exists only under a quadratic trend (Table 2). The optimal lag structure was determined by applying a range of tests and selection criteria.[13] Estimates of the cointegrated coefficients obtained through the Stock-Watson-Shin are reported in table A2 in Appendix A.

Table 2. Johansen-Juselius Cointegration Tests

		Johansen Trace Test					
		Data Trend	None	None	Linear	Linear	Quadratic
	Lag	Test type	No intercept No trend	Intercept No trend	Intercept No trend	Intercept trend	Intercept trend
Australia	2		0	0	0	0	0
Austria	5		1	1	1	1	2
Czech Republic	2		0	0	0	0	1
Finland	5		0	0	0	0	0
Germany	5		0	0	0	0	0
Hungary	3		0	0	0	0	0
Norway	5		0	1	2	0	2
Poland	6		1	1	2	0	0
Portugal	5		2	1	0	1	2
Sweden	5		2	2	1	1	2
United Kingdom	3		0	1	1	1	2
United States	2		0	0	0	0	0

Cointegration results are very sensitive to the presence of a break in the cointegrating relationship, hence a cointegration test would generally fail to capture a long run relationship if the series feature

[13] See Table A1 in Appendix A for further details.

a structural shift. To test for a break in the cointegration, we follow Gregory and Hansen's procedure (1996) which detects the presence of cointegration under breaks and provides information about the time of the break (Table 3).[14] We find that when accounting for a break, either in the intercept (*level shift*) or in the intercept and slope (*regime shift*) breaks, the series for unemployment and vacancies are cointegrated for Australia, Finland, Germany, Hungary, Norway, Portugal, Sweden, the United Kingdom, and the United States; and Austria, Finland, and Poland when considering the Z statistic. The only countries for which no cointegration was found is the Czech Republic and Norway. Interestingly, breaks tend to cluster around the global financial crisis.

Table 3. Testing for Regime Shifts in Cointegration: Gregory-Hansen

	Unemployment and Vacancies							
	Level shift				Regime shift			
Country	ADF test		Phillips Test		ADF test		Phillips Test	
	ADF^* stat	Estimated break date	Z_α^* stat	Estimated break date	ADF^* stat	Estimated break date	Z_α^* stat	Estimated break date
Australia	-6.97*	2008Q3	-55.906*	2008Q4	-6.75*	2008Q3	-55.613*	2008Q4
Austria	-3.80	2004Q4	-38.54*	2004Q3	-3.88	2006Q4	-38.45	2004Q2
Czech Republic	-3.73	2010Q3	-17.89	2007Q3	-3.59	2010Q1	-15.56	2009Q1
Finland	-3.93	2010Q2	-92.57*	2004Q3	-4.05	2010Q4	-94.20*	2004Q3
Germany	-4.86*	2009Q1	-11.06	2008Q1	-5.36*	2001Q4	-18.27	2005Q2
Hungary	-4.13	2011A1	-35.43	2010Q3	-3.47	2011Q1	-42.34*	2011Q1
Norway	-4.17	2007Q3	-32.14	2008Q2	-3.57	2007Q4	-36.95	2005Q2
Poland	-3.68	2004Q1	-37.65*	2003Q3	-3.75	2004Q1	-37.29	2003Q3
Portugal	-5.59*	2007Q3	-22.41	2006Q3	-5.32*	2007Q3	-23.84	2010Q4
Sweden	-4.92*	2008Q1	-39.93*	2006Q1	-4.66	2008Q1	-39.78	2005Q3
United Kingdom	-5.98*	2005Q3	-26.77	2001Q3	-5.85*	2002Q3	-31.43	2001Q3
United States	-5.04*	2008Q3	-36.46*	2008Q3	-5.18*	2008Q3	-39.21	2006Q3

Note: ADF^* and Z_α^* refer to the Augmented Dickey-Fuller (ADF) and to the Phillips Z_α^* tests statistics; null of no cointegration. * denote significance at the 10% level or lower, using the critical values from Gregory and Hansen (1996), Table 1.

While informative, the results of the cointegration analysis show in some instances the limitations associated with a linear representation of the Beveridge curve. The following section therefore examines non-linear specifications in more detail.

Non-linear estimation

To identify timing and direction of shifts in the Beveridge curve, we complement graphical analysis and estimation of the break tests with the non-linear estimation of the curve. As explained in Section 3, the non-linear estimation is run on a Beveridge curve, which includes the shift dummy based on the break dates identified by visual examination and cointegration analysis.[15] The regression

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[14] As distinguished in Gregory and Hansen (1996), a series can be affected by: (i) a level shift, namely a change in the slope coefficient; (ii) a trend shift, where both the slope and the trend are affects; and (iii) a regime shift, where the intercept is affected. Table A3 in the appendix provides the test results.

[15] Except for the case of Norway for which neither visual examination nor cointegration could identify a clear break date.

outcome in Table 4a provides an indication of the distance of the curve from the horizontal axes, more precisely, the level of unemployment in place when vacancies are infinite. This distance corresponds to the constant before the shift, and the constant plus the shift interaction after the shift. The coefficient associated with the shift is significant for all countries examined. Positive shifts (deterioration in the matching) are found in Australia, Austria, Hungary, Portugal, Sweden, the United Kingdom, and the United States and negative shifts (improvement in the matching) are found in the Czech Republic, Finland, and Germany. Poland's dummy—coded as first outward shift and then inward shift—is also significant confirming the double shift in the Beveridge curve. The results are robust against the inclusion of a slope parameter (Table 4b).

