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Shifts in euro area Beveridge curves and their determinants *

Boele Bonthuis[†] Valerie Jarvis [‡] Juuso Vanhala[§]

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Abstract

This paper analyses euro area Beveridge curves at the euro area aggregate and country level over the past 25 years. Using an autoregressive distributed lag model we find a significant outward shift in the euro area Beveridge curve since the onset of the crisis, but considerable heterogeneity at country level. We test for factors underlying these developments using the local projections method of Jordà (2005). Skill mismatch, high shares of workers in the construction sector, as well as high pre-crisis financial slack and home ownership rates appear strong determinants of outward shifts in Beveridge curves in response to a negative shock. Higher female participation rates mitigate these effects.

Keywords: Beveridge curve, crisis, mismatch, unemployment, labour shortages, vacancies

JEL classifications: J62, J63, E24, E32

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1 Introduction

The Beveridge curve is widely used as a succinct summary of the overall state of the labour market and to distinguish structural shifts from cyclical developments. It traces a negative relationship between unemployment rates and vacancy rates over the course of a business cycle, with low unemployment and high vacancies in expansionary phases and vice versa in contractions. In the initial stages of the global economic and financial crisis, vacancy rates fell sharply, while unemployment rates rose across almost all euro area economies. Since 2009 vacancy rates have recovered somewhat in many countries, but unemployment rates have remained high or kept rising, suggesting outward shifts in Beveridge curves. Such shifts in the Beveridge curve are of particular interest in times of crisis, since they are suggestive of structural changes in the labour market.

This paper analyses euro area Beveridge curves over the past 25 years, at both the aggregate euro area level and at country level, focusing in particular on Beveridge curve developments since the onset of the global financial crisis. Our aim is to identify shifts of Beveridge curves and to isolate salient structural factors influencing these movements. Distinguishing between high unemployment rates that are due to cyclical factors and a lack of labour demand, or to labour market mismatches, has important policy implications.

In the literature, cross-country analysis of euro area Beveridge curves has been limited by the absence of a long and harmonised vacancy series for the euro area and its constituent economies. To address this challenge, we consider two vacancy series: firstly, Eurostat's relatively recent series on euro area job vacancy rates; secondly, the longer European Commission series of employers' perceptions of labour shortages in manufacturing, as used by ECB (2002) and European Commission (2011b).

We first present a graphical depiction of recent Beveridge curve developments using both vacancy series, and illustrate shifts of the curve in a number of euro area countries since the onset of the crisis. This overview also motivates our use of the series of employers' perceptions of labour shortages in manufacturing as a reasonable proxy for vacancies. Both series produce a similar picture of recent labour market developments, and the series correlate well. Additionally, the two concepts are closely related; a larger shortage of labour is likely to be reflected in a high number of unfilled vacancies.

Next, we proceed to the econometric analysis in which we apply an autoregressive distributed lag (ARDL) model to test for statistical significance of observed shifts for both the euro area aggregate and the individual countries since the onset of the global financial and economic crisis. We find a significant shift in the euro area Beveridge curve since the onset of the crisis, but considerable heterogeneity at country level. At the extremes, country level differences include a significant outward shift in the Beveridge curve for Spain, France and Greece, but an inward shift for Germany. We then extend our analysis to a second stage, in order to examine factors underlying the observed developments. A range of country-specific factors — including labour force characteristics, sectoral employment composition and financial conditions — are tested using the local projections method of Jordà (2005). We find evidence for skill mismatch and tentative evidence for sectoral and geographical mismatch. A high share of low skilled workers, a high homeownership rate and a high share of workers (previously) employed in the construction sector tends to shift the Beveridge curve outward in case of a negative shock. A high share of female workers in the labour force on the other hand tends to mitigate these effects.

The Beveridge curve has raised a lot of interest in the literature lately, but with some exceptions (e.g. ECB (2002), European Commission (2011b), Hobijn and Sahin (2012) and Bouvet (2012)), most studies are country specific, in part due to the lack of long and comparable cross-country vacancy series.[1] Our choice of using the European Commission series of employers' perceptions of labour shortages in manufacturing data allows us to do cross-country analysis. Like our analysis, ECB (2002) covers most euro area countries, but that study relates to developments in the 1990s whereas we focus on the Great Recession. Hobijn and Sahin (2012) provide a cross-country analysis for a number of OECD countries, including some euro area countries, however their analysis does not cover all euro area countries.

Our analysis builds on a number of earlier studies. Borsch-Supan (1991) tests for structural shifts in unemployment as a consequence of recessions in a panel of German federal states from 1963 to 1988. Shift periods are identified by visual inspection of regional Beveridge curves, so as to specify shift

[1] There is an increasing number of recent studies that estimate matching functions and Beveridge curves for the U.S., including Barnichon et al. (2010) Barnichon and Figura (2011), Daly et al. (2011), Elsby et al. (2010).

dummies, which are then tested for statistical significance. Wall and Zoega (2002) use a similar, though two-stage, approach; first identifying shifts in the Beveridge curve, before trying to explain the shifts by means of institutional variables. Examining Beveridge curves and its shifts for Australia, Groenewold (2003) suggests coefficients of a similar magnitude to Wall and Zoega (2002) and confirms the importance of worker characteristics as a major determinant of increased structural unemployment. Our ARDL specification is a dynamic variation of the basic OLS model originally applied to the United States by Valletta (2005), who estimates a reduced form equation using a similar method to Borsch-Supan (1991). Valletta (2005) does not fully isolate the structural shifts in Beveridge curve movements, since Beveridge curves are able to move back and forth from year to year, because of the use of yearly dummies. Our method restricts the movements to specific — and rather more protracted — periods. To reproduce the dynamics of the Beveridge curve accurately we augment these models into an autoregressive distributed lag model. In the second step of our analysis, we investigate what has driven the shifts of the euro area Beveridge curves using the local projections method of Jordà (2005) where we apply specifications developed in Teulings and Zubanov (2010).