Table 4a. Nonlinear Estimation: Vertical Shift

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
VARIABLES	Australia	Austria	Czech Rep.	Finland	Germany	Hungary	Poland	Portugal	Sweden	UK	US
Constant	6.112***	4.727***	5.697***	5.143***	8.040***	5.421***	7.239***	5.338***	5.330***	7.140***	8.777***
	(0.0173)	(0.0222)	(0.0262)	(0.0180)	(0.0216)	(0.0270)	(0.0437)	(0.0496)	(0.0286)	(0.0345)	(0.0207)
Shift	0.122***	0.246***	-0.127***	-0.106***	-0.245***	0.460***	0.351***	0.730***	0.354***	0.305***	0.522***
	(0.0272)	(0.0269)	(0.0409)	(0.0218)	(0.0419)	(0.0583)	(0.0697)	(0.0728)	(0.0420)	(0.0461)	(0.0318)
Observations	57	56	56	56	49	56	56	56	52	50	52
R-squared	0.305	0.619	0.298	0.488	0.456	0.567	0.494	0.635	0.545	0.489	0.845

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 4b. Nonlinear Estimation: Vertical Shift with Slope Coefficient

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
VARIABLES	Australia	Austria	Czech Republic	Finland	Germany	Hungary	Poland	Portugal	Sweden	United Kingdom	United States
Constant	3.931***	3.754***	4.346***	5.199***	6.095***	4.350***	6.331***	4.063***	5.450***	3.685***	6.042***
	(0.191)	(0.198)	(0.109)	(0.117)	(0.297)	(0.158)	(0.0946)	(0.408)	(0.196)	(0.545)	(0.690)
Shift	0.249***	0.286***	-0.235***	-0.113***	-0.208***	0.555***	0.373***	0.880***	0.342***	0.299***	0.477***
	(0.0185)	(0.0239)	(0.0226)	(0.0262)	(0.0309)	(0.0451)	(0.0415)	(0.0827)	(0.0465)	(0.0342)	(0.0302)
Slope	11.51***	4.180***	6.500***	0.833**	12.30***	4.785***	3.907***	4.019***	0.611	22.74***	17.36***
	(0.921)	(0.644)	(0.441)	(0.343)	(1.721)	(0.553)	(0.291)	(0.961)	(0.625)	(3.423)	(4.125)
Observations	57	56	56	56	49	56	56	56	52	50	52
R-squared	0.796	0.739	0.821	0.491	0.719	0.770	0.824	0.692	0.548	0.725	0.883

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

A single dummy

On the grounds of visual examination, cointegration analysis, and non-linear estimations, we identify the presence of a shift in each country (Table 5). The last two columns of Table 5 provide information on the final choice regarding the timing and type of the shift. Some judgment was used in more complex cases where the methods were not entirely consistent, notably in the case of Finland. The country was classified as 'no break' despite a (weakly) significant Phillips test and non-linear estimation as the depicted Beveridge curve shows no sign of a shift at the suggested break date. Finally, Norway was classified as 'no break' following no clear visual shift and no significance in the cointegration tests.

Overall, we found ten shifts in the Beveridge curves of twelve countries. Shifts are outward for most countries, but the Czech Republic and Germany. Poland displays two breaks, an outward shift followed by an inward shift. Except for Austria and the United Kingdom, the deterioration of matching took place around the global financial crisis—a finding that lends further support to the hypothesis raised by the new generation of studies on the Beveridge curve that associates the occurrence of frictional unemployment with economic recessions.

Table 5. Identifying Shifts in the Beveridge Curve

Country	Graphical examination	Granger and Hansen test for level and regime shifts	Nonlinear Estimation	Break date selected	Break direction
Australia	Outward shift in 2008-09	ADF significant: 2008Q3 Phillips significant: 2008Q4	Significant outward shift in 2008Q3	2008Q3	Outward
Austria	Outward shift in 2004	ADF not significant Phillips significant: 2004Q3	Significant outward shift in 2004Q3	2004Q3	Outward
Czech Republic	Inward shift in 2008	Not significant	Significant inward shift in 2008Q2	2008Q2	Inward
Finland	No break	ADF not significant Phillips significant: 2004Q3	Significant inward shift in 2004Q3	No break	No break
Germany	Inward shift in 2008-09	ADF significant: 2001Q4, 2009Q1 Phillips not significant	Significant inward shift in 2009Q1	2009Q1	Inward
Hungary	Outward shift in 2010-11	ADF not significant Phillips significant: 2011Q1	Significant outward shift in 2011Q1	2011Q1	Outward
Norway	No clear shift	ADF and Phillips not significant	-	No break	No break
Poland	Possibly two breaks: outward in 2002, inward in 2008	ADF not significant Phillips significant: 2003Q3	Significant outward shift in 2002Q2 and inward shift in 2008Q4	2002Q3 and 2008Q4	Outward then Inward
Portugal	Outward shift in 2007 (possibly second outward shift in 2012)	ADF significant: 2007Q3 Phillips not significant	Significant outward shift in 2007Q3	2007Q3	Outward
Sweden	Two outward shifts: one in 2005 and one in 2009	ADF significant: 2008Q1 Phillips significant: 2006Q1	Significant outward shift in 2008Q1	2008Q1	Outward
UK	Outward shift in 2006	ADF significant: 2002Q3, 2005Q3 Phillips not significant	Significant outward shift in 2005Q3	2005Q3	Outward
US	Outward shift in 2008	ADF significant: 2008Q3 Phillips significant: 2008Q3	Significant outward shift in 2008Q3	2008Q3	Outward

B. What Affects the Probability of the Shifts?

Our baseline regression includes the contemporaneous and lagged output gap, the growth rate of the labor force, as well as the overall balance when testing for policy variables to control for possible effects stemming from fiscal expansions or contractions and time fixed effects. We find that the output gap (both contemporaneous and lagged) is not statistically significant, suggesting that outward or inward shifts do not occur in a systematic way at specific phases of the business cycle.[16] Labor force growth is however highly significant and negative throughout almost all specifications. Given shrinking labor forces in many advanced economies due to various reasons including demographics, this finding might help explain why Beveridge curves have not been able to shift back after the crisis. This has occurred despite recent improvements in other determinants, such as long term unemployment. The overall fiscal balance is mostly significant with a negative sign. We therefore do not find systematic evidence suggesting that low budget deficits, over the long term, adversely affect matching.