The paper proceeds as follows. Section 2 briefly describes the data and presents a graphical depiction of developments of the euro area Beveridge curve(s) over the past two decades. In section 3 we examine the statistical significance of observed shifts using an ARDL-model. Section 4 extends the analysis to a second stage, using the local projections method, to examine factors underlying the observed shifts. Section 5 concludes.

2 Overview of Beveridge curve developments

2.1 The data

The basis for our analysis are quarterly data on unemployment and vacancy developments. To ensure cross-country comparability, we use Eurostat's harmonised unemployment rate for the euro area countries and the aggregate. Since official data on job vacancy developments are still somewhat embryonic, two vacancy series are considered: firstly, Eurostat's job vacancy rates for the euro area

as a whole;[2] secondly, the longer European Commission series of employers' perceptions of labour shortages in manufacturing. These data are taken from the European Commission's regular Surveys of Business Confidence - specifically the aggregated responses from the question relating to employers' perceptions of labour shortages as limits to business.[3] Advantages of these data over Eurostat's job vacancy rates stem from the longer availability of the series (for most countries, from at least 1990) and their seasonally-adjusted form. These data have a very similar cyclical pattern as Eurostat's job vacancy rates, correlating well with contemporaneous vacancy movements in the Eurostat series.

In our analysis of the drivers of the Beveridge curve shifts we use data on sectoral, age, skill and gender (un-)employment figures. In an attempt to isolate the impact of financial factors on labour market outcomes, we assess also the impact of non-performing loans (using data from the IMF) and the inverted financial shortage index of the European Commission series of employers' perceptions of financial shortages in manufacturing (European Commissions' Surveys of Business Confidence) as a limit to business as a measure of financial slack.

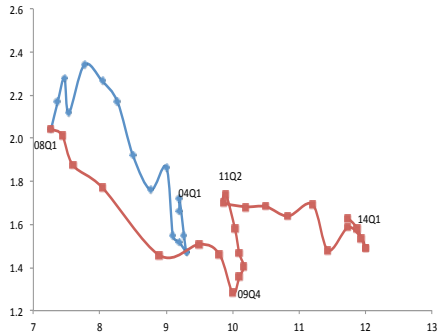
2.2 Beveridge curve developments in the euro area

Figure 1(a) shows developments in the aggregate euro area Beveridge curve since 2006Q1 on the basis of Eurostat job vacancy data. The counter-clockwise movements of the pre-crisis observations trace the typical business cycle pattern of falling unemployment as vacancies increased, thus tightening the labour market. As the recession took hold, the vacancy rate fell sharply and unemployment increased strongly, represented by a south- easterly movement in the Beveridge coordinates. This pattern continued even after the resumption of economic growth (from 2009Q3). However, following the partial recovery in the aggregate euro area vacancy rate, the unemployment rate has not declined.

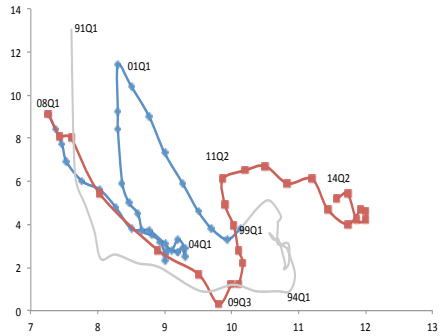
[2] Although job vacancy data are available from Eurostat since 2006Q1, these data are not fully harmonised across countries (e.g. cross-country sectoral and coverage differences).

[3] See European Commission (2011a). Three labour shortages series are available, covering manufacturing, construction and services. We use labour shortages for manufacturing, since (a) this is the longest of the series and (b) has been used extensively in the literature (see, for instance, ECB (2002), European Commission (2011b)). Composite indexes of manufacturing, services and construction labour shortages render largely similar results. (For a comparison of the co-movements between the official euro area vacancy rates and employers' perceptions of labour shortages, see Figure 9 in the appendix).