Labor market characteristics

Table 6 reports the implications of labor market characteristics for the matching process. Overall, we find that the security of jobs is associated with lower frictional unemployment; yet, compensation and length of contracts do not seem to affect the Beveridge curve. Real wages and temporary contracts are in fact not significantly associated with the shifts, while a higher level of the employment protection legislation (EPL) is associated with a higher probability of inward shifts. By increasing hiring and firing costs, stronger EPL lowers the number of hiring and firing events thereby mechanically reducing searching activity and labor turnover. The literature finds a small impact of EPL on overall unemployment in both directions (Pissarides 2010), and evidence for less labor turnover and longer durations of both unemployment and employment (OECD 1999), which would support our findings on the impact on frictional unemployment.

The composition of the unemployed population seems to play a stronger role than labor market structures. In line with the literature (see Bonthius and others 2013), a higher share of young unemployed to total unemployed is associated with outward movements of the curve, while the Beveridge curve is less likely to shift outward when the share of old-age unemployed is larger. This might be due to employers' preferences for more (on-the-job) experience and easier signaling during the hiring process, which could have been important notably during the crisis years during which our sample features most shifts. For female unemployment, evidence seems to be supportive of a male-biased labor matching preference. Finally, for long-term unemployment our results seem to support the theory that matching is more difficult when the unemployed have been out of the labor market for more than a year, a fact easily explained by continued skills erosion and an increasingly outdated skill set.

Turning to the overall level of education in the labor force, results show that matching may be more difficult or lengthy if a larger share of the labor force has an intermediate level of education. This result suggests that skill-mismatches might exist between job seekers and employers in economies with this type of skill set.

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[16] For the majority of identified shifts, the timing was at the onset of the global financial crisis when output gaps were still positive.

Table 6. Labor Market Characteristics

Specification	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Output gap	-0.0166	-0.00123	0.00321	5.34e-05	0.00654	-0.0152	0.00734	-0.00895	-0.0526	-0.00773	0.00429	-0.00677
	(0.0924)	(0.0936)	(0.0925)	(0.0929)	(0.0918)	(0.0997)	(0.101)	(0.0934)	(0.135)	(0.0949)	(0.100)	(0.0991)
L.Output gap	-0.0503	-0.0970	-0.0820	-0.0824	-0.0855	-0.132	-0.0510	-0.0985	0.213	-0.109	-0.103	-0.130
	(0.0940)	(0.0956)	(0.0939)	(0.0942)	(0.0933)	(0.102)	(0.104)	(0.0951)	(0.140)	(0.0971)	(0.103)	(0.1000)
Labor force (growth)	-0.301***	-0.308***	-0.326***	-0.324***	-0.320***	-0.527***	-0.373***	-0.402***	0.0455	-0.240***	-0.137	-0.273***
	(0.0807)	(0.0840)	(0.0828)	(0.0832)	(0.0819)	(0.0982)	(0.0922)	(0.0876)	(0.152)	(0.0810)	(0.0856)	(0.0839)
Regressors	**DL.wages**	**Empl protection**	**Collect dismissal**	**Individual dismissal**	**Temp empl**	**Youth unemp**	**Elderly unemp**	**Female unemp**	**Long-term unemp**	**Advanced edu**	**Intermed. edu**	**Basic edu**
Coefficient	-0.0331	-0.784*	-0.375	-0.141	-1.863	0.0735***	-0.384***	0.131***	1.204***	-0.0141	0.376***	-0.0519
	(0.0362)	(0.439)	(0.392)	(0.269)	(1.750)	(0.0248)	(0.0539)	(0.0379)	(0.149)	(0.0160)	(0.0166)	(0.0346)
Observations	624	624	624	624	624	608	612	624	468	588	596	560
Countries	12	12	12	12	12	12	12	12	9	12	12	11

Note: Estimated using a panel probit with random effects. A constant and time fixed effects are included in the regression but omitted. Standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

Table 7. Fiscal and Labor Market Policies

Specification	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
Output gap	-0.00202	0.0233	-0.00215	0.00694	0.0366	0.00481	-0.00347	0.000662	9.35e-06	-0.136	-0.1000	-0.186	-0.204	-0.111	-0.107	-0.108
	(0.118)	(0.118)	(0.116)	(0.121)	(0.121)	(0.121)	(0.110)	(0.115)	(0.109)	(0.133)	(0.134)	(0.145)	(0.167)	(0.143)	(0.133)	(0.122)
L.Output gap	-0.0593	-0.0694	-0.0532	-0.0603	-0.0591	-0.0618	-0.0664	-0.103	-0.0607	-0.146	-0.136	-0.180	-0.121	-0.124	-0.137	-0.00390
	(0.117)	(0.117)	(0.115)	(0.121)	(0.121)	(0.121)	(0.110)	(0.114)	(0.109)	(0.134)	(0.134)	(0.147)	(0.165)	(0.142)	(0.133)	(0.118)
Labor force (growth)	-0.411***	-0.372***	-0.424***	-0.356***	-0.306**	-0.355***	-0.449***	-0.394***	-0.453***	-0.554***	-0.567***	-0.447***	-0.718***	-0.616***	-0.587***	-0.376***
	(0.109)	(0.108)	(0.108)	(0.121)	(0.120)	(0.121)	(0.105)	(0.106)	(0.105)	(0.133)	(0.135)	(0.142)	(0.181)	(0.144)	(0.134)	(0.113)
Overall balance	-0.217***	-0.205***	-0.222***	-0.264***	-0.230***	-0.266***	-0.232***	-0.245***	-0.227***	-0.164***	-0.152***	-0.124***	-0.124***	-0.175***	-0.153***	-0.155***
	(0.0396)	(0.0399)	(0.0383)	(0.0426)	(0.0416)	(0.0424)	(0.0358)	(0.0391)	(0.0349)	(0.0387)	(0.0402)	(0.0434)	(0.0432)	(0.0426)	(0.0394)	(0.0409)
Regressor	**ESSC_100**	**ESSC_167**	**ESSC_67**	**WSSC_100**	**WSSC_167**	**WSSC_67**	**TW_100**	**TW_167**	**TW_67**	**Job creation**	**Incentives**	**Rehabilit.**	**Job sharing**	**Start-up incentive**	**Training**	**Unemp benefits**
Coefficient	1.116***	1.247***	0.802***	1.090***	1.122***	1.094***	0.151**	0.485***	0.0778*	-0.0795**	-0.0111	-0.152***	-1.519**	-0.147***	-0.00364	0.0114***
	(0.0312)	(0.0355)	(0.0254)	(0.157)	(0.0403)	(0.158)	(0.0697)	(0.0856)	(0.0435)	(0.0361)	(0.00778)	(0.0459)	(0.602)	(0.0333)	(0.00476)	(0.00205)
Obs.	520	520	520	520	520	520	520	520	520	408	408	360	360	408	408	411
Countries	11	11	11	11	11	11	11	11	11	9	9	9	9	9	9	10

Note: ESSC denotes employer social security contributions, at the 100, 167 and 67 percent average earnings of a single individual. WSSC denotes employee social security contributions, at the 100, 167, 67 percent average earnings of a single individual. TW denotes the tax wedge at the 100, 167, and 67 average earnings of a single individual. Estimated using a panel probit with random effects. A constant and time fixed effects are included but omitted. Standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1. Hungary was omitted from the estimation of the tax wedge and its components, as social security contributions changed largely during the period under study affecting the results as outliers.

Fiscal and labor market policies

We find a strongly significant, positive coefficient of the tax wedge and security contributions (Table 7), with both employer and employee contributions increasing the likelihood of an outward shift. With larger contributions, the take-home-pay diminishes making a job less attractive to the job seeker and more expensive for the employer, who would probably tend to increase the searching time. Hence, this affects the ease at which vacancies are filled. Consistently we find that the coefficient is smaller at lower levels of earnings, and broadly similar for employee and employer social contributions.

Active labor market programs such as job creation, job sharing, job rehabilitation and start up incentives improve labor market matching (Table 7, columns 10–16). Among these, spending on job sharing programs seems to have the highest impact in reducing frictional unemployment. Spending on job incentives and training are the only variable yielding a statistically insignificant coefficient. On the contrary, higher unemployment benefits make the matching process harder, as expected, given higher reservation wages. Our findings are therefore in line with Johansen 2004, Jackman and others (1990) and Arpaia and Turrini (2014) on labor market policies and Hobijn and Sahin (2012) on unemployment benefits.

C. Robustness Analysis

Alternative specifications of the model broadly support the results of the baseline. Tables 8 and 9 report regression results equivalent to those of Tables 6 and 7 but with an array of robustness checks. We first apply two alternative estimation methods to the panel probit, that is, a random effects logit and a fixed effects logit. Then, we consider two alternative specifications of the shift variables, as mentioned earlier: i) the variable *Shift size;* and ii) the variable *Mismatch*. As these two variables are not binary, the estimation employs country and time fixed effects panel techniques. Since outward shifters might behave differently than inward shifters, we tried splitting the sample. Unfortunately, the number of observations become relatively limited and the results were mainly insignificant.

Focusing on labor market characteristics (Table 8), we find that the results on employment protection, long-term unemployment and education are robust to all alternative estimation techniques. However, unemployed groups (young age and gender) appear insignificant in the simple panel estimations (for shift size and mismatch) except for long term unemployment, which significantly increases the likelihood of an outward shift throughout all specifications. For fiscal and labor market policies, Table 9 further confirms the robustness of the previous results to different estimation techniques. Social security contributions remain significant when using different estimation techniques and dependent variables. The tax wedge maintains its significant detrimental impact on frictional unemployment under the logit specifications, but shows significance for high level of income (tw_167) only with shift size and mismatch as dependent variables. Similar to the baseline, unemployment benefits display a positive and significant coefficient. Active labor market policies are somewhat less robust under alternative specifications, with the exception of spending on incentives to start-ups, which retains its strongly significant and negative coefficient throughout, and spending on job sharing and rehabilitation programs, which is still significant under two of the four specifications.