(a) Beveridge curve for the euro area



(b) Beveridge curve for the euro area, using labour shortages



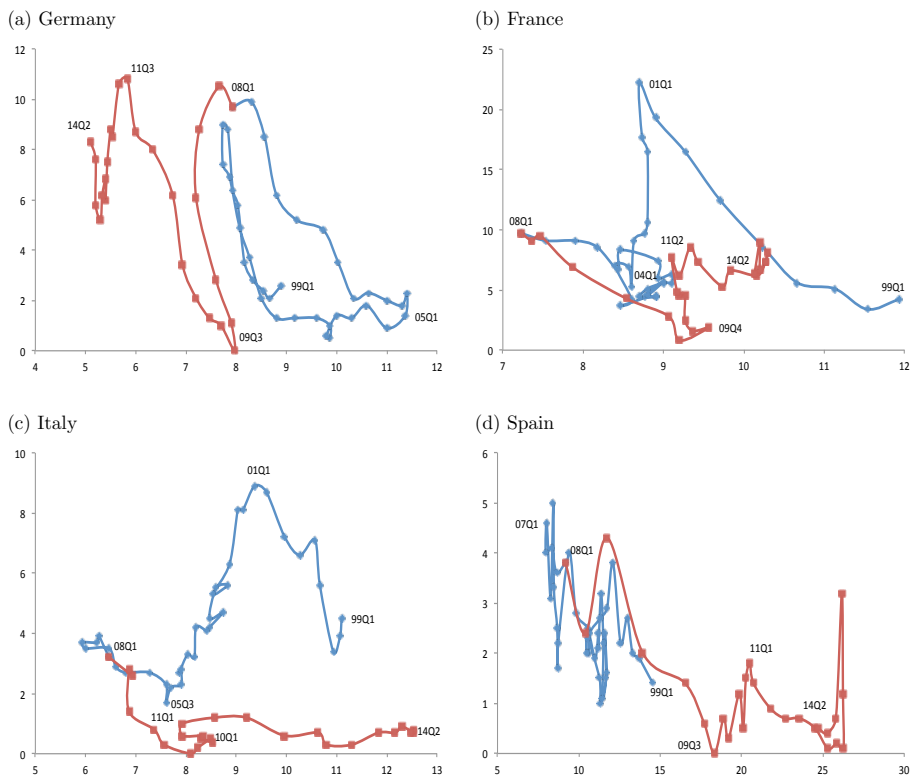
91Q1 - 99Q1 (——), 99Q1/04Q1 - 08Q1 (——), 08Q1-14Q2 (——)
x-axis: unemployment rate (%);
y-axis: (a) Eurostat vacancy series (%); (b) labour shortages (%)
Sources: Eurostat, European Commission

Figure 1: Movements of the euro area Beveridge curve

Figure 1(b) makes use of the time series on labour shortages to trace the euro area Beveridge curve since 1990. This suggests that, following an outward shift in the Beveridge curve in the late 1990s, over the course of much of the first decade of economic and monetary union (EMU), euro area unemployment appears to have become considerably more responsive to vacancy developments, resulting in an inward shift in the euro area Beveridge curve during the middle years of the 2000s (blue lines in Figure 1(b)). This longer series, however, suggests a clear deviation from the previous unemployment-vacancy relationship since the onset of the crisis (2008Q1), alluding to growing structural problems in some euro area labour markets. However, a salient feature of euro area labour markets in the recent period has been the growing degree of cross-country heterogeneity.

To understand better the possible sources of the apparent shift in euro area Beveridge curves, Figure 2 shows developments for the four largest euro area economies since 1999, again using labour shortages as a proxy for vacancy developments.[4] For Germany, the Great Recession had a relatively short-lived

[4]For a more detailed elaboration of the various country-level developments, see the country sections of the earlier paper entitled "What's going on behind the euro area Beveridge Curve(s)?" by the same authors (Bonthuis et al. (2013)).



99Q1 - 08Q1 (——), 08Q1-14Q2 (——)
x-axis: unemployment rate (%);
y-axis: labour shortages (%)
Sources: Eurostat, European Commission

Figure 2: Movements of the Beveridge curve for the four largest euro area economies

impact on the labour market. The relatively short-lived fall in the vacancy rate following the onset of the Great recession (in 2008Q2) led to very little increase in unemployment in Germany — as has been widely studied in the literature.[5] Since the start of the recovery, the German unemployment rate has continued to decline as vacancies have increased modestly, resulting in suggestions of an inward shift in the Beveridge curve over the crisis period. Meanwhile in France, the crisis looks to have had a strong and considerable adverse reaction. Thus, despite some rebound in labour demand since the depths of recession were reached in 2009, the unemployment rate in France remains considerably above its pre-crisis level, effectively undoing much of the progress made over the course of EMU. The pattern is similar in Italy, though low levels of labour shortages and the long and sluggish reaction speeds evident in the Italian Beveridge curves render clear conclusions difficult to draw.[6]

Developments in Spain, on the other hand, are clearly less ambiguous. While vacancy rates and reports of labour shortages remain close to their series lows, the exceptionally strong rise in the unemployment rate (an increase of over 10 percentage points since 1999 — though similar to rates seen in the early 1990s), together with the strong sectoral dimension of job losses following the bursting of the housing bubble are all highly suggestive of a deep and significant increase in structural mismatch in the Spanish labour market.

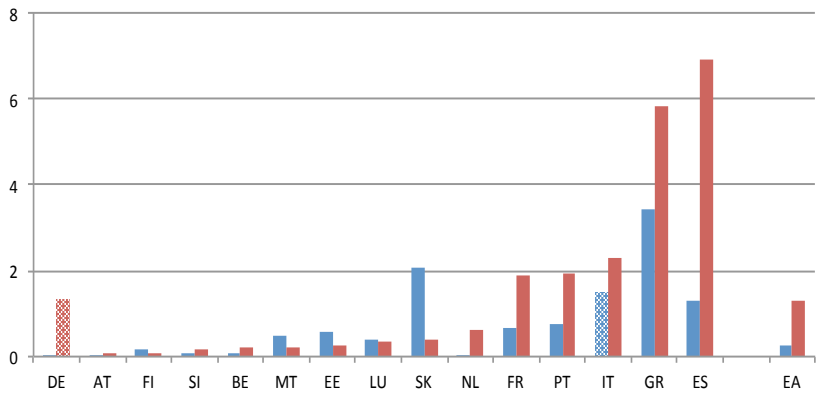
Figure 3 summarises the full effect of Beveridge-type elasticities for all euro area countries for the pre-crisis period and since the onset of the financial crisis.[7] Two countries — Germany and Italy — have seen periods in which labour market tightness drop slightly in combination with a decline in unemployment. For Germany this happened since the start of the Great Recession, while Italy experienced a similar move prior to the crisis (see checkered observations for Germany and Italy in Figure 3).