Table 8. Robustness—Labor Market Characteristics

Spec.	Shift		Shift size	Mismatch
Estimation	**Panel logit (RE)**	**Panel logit (FE)**	**Panel**	**Panel**
Regressors				
DL.Wages	-0.0469	-0.0338	-0.00578	-0.00421
	(0.0614)	(0.0618)	(0.0100)	(0.0121)
Employment protection	-1.293*	-2.173***	-0.377*	-0.390**
	(0.741)	(0.777)	(0.186)	(0.165)
Collective dismissal	-0.588	-1.551	-0.405**	-0.390**
	(0.664)	(0.975)	(0.150)	(0.148)
Individual dismissal	-0.205	-0.488	-0.265*	-0.245*
	(0.459)	(0.758)	(0.127)	(0.132)
Temporary employment	-3.280	27.38***	1.819	2.171
	(2.971)	(8.062)	(1.114)	(2.102)
Youth unemployment	0.121***	0.150***	-0.00430	-0.00268
	(0.0423)	(0.0452)	(0.00948)	(0.00872)
Elderly unemployment	-0.731***	-0.767***	-0.0177	-0.0196
	(0.104)	(0.106)	(0.0120)	(0.0130)
Female unemployment	0.225***	0.249***	0.00253	-0.00329
	(0.0637)	(0.0664)	(0.00851)	(0.0117)
L-t unemployment	2.293***	2.423***	0.0770***	0.0760***
	(0.303)	(0.313)	(0.00843)	(0.00892)
Advanced education	-0.0211	-0.00121	0.000103	0.00285
	(0.0272)	(0.0351)	(0.00485)	(0.00780)
Intermediate education	0.670***	0.768***	0.0238*	0.0368***
	(0.0661)	(0.100)	(0.0110)	(0.0110)
Basic education	-0.0900	-0.290***	-0.0107	-0.0177
	(0.0604)	(0.0864)	(0.0107)	(0.0196)

Note: The table reports only the coefficients of interest based on regressions carried out independently variable by variable. The output gap, its lagged value, the overall balance and labor force growth are included in each regression as control variables but not reported for reasons of parsimony. Only the overall balance is statistically significant. A constant is also included but omitted. Standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1.

Table 9. Robustness—Fiscal and Labor Market Policies

Spec	Shift		Shift size	Mismatch
Estimation	Panel logit (RE)	Panel logit (FE)	Panel	Panel
Regressors				
ESSC_100	2.485***	2.785***	0.137***	0.139***
	(0.354)	(0.404)	(0.0248)	(0.0317)
ESSC_167	2.419***	2.658***	0.137***	0.142***
	(0.326)	(0.355)	(0.0306)	(0.0354)
ESSC_67	2.304***	2.731***	0.116***	0.113***
	(0.372)	(0.428)	(0.0191)	(0.0247)
WSSC_100	1.940***	2.173***	0.0765*	0.102**
	(0.289)	(0.318)	(0.0348)	(0.0330)
WSSC_167	2.571***	2.860***	0.0794**	0.0973**
	(0.369)	(0.409)	(0.0286)	(0.0333)
WSSC_67	1.949***	2.176***	0.0776*	0.106**
	(0.290)	(0.319)	(0.0359)	(0.0330)
TW_100	0.241**	0.463***	0.0500	0.0476
	(0.113)	(0.111)	(0.0375)	(0.0387)
TW_167	0.813***	0.955***	0.0664**	0.0649**
	(0.149)	(0.139)	(0.0230)	(0.0245)
TW_67	0.128*	0.289***	0.0399	0.0367
	(0.0726)	(0.109)	(0.0391)	(0.0391)
Job creation	-0.141**	-0.0884	-0.0125	-0.0206
	(0.0620)	(0.0750)	(0.0172)	(0.0179)
Incentives	-0.0186	-0.0280*	-0.00300	-0.00366
	(0.0132)	(0.0148)	(0.00305)	(0.00314)
Rehabilitation	-0.257***	-0.140	-0.0259*	-0.0240
	(0.0779)	(0.133)	(0.0132)	(0.0171)
Job sharing	-2.587**	-3.548*	-0.00499	-0.00337
	(1.074)	(1.945)	(0.00792)	(0.00998)
Start-up	-0.255***	-0.255***	-0.0174***	-0.0173***
	(0.0589)	(0.0600)	(0.00335)	(0.00403)
Training	-0.00706	-0.00212	-0.000141	0.000302
	(0.00814)	(0.00876)	(0.000978)	(0.000997)
Unempl benefits	0.0194***	0.0219***	0.00144***	0.00140***
	(0.00357)	(0.00365)	(0.000285)	(0.000278)

Note: The table reports only the coefficients of interest based on regressions carried out independently variable by variable. The output gap, its lagged value, the overall balance and labor force growth are included in each regression as control variables but not reported for reasons of parsimony. Only the overall balance is statistically significant. ESSC denotes employer social security contributions, at the 100, 167 and 67 percent average earnings of a single individual. WSSC denotes employee social security contributions, at the 100, 167, 67 percent average earnings of a single individual. TW denotes the tax wedge at the 100, 167 and 67 average earnings of a single individual. A constant and time fixed effects are also included but omitted. Standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1. Hungary was omitted from the estimation of the tax wedge and its components, as social security contributions changed largely during the period under study affecting the results as outliers.

D. The Role of Shocks and Labor Market Institutions

Since the majority of the identified shifts in the Beveridge curve took place around the global financial crisis, we explore to which extent specific labor market institutions affect the impact of exogenous shocks on labor markets. This issue has been explored by Blanchard and Wolfers (2000) who analyze why labor market institutions in place since the late 1950s in OECD countries could not explain the suddenly deteriorating performance of employment in the aftermath of the 1970s/1908s oil shocks. While these shocks hit several economies in a very similar way, the responses of labor markets were quite different. The authors claim that while there are common but unobservable shocks across countries, these shocks have a larger and more persistent effect in countries with poor labor market institutions. To test this hypothesis, they construct a series of macro shocks and find evidence that a similar-size shock has differential effects on unemployment when labor market institutions differ. The authors suggest as interpretation that institutions determine the sensitivity of the unemployed to wage-setting, thereby determining the evolution of equilibrium unemployment rates following a shock.

In our particular setting, instead of looking at a series of past shocks, we focus our attention on the global financial crisis (to our knowledge no other study has done so), and explore possible interactions between two time dummies (2008Q3 and 2008Q4 identified as the trough of the crisis as far as labor variables are concerned, see figure 1) and labor market policies and conditions. Following Blanchard and Wolfers (2000) our assumption is that the impact of these institutions on the Beveridge curve may be altered by the existence of shocks. Table 10 reports only those coefficients for which the interaction terms with time dummies was significant. Evidence suggests that at the trough of the crisis the level of education and the length of unemployment had a less strong impact on the likelihood of an outward shift (columns 1, 2, 3 and 4). However, the detrimental impact of unemployment benefits was stronger (columns 5 and 6). It is interesting to note that for all other variables the incidence of the financial crisis did not matter in the way they impact labor market dynamics.

Finally, recent work has highlighted the importance of considering the combined effect of institutions and policies on unemployment (Bassanini and Duval, 2009). We explored this avenue by interacting the share of temporary contracts with our EPL variable (and also its two variants, namely collective and individual). Coefficient estimates using alternative estimation techniques and dependent variables (as discussed in the robustness section) yield either statistically insignificant results or led to inconclusive inferences. This is also in line with the literature that reported little or no evidence of complementarities between structural reforms and labor market characteristics.

Table 10. The Role of Shocks and Labor Market Institutions in the Matching Process

Variables	(1)	(2)	(3)	(4)	(5)	(6)
2008Q3	4.1004**		12.0469	-3.4393	-0.95	
	(1.966)		(7.655)	(2.14)	(1.035)	
2008Q4		3.5358*				-0.6504
		(1.88)				(1.07)
Intermediate education			0.2899***			
			(0.045)			
2008Q3* Intermediate education			-0.1912			
			(0.122)			
Basic education				-0.1333***		
				(0.03)		
2008Q3* Basic education				0.2779*		
				(0.158)		
Long-term unemployment	0.7411***	0.7331***				
	(0.083)	(0.083)				
2008Q3*L-t unemployment	-0.3649**					
	(0.185)					
2008Q4*L-T unemployment		-0.2709				
		(0.195)				
Unemployment benefits					0.0072***	0.0072***
					(0.002)	(0.002)
2008Q3*Unemployment benefits					0.0161*	
					(0.009)	
2008Q4*Unemployment benefits						0.0142*
						(0.008)
Observations	468	468	596	560	444	444
Countries	9	9	12	11	10	10

Note: The table reports only the coefficients of interest where the output gap, its lagged value, the overall balance and labor force growth have been included in each regression as control variables but not reported for reasons of parsimony. A constant has also been included but omitted. Standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1.

V. Conclusion

This paper revisits labor market matching in the context of the Beveridge curve. The analysis has been motivated by the presence of still very high levels of unemployment at times of an increasing number of vacancies in many OECD countries. Also, this study seeks to fill a major gap in the literature which has somehow neglected the role that policies can play in spurring jobs through measures other than those stimulating aggregate demand.

Grounding our analysis in the Beveridge curve's theoretical framework, we construct individual Beveridge curves for 12 OECD countries between 2000Q1 and 2013Q4. By means of three complementing methodologies we identify the timing and direction of these shifts. Distinguishing between outward and inward shifts of the curve, reflecting deteriorations and improvements of labor market matching respectively, we test possible determinants of these shifts by means of panel estimations.

We find that several factors significantly affect labor market matching.

- ***A negative impact*** (increasing the likelihood of an inward shift – implying a faster matching process and less frictional unemployment) is associated with higher labor force growth; stronger employment protection legislation; an older unemployed population and government spending in active labor market policies, such as job sharing programs and start-up incentives.

- ***A positive impact*** (increasing the likelihood of an outward shift – implying worse matching) is associated with a larger share of long-term unemployed, female and young unemployed; more employees with intermediate education in the labor force, as well as higher social security contributions and tax wedge and higher unemployment benefits.

In terms of policy implications, in line with the relevant literature, the emphasis on active labor market policies at the expense of passive ones applies. In particular, our study highlights that in order to reduce frictional unemployment preference should be given to programs for job sharing and incentives for start up activities while unemployment benefits and labor taxation should be reconsidered. An important result of this study is the finding that job protection is negatively associated with frictional unemployment. By reducing labor turnover and thus searching activity, frictions are smaller in the case of tighter protection legislation. While this result would lend support to tightening labor protection, it is important to consider other consequences of this policy. Higher EPLs lower the flows into and out of unemployment possibly leading to higher overall unemployment, and are associated with lower average productivity and higher entry barriers for young workers.

Finally, the results also warrant some caveats. As indicated, the analysis rests ultimately on a limited number of shifts in the Beveridge curve over a time span of only 13 years. Most shifts are found to take place at the onset of the global financial crisis, and so far we have not observed any backward shift in the curves shifted outward during that time. However, the question of whether we still face a slower pace of recovery in the labor market compared to the recovery in output remains to be answered (see Arpaia and Turrini, 2014). Going forward, additional analyses could be aimed at assessing the implications of business cycle fluctuations on labor market frictions, with a focus on long-term unemployment and the uncertainty it generates.