This chart shows that, on average euro area unemployment rose slightly

[5] A prominently cited explanation has been the private sector's strong reliance on publicly-funded short-time working schemes (e.g. Cahuc and Carcillo (2011)). Other explanations have been cited as well; Burda and Hunt (2011) claim that in the 2005–2007 expansion, firms hired significantly less than expected given the extent warranted by GDP and wages, moderate wage growth in recent years as well as the Hartz reforms are frequently quoted as having played an important role.

[6] See Scarpetta (1996), Bonthuis et al. (2013) and OECD (2014).

[7] Figure 10 in the Appendix shows Beveridge curve profiles for the remaining euro area countries



2002 - start crisis (■), start crisis - 2013 (■).
Elasticity defined as : $|\Delta UR/\Delta LS|$. Both in percentage points.
Germany (crisis - 13) and Italy (02 - crisis) have both declining labour shortages and declining unemployment.
Sources: Eurostat, European Commission, own calculations.

Figure 3: Summary of Beveridge curve developments

more than labour shortages fell. More importantly, it shows that the reaction of unemployment to changing labour shortages during the crisis was much larger than during the pre-crisis period. The chart also summarises the considerable heterogeneity in unemployment responses to subdued labour shortages since the 2008 recession. For all countries labour shortages and vacancies remain below their pre-crisis levels, though to markedly differing degrees. Unemployment reactions have varied significantly, with disproportionately large elasticities in Spain, Greece, Italy, Portugal and France in stark contrast to the lower elasticities of Malta, Belgium, Slovenia, Finland and Austria despite broadly similar proportional declines in labour shortages. Moreover, most of the countries on the right have experienced large increases of elasticities compared to the pre-crisis situation, revealing clear candidates of suspected outward movements of the Beveridge curve.

3 Econometric analysis of euro area Beveridge curve movements

To test for statistical significance of the observed shifts, we apply an autoregressive distributed lag (ARDL) model to a basic Beveridge curve specification:[8]

$$U_t = \beta_0 + \sum_{i=1}^{p} \beta_{i,1} U_{t-i} + \sum_{j=0}^{q} \beta_{j,2} LS_{t-j} + \beta_3 D_t^{cri} + \beta_4 D_t^{emu} + \epsilon_t \qquad (1)$$

where U_t is the official Eurostat harmonised unemployment rate and LS_t is the labour shortages variable serving as proxy for vacancy developments.[9] To test the impact of the crisis on euro area Beveridge curves, we incorporate a dummy variable, D^{cri} (taking a value of one from the first of at least two consecutive quarters of negative quarter-on-quarter GDP growth after 2007 to the end of the series, this way identifying the period from the start of the crisis until the end of the sample).[10] Finally, to identify possible shifts in the Beveridge curve over the course of monetary union, a dummy variable, D^{emu}, (taking a value of 1 at each country's entry into EMU) is used. Therefore, in our model we effectively allow for three different Beveridge curve positions; our baseline 1990s, the EMU period and the crisis period.

The model is estimated on quarterly data covering the period 1990Q1 to 2014Q1.[11] So as to improve the comparability of the Beveridge curve parameter estimates across countries (by taking specific account of the typical reported degree of variability in labour demand over the respective business cycles), the labour shortages data were mean-adjusted. Moreover, country-specific differences in lag structure of unemployment adjustment were taken into account (by allowing p and q to differ across countries, according to country-specific values suggested by AIC and BIC information criteria). This specification produces stationary results, stable ($\sum_i \beta_{i,1} < 1$) and downward-sloping ($\sum_j \beta_{j,2} < 0$)

[8] The simplest specification used here follows the spirit of earlier studies by Borsch-Supan (1991), Wall and Zoega (2002), Groenewold (2003), Valletta (2005) and, more recently, the European Commission (2011b).

[9] For an analysis of the use of vacancy data instead of labour shortages see Bonthuis et al. (2013)

[10] For country regressions, all crisis periods are country-specific.

[11] Data for France and Finland from 1992, for Malta from 2004 and for Slovakia from 2000. The labour shortages series for Ireland stops in 2008. Earlier observations appear exceptionally volatile and outside the range of all subsequent observations in these series.

Beveridge curves for most countries.[12]

Table 1 summarises the main results for the four biggest euro area economies as well as the euro area aggregate. Beginning with the results at the euro area aggregate level (column 1), as anticipated, the sum of coefficients on the lagged unemployment rate is large and highly significant, suggesting considerable persistence in euro area unemployment. As expected, the labour shortages variable, LS_t, displays the necessary negative coefficient, confirming the well-behaved inverse relationship between unemployment and vacancies, which underlies the Beveridge curve.