Appendix A

Table A1. Lag length Criteria for the Relationship between Unemployment and Vacancies

	Selected Lag	AIC	LR	FPE	SIC	HQ
Australia	2	-6.416	17.498*	5.61e-06*	-6.027*	-6.269*
Austria	5	-5.97*	17.06*	8.80e-06*	-5.13*	-5.65*
Czech Republic	2	-5.29*	30.49*	1.72e-05*	-4.91*	-5.14*
Finland	5	-6.20*	26.43*	7.05e-06*	-5.36*	-5.88*
Germany	5	-6.58*	16.48*	4.83e-06*	-5.68*	-6.25*
Hungary	3	-3.71*	14.18*	8.42e-05*	-3.17	-3.50*
Norway	5	-4.63	32.48*	3.37e-05	-3.79*	-4.31*
Poland	6	-5.45*	8.93	1.50e-05*	-4.46	-5.07*
Portugal	5	-5.27*	17.67*	1.78e-05*	-4.43*	-4.95*
Sweden	5	-4.51*	31.13*	3.81e-05*	-3.64*	-4.18*
United Kingdom	3	-7.00*	16.29*	3.12e-06*	-6.43*	-6.79*
United States	2	-5.76*	48.63*	1.07e-05*	-5.36*	-5.61*

Note: AIC (Akaike information criterion), LR (sequential modified likelihood ratio test statistic), FPE (Final prediction error criterion by Lutkepohl, 1993), SIC (Schwarz information criterion), HQ (Hannan-Quin information criterion).

Table A2. Estimation of Long-Run Relationships: Stock-Watson-Shin Cointegration

Country	β	s.e.	C_μ	s.e.	$\overline{R}^2$
Australia	-0.159	0.108	7.147***	0.536	0.285
Austria	-0.144	0.185	5.691***	0.626	0.188
Czech Republic	-0.303***	0.0677	7.103***	0.271	0.643
Finland	-0.363***	0.053	6.572***	0.177	0.748
Germany	-0.488***	0.145	11.004***	0.851	0.499
Hungary	-0.498***	0.170	7.583***	0.615	0.428
Norway	-0.303***	0.091	5.306***	0.266	0.437
Poland	-0.491***	0.060	9.326***	0.207	0.822
Portugal	0.397	0.444	5.087***	1.124	0.126
Sweden	0.244	0.198	4.946***	0.683	0.123
United Kingdom	-0.970***	0.251	13.600***	1.591	0.538
United States	-1.847***	0.661	20.146***	3.924	0.398

Note: The C_μ is the Shin (1994) LM statistic which tests for deterministic cointegration. The critical values are taken from Shin (1994), Table 1, for m=1. Standard errors are adjusted for long-run variance. The long-run variance of the cointegrating regression residuals was estimated using the Barlett window with $l = 6 \approx INT(T^{1/2})$ as proposed by Newey and West (1987). The number of leads and lags selected was $q = 3 \approx INT(T^{1/3})$ as proposed in Stock and Watson (1993). *, ** and *** denote significance at 10, 5 and 1% levels, respectively.

APPENDIX B

Table B1. Summary Statistics

Variable	Observations	Mean	Std. Deviation	Min	Max
wages	681	89.92	14.54	41.34	123.83
EPL	672	2.24	0.98	0.256	4.58
EPL individual	672	2.24	0.98	0.256	4.58
EPL collective	672	2.77	0.53	1.625	3.625
Unemployment young	650	28.92	8.01	14.72	45.56
Unemployment old	655	1.19	0.95	0.035	4.496
Female unemployment	670	46.62	4.22	37.5	59.615
Long term	504	8.09	3.41	1.44	14.491
Advanced education	632	23.33	12.11	5.27	61.86
Intermediate education	640	52.53	16.42	11.99	79.16
Basic education	604	19.78	15.52	5.24	74.30
Overall_balance	613	-1.43	5.74	-18.18	38.82
ESSC_100	672	21.02	9.83	5.94	41.81
ESSC_167	672	20.51	9.63	5.94	40.09
ESSC_67	672	21.02	10.01	5.94	43.96
WSSC_100	672	11.24	6.05	0	22.17
WSSC_167	672	10.39	5.69	0	22.17
WSSC_67	672	11.16	6.01	0	22.17
TW_100	672	40.59	7.83	26.65	55.8
TW_167	672	45.13	7.55	32.2	59.14
TW_67	672	36.94	7.55	20.6	51.38
Job-creation	440	0.0069	0.0069	-0.0018	0.0325
Incentives	440	0.030	0.0373	-0.0004	0.167
Rehabilitation	412	0.0059	0.0063	0	0.023
Job-sharing	412	0.0022	0.0048	-0.0008	0.018
Start-up incentives	440	0.0025	0.0042	-0.00045	0.027
Training	440	0.0495	0.0426	0.00047	0.018
Unemployment benefits	464	0.193	0.121	0.0336	0.556

References

Abraham, K. G. (1987), "Help-Wanted Advertising, Job Vacancies, and Unemployment", *Brookings Papers on Economic Activity,* 1, 207–248.

Bassanini, A. and R. Duval (2009), "Unemployment, institutions, and reform complementarities: reassessing the aggregate evidence for OECD countries," *Oxford Review of Economic Policy*, 25 (1), 40–59.

Blanchard, O., and P. Diamond (1989), "The Beveridge Curve", *Brookings Papers on Economic Activity* 1: 1–76.

Blanchard, O. and Wolfers, J. (2000), "The role of shocks and institutions in the rise of European unemployment: the aggregate evidence", *Economic Journal*, 110(462), pp. C1–C33.

Bleakley, H., and J. C. Fuhrer (1997), "Shifts in the Beveridge Curve, Job Matching, and Labor Market Dynamics", *New England Economic Review* Sept to Oct.: 3–19.

Bonthuis, B., V. Jarvis, and J. Vanhala (2013), "What's Going on Behind the Euro Area Beveridge Curve?", ECB Working Paper, 1586, September 2013.

Börsch-Supan, A. H. (1991), "Panel Data Analysis of the Beveridge Curve: Is There a Macroeconomic Relation between the Rate of Unemployment and the Vacancy Rate?", *Economica* 58: 279–297.