Turning to the dummy variables, EMU looks to have had a significant and favourable impact on euro area labour markets, coinciding with an inward shift in the euro area Beveridge curve. To some extent, this inward shift could be a result of structural labour market reforms which accompanied EMU membership in several euro area countries. As regards the impact of the crisis, D_{cri} is both positive and highly significant, suggestive of a strong outward shift in the euro area Beveridge curve since the onset of the recession.

Turning to the results of the four largest euro area countries, the model performs well for Germany, Spain and France, with the expected signs on all variables. The coefficient on the crisis dummy for Germany is strongly significant but negative, suggesting a coincident apparent inward shift of the German Beveridge curve since the crisis and suggestive of an ongoing improvement in labour market matching in recent years. This inward shift, however, is more likely to reflect the implementation of the structural labour market reforms (Hartz reforms) undertaken from the mid-2000s in Germany, than the impact of the crisis. Also, the widespread use of short time working schemes ($Kurzarbeit$) and working time accounts have played a role in containing adverse labour market effects of the crisis.

For France and Spain, meanwhile, the model suggests strong and significant

[12] Only for Malta a Beveridge curve with stationary standard errors cannot be found, additionally its Beveridge curve is not downward sloping. Cyprus, Ireland, Italy, Luxembourg and Slovakia have stability issues since the sum of the lagged dependent variables is not significantly different from unity. For Cyprus, Germany, Ireland, Luxembourg, the Netherlands and Slovakia it is not immediately clear that their Beveridge curve is downward sloping (see bottom two rows in table 1 and 2). However, both Germany and the Netherlands have significantly downward sloping Beveridge curves if we test the long run parameter on labour shortages $\sum LS/(1-\sum U)$. For robustness checks see Bonthuis et al. (2013)

Table 1: Beveridge curve estimation

Dependent var.: U_t	(1) EA	(2) DE	(3) ES	(4) FR	(5) IT
U_{t-1}	1.742***	1.967***	1.612***	1.300***	0.992***
	(0.101)	(0.105)	(0.077)	(0.092)	(0.016)
U_{t-2}	-0.919***	-1.332***	-0.684***	-0.407***	
	(0.202)	(0.191)	(0.068)	(0.085)	
U_{t-3}	0.364	0.332***			
	(0.221)	(0.103)			
U_{t-4}	-0.537***				
	(0.201)				
U_{t-5}	0.307***				
	(0.098)				
LS_t	-0.014**	-0.035***	-0.047	-0.012***	-0.033***
	(0.007)	(0.011)	(0.041)	(0.004)	(0.012)
LS_{t-1}		0.022**	-0.027		
		(0.011)	(0.044)		
LS_{t-2}			0.040		
			(0.044)		
LS_{t-3}			-0.086**		
			(0.041)		
D_t^{emu}	-0.076***	0.017	-0.376***	-0.177***	-0.175***
	(0.027)	(0.032)	(0.103)	(0.047)	(0.063)
D_t^{cri}	0.152***	-0.091**	0.769***	0.153***	0.259***
	(0.037)	(0.041)	(0.163)	(0.048)	(0.078)
$Cons.$	0.425***	0.277***	1.217***	1.112***	0.140
	(0.109)	(0.100)	(0.260)	(0.223)	(0.167)
$Obs.$	98	91	98	98	98
$Adj-R^2$	0.994	0.996	0.997	0.972	0.981
$P(\sum U \geq 1)$	0.000	0.004	0.000	0.000	0.315
$P(\sum LS \geq 0)$	0.037	0.068	0.033	0.003	0.009
$P(\frac{\sum LS}{1-\sum U} \geq 0)$	0.013	0.018	0.001	0.000	0.323

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1
Sample period: 1990Q1-2014Q1

outward shifts in the Beveridge curve. For France, this result appears to confirm that the recent outward movement seen in the graphical representations of the French Beveridge curve (in Figure 2). However, it should be noted that this outward shift merely offsets the inward shift exhibited over the course of the EMU. Results for Spain, meanwhile, suggest that the crisis has led to a substantial shift in that country's unemployment-vacancy relationship. The significance of the positively-signed shift dummy D_{cri} is strongly suggestive of a significant increase in the degree of mismatch since the onset of the crisis for Spain.

The model does not perform well for Italy. All parameters are estimated with the correct signs, but there is an almost unit root on the lagged dependent variables. This reflects the typically sluggish adjustment of the Italian labour market noted earlier. Overall the lack of a well-behaved Beveridge curve relationship for Italy means that the suggestion of an outward shift of the Italian Beveridge curve since the onset of recession should be viewed with caution.

Analysis of the largest euro area economies suggests strong evidence of definitive Beveridge curve shifts in two and possibly three of the four biggest euro area labour markets. However, this is not the general picture for the euro area. Table 2 in the appendix shows that only two of the 13 remaining countries — Greece and the Netherlands — have any suggestion of an outward shift in their respective Beveridge curves (though the Beveridge curve for the Netherlands is not particularly well-behaved).[13]

4 What drives shifts in euro area Beveridge curves?

For policy purposes, it is not sufficient to know whether shifts in the Beveridge curves are evident, but rather to understand what is driving those shifts. In this section we investigate the role of labour force characteristics, sectoral composition as well as financial factors in driving outward shifts in euro area Beveridge curve(s) using the local projections method of Jordà (2005) augmented with specifications developed in Teulings and Zubanov (2010). Institutional variables

[13] The estimate for the Netherlands does not yield a downward-sloping Beveridge curve with the desired statistical significance. However, the long run parameter on labour shortages $LS_t/(1-\sum U_{t-i})$ is significant at the 5% level.

were tested in our analysis but robust results were not found.[14]

We start with a Beveridge curve specification similar to section 3 using the local projections method proposed by Jordà (2005):

$$U_{c,t+k} = \beta_{c,0} + \sum_{i=1}^{p} \beta_{ik,1} U_{c,t-i} + \sum_{j=0}^{q} \beta_{jk,2} LS_{c,t-j} + \sum_{l=0}^{r} \beta_{lk,3} D_{c,t-l} + \epsilon_{c,t} \quad (2)$$

in which $D_{c,t}$ takes the value of 1 at the time of the shock but is 0 otherwise, $\beta_{c,0}$ is the country fixed effect (we ignore the EMU dummy for the moment). For each period k following the crisis we can estimate this equation forward, obtaining the impulse response function described by the parameter $\beta_{0k,3}$. However, as Teulings and Zubanov (2010) note, the forecast k periods ahead will not only be influenced by crises that occurred before or at period t but also by any crisis occurring between t and the forecast horizon k. A similar argument applies to the labour shortage variable. This is of particular importance in our analysis since rising unemployment as such does not necessarily constitute an outward shift of the Beveridge curve: if vacancies drop as well, this represents simply a movement along a given Beveridge curve towards the extremes. We follow Teulings and Zubanov (2010) by retaining all manifestations of the crisis variable up to period k. Additionally, we will include labour shortages up to period k:

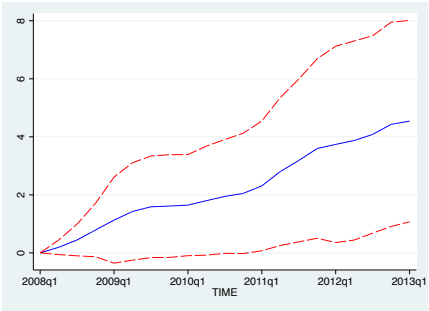
$$U_{c,t+k} = \beta'_{c,0} + \sum_{i=1}^{p} \beta'_{ik,1} U_{c,t-i} + \sum_{j=0}^{k+q} \beta'_{jk,2} LS_{c,t+k-j} + \sum_{l=0}^{k+r} \beta'_{lk,3} D_{c,t+k-l} + \epsilon_{c,t} \quad (3)$$

Because we account for the change in the labour shortages, the projection should not be interpreted as an impulse response function, rather it should be considered as a *conditional* impulse response (or, more precisely, a deviation from an out of sample forecast).[15]

To determine which sample of countries and time period to use in our panel we test for a common slope across countries (see results in table 3 in

[14] Often institutional variables do not work well in econometric analyses - due, in large part, to data limitations, such as: short and infrequent series; the inherent need for heavy synthesis of complex cross-country indicators in very different institutional settings; lack of cross-country variation and lack of temporal variation. Given these and associated problems, it was difficult to include institutional features directly in our econometric analysis. For an extended discussion of institutional variables in a Beveridge curve analysis see Bonthuis et al. (2013).

[15] We estimate the errors using cluster robust errors as is done in Teulings and Zubanov (2010).



Local projection (——), 95% confidence interval (- - -)

Figure 4: Baseline result

the appendix). For the entire sample starting in 1990 we find that the null-hypothesis of poolability is rejected for all euro area countries, all countries with a significantly downward sloping Beveridge Curve in the long run (i.e. $P(\sum LS/(1-\sum U) \geq 0) < 0.05$) and all original euro area countries with a downward sloping Beveridge Curve.[16] Restricting the sample period to the EMU period improves the results for countries with a downward sloping Beveridge Curve, particularly if we restrict this sample to the original euro area countries. We therefore restrict ourselves to the EMU period (which allows us to exclude the EMU dummy) and estimate the projections using only the sample of original euro area countries yielding downward-sloping Beveridge Curves — i.e., Austria, Belgium, Germany, Spain, Finland, France, Greece, the Netherlands and Portugal.[17] Several of these countries — Greece, Ireland, Portugal and Spain — were subsequently subject to intense financial stress, resulting in eventual reliance on international aid programmes, and are henceforth referred to collectively as the "stressed" economies. As another robustness check we use the local projection method of Jordà (2005) directly; excluding contemporaneous observations of the crisis and labour shortages from the projections.

Figure 4 shows the results of the local projections method for the baseline crisis dummy with a 95% confidence interval using equation 3. We observe a persistent and significant rise in the unemployment rate — corrected for the vacancy rate — which is consistent with the shift of the euro area aggregate

[16] These countries also have stable Beveridge curves $P(\sum U \geq 1) < 0.05$.

[17] We find however that our results are robust to including Estonia and Slovenia.

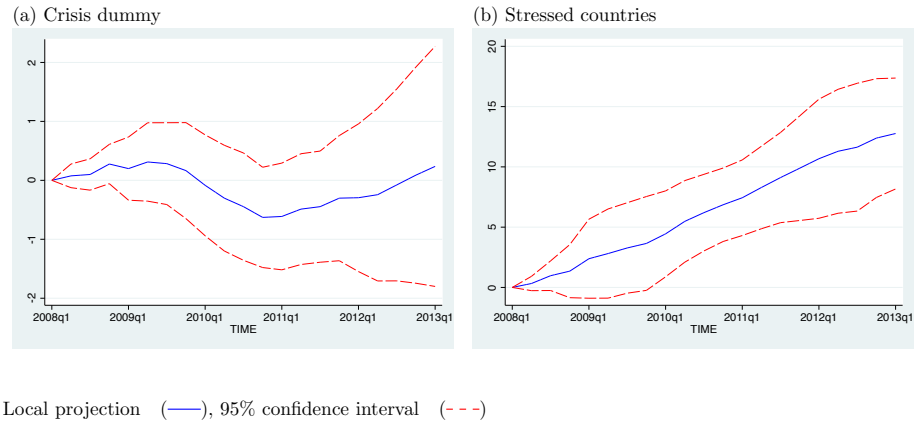


Figure 5: Stressed vs. non-stressed

Beveridge curve in section 3. This effect becomes significant in 2011. However, there is still tentative evidence of a considerable long run effect of the crisis on unemployment. Splitting the countries between two distinct groups of stressed economies (containing Spain, Portugal and Greece) and the rest (Austria, Belgium, Germany, Finland, France and the Netherlands) suggests a strong dichotomy. While the whole sample does not seem to shift outward the stressed countries exhibit a large and significant outward shift (see Figure 5).

Turning to the drivers behind the Beveridge curve shifts we follow for a large part Bernal-Verdugo et al. (2013). Rewriting equation 3 as:

$$U_{c,t+k} = \beta''_{c,0} + \sum_{i=1}^{p} \beta''_{ik,1} U_{c,t-i} + \sum_{j=0}^{k+q} \beta''_{jk,2} LS_{c,t+k-j} + \sum_{l=0}^{k+r} \beta''_{lk,3} D_{c,t+k-l} + \sum_{l=0}^{k+r} \beta''_{lk,4} D_{c,t} N_{c,t} + \epsilon_{c,t+k} \tag{4}$$

in which $N_{c,t}$ is a matrix with variables influencing the position of the Beveridge curve expressed as deviation from the euro area aggregate of which we take the pre-crisis four quarter average.[18] To test for the effect of these variables during the crisis we interact them with the crisis dummy.[19] This way we can compare the impact of the crisis (reflected in the simple crisis dummy) on the position

[18] This means for factor n we take: $(\sum_{i=0}^{3} n_{c,t-i} - \sum_{i=0}^{3} n_{ea,t-i})/4$. This way we assure that we are not picking up a one off spike in the data. For yearly data we pick the value of the year in which the crisis starts.

[19] Most of these variables are relatively stable throughout our sample which is why we do

of the Beverige curve with features most likely to influence the position of the Beveridge curve (reflected in the interaction term). Since the interaction term deviates from zero only at crisis impact we can exclude the possibility of reverse causality; only the pre-crisis values of our drivers influence the position of the Beveridge curve.

4.1 Labour force characteristics

Strong increases in unemployment have been heavily concentrated among the low skilled and young people in many euro area countries. Furthermore, the strong increase in female participation in many countries over the last decades seem to have mitigated the adverse effects of the crisis somewhat. In figure 6 we plot the projections for the baseline crisis dummy and different worker characteristics. The results in Figure 6 confirm that labour force composition had significant impact on the outward shift of a country's Beveridge curve over the crisis period.

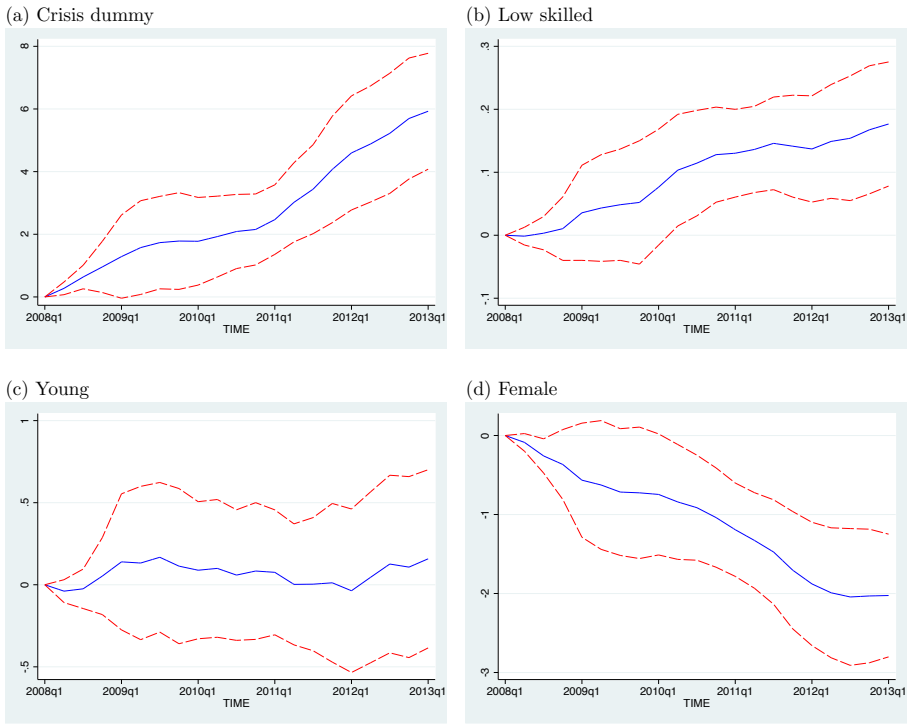
Higher pre-crisis proportions of low-skilled in the labour force — defined as the number of low skilled (employed and unemployed) divided by the total labour force — seem to produce a significant and persistent outward shift of a country's Beveridge curve.[20] One possible explanation is that sectors with a large amount of low skilled workers were especially hard hit during the crisis (for instance construction and to a lesser extent manufacturing). Restructuring of these sectors and difficulties in reallocating labour to other sectors can lead to permanent losses in employment.

The record level of youth unemployment in many euro area countries raises the question of the influence of the age distribution of the labour force on the Beveridge curve. However, in the local projections method, the pre-crisis proportion of young in the labour force does not show a significant effect.[21] Thus, it seems that although young people in many countries may have been particularly hard hit by the Great Recession, this is not to say that a younger average labour force is likely to increase (or reduce) the likelihood of structural mismatch, sim-

not include them as separate variables in our main analysis since the cross country differences are already picked up by the country fixed effects, however, we do include them separately as a robustness check and find qualitatively the same results.

[20] Low skilled is defined as having attained up to lower secondary education. Countries with a high share of low skilled are Spain, Portugal and Greece.

[21] This result holds even if we control for sectoral composition effects.



Local projection (——), 95% confidence interval (- - -)

Figure 6: Labour force characteristics

ply that it reflects the higher volatility of youth unemployment (which tends to rise strongly in recessions but also falls more rapidly than unemployment rates among older workers).[22]

High shares of women participating in the labour force on the other hand seem to shift the Beveridge curve inward (countries with a high share of female workers include Portugal, France and Finland). One potential explanation is that the crisis has mainly hit male dominated sectors, whereas public sector employment - where women are typically more strongly represented - has suffered smaller losses. Furthermore, economies with higher female participation are more likely to keep a shock to consumption to a minimum. For households in which income is mainly provided by one of the members of the household a spell of unemployment is likely to significantly reduce consumption, whereas in

[22]This effect can be stronger or weaker depending on the movements into and out of education.

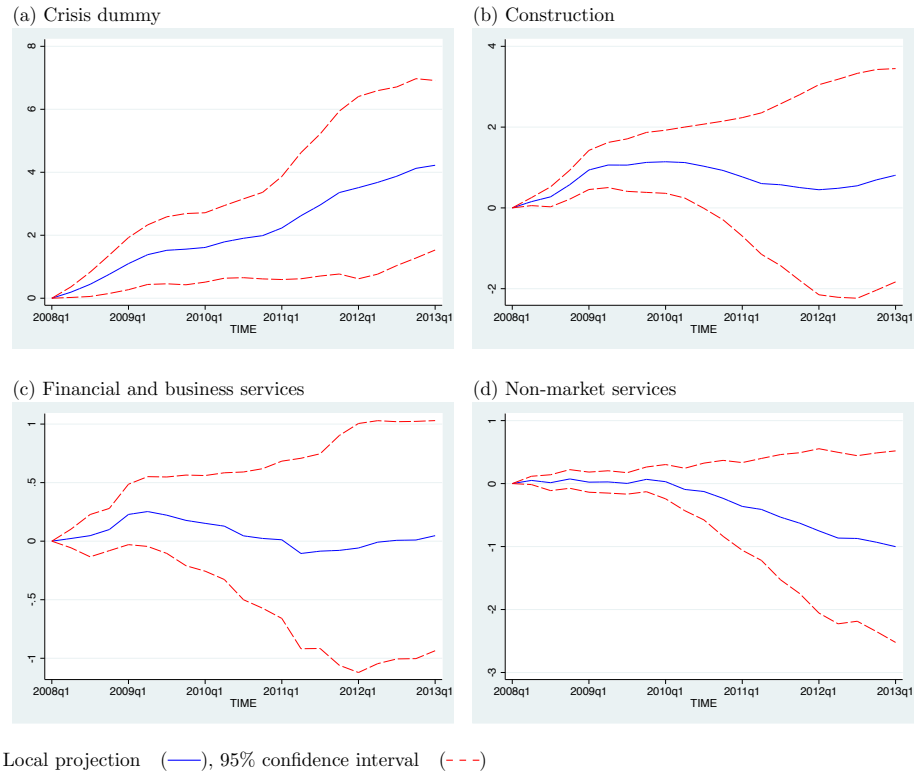


Figure 7: Sectors

a dual-earner household the effects will be dampened.

However, including these three labour force composition indicators does not render the long term effect of the crisis dummy insignificant. The "unexplained" part of the rise in unemployment is still present.[23]

4.2 Sectoral mismatch

To shed light on the extent to which sectoral developments were a key driver of the observed outward shifts (whereby displaced workers from one sector were not able to reallocate to employment in alternative sectors), we extend our analysis

[23] One explanation for this could be the fact that the other variables are expressed as deviations from the euro area aggregate. We have shown that the euro area as a whole exhibits an outward shift, since the effects of the other variables are fixed to be zero for the euro area, the overall shift of the Beveridge curve needs to be picked up by the simple crisis dummy.

using shares of employment by sector.[24] Using the NACE2 sectoral breakdown, we distinguish three broad sectors, construction, financial and business services, and non-market services. This means that our baseline category in this case is the rest of the economy dominated by the largest sector, trade and transport.

Including other sectors were tested but not found to produce significant results. The pre-crisis proportion of workers employed in industry (excluding construction) does not seem to have a significant effect on the position of the Beveridge curve (not shown). As Burda and Hunt (2011) point out, it could be that industry