Bruggemann, A., P. Donati, and A. Warne (2003), "Is the demand for euro area M3 stable?", ECB Working Paper No. 255.

Darius, R., Mwanza, N., Thomas, A., Vamvakidis, A., Vidon, E. and Vitek F. (2010), "Cross-Cutting Themes in Employment Experiences during the Crisis", IMF Staff Position Note 10/18.

De Mooij, R., and M. Keen (2012), "'Fiscal Devaluation' and Fiscal Consolidation: The VAT in Troubled Times", NBER Working Paper No. 17913.

Detriagiache, E., Engbom, N. and F. Raei (2015), "The Effects of German Labor Market Reforms on Employment and Wages", forthcoming IMF Working Paper

Di Fonzo, T., and M. Marini (2012), "On the Extrapolation with the Denton Proportional Benchmarking Method", IMF Working Paper No. 12/169.

European Central Bank (2002), "Labour market mismatches in the euro area", Occasional paper series, European Central Bank.

Fahr, R., and U. Sunde (2009), "Did the Hartz Reforms speed-up the matching process? A macro-evaluation using empirical matching functions", *German Economic Review*, 10: 3, 284–316.

Fiscal Monitor (2014), "Back to Work: How Fiscal Policy Can Help", International Monetary Fund, October 2014.

Franz, W. (1987), "Hysteresis, Persistence and the NAIRU: An Empirical Analysis for the Federal Republic of Germany", in: R. Layard and L. Calmfors (eds.), The Fight Against Unemployment, Cambridge, Mass. (MIT–Press), 91–122.

Greene, W.H. (2012) Econometric Analysis, Seventh edition, Upper Saddle River: Prentice Hall.

Gregory, A. W. and B. E., Hansen (1996), "Residual-Based Tests for Cointegration in Models with Regime Shifts", *Journal of Econometrics*, 70, 99–126.

Groenewold, N. (2003), "Long-run Shifts of the Beveridge Curve and the Frictional Unemployment Rate in Australia", *Australian Journal of Labour Economics*, Vol. 6, No. 1: 65–82.

Hansen, H. and S. Johansen (1993), "Recursive Estimation in Cointegrated VAR-Models", Institute of Mathematical Statistics Working paper 1, University of Copenhagen.

Hansen, H. and S. Johansen (1999), "Some tests for parameter constancy in cointegrated VAR models", *Econometrics Journal*, 2, 306–333.

Hobijn, B. and Sahin, A. (2012), "Beveridge curve shifts across countries since the great recession", Working Paper Series 2012–24, Federal Reserve Bank of San Francisco.

Hoffman, D. L., R. H. Rasche, and M. A. Tieslau (1995), "The Stability of Long-Run Money Demand in Five Industrial Countries", Journal of Monetary Economics, Vol. 35, No. 2, 317–339.

IMF (2010), Germany: 2010 Article IV Consultation—Staff Report, IMF Country Report No. 10/85.

IMF (2008a), Czech Republic: 2007 Article IV Consultation—Staff Report, IMF Country Report No. 08/39.

IMF (2008b), Republic of Poland: 2007 Article IV Consultation—Staff Report, IMF Country Report No. 08/130.

Jackman R., C. Pissarides and S. Savouri (1990), "Labour market policies and unemployment in the OECD", *Economic Policy* 5, 449 – 490.

Johansen, K. (2004), "Active Labour Market Policy and the Beveridge Curve: Panel data evidence for Norwegian counties", mimeo, Norwegian University of Science and Technology.

Johansen, S., and Juselius, K. (1990), "Maximum Likelihood Estimation and Inference on Cointegration – with Applications to the Demand for Money", *Oxford Bulletin of Economics and Statistics* 52, 169–210.

Klinger, S., and Rothe, T. (2012), "The Impact of Labour Market Reforms and Economic Performance on the Matching of the Short-term and the Long-term Unemployed," *Scottish Journal of Political Economy*, 59:1.

Kugler, A. (2014), "Labor Market Analysis and Labor Policymaking in the Nation's Capital", *Industrial & Labor Relations Review,* 67: 594.

Lutkepohl, H. (1993), "Introduction to Multiple Time Series Analysis." 2nd ed. New York: Springer.

Mehrotra, N. R. and D. Sergeyev (2012),"Sectoral Shocks, the Beveridge Curve and Monetary Policy", mimeo, Columbia University.

Mortensen, D. T. and C. A. Pissarides (1994), "Job Creation and Job Destruction in the Theory of Unemployment", *Review of Economic Studies*, 61, 397–415.

Ng, S. and P. Perron (2001), "Lag length selection and the construction of unit root tests with good size and power", *Econometrica*, 69, 1519–1554. OECD (1999), "Employment Protection and Labour Market Performance" Employment Outlook, chapter 2. OECD, ParisPissarides, C. A. (2010), "Equilibrium in the Labour Market with Search Frictions", Nobel Prize Lecture

Pesaran, M. H. (2007), "A simple panel unit root test in the presence of cross section dependence", *Journal of Applied Econometrics* 22, 265–312.

Stock, J. H. and Watson, M. W. (1993), "A simple estimator of co-integrating vectors in higher order integrated systems", *Econometrica*, 61 (4): 783–820.

Valletta, Robert G. (2005), "Why Has the U.S. Beveridge Curve Shifted Back? New Evidence Using Regional Data," FRB SF Working Paper 2005–25.

Wall, H. J. and G. Zoega (2002), "The British Beveridge curve: A tale of ten regions," *Oxford Bulletin of Economics and Statistics*, 64 (3), 257–276.

Yashiv, E. (2006), "The Beveridge Curve", IZA DP No. 2479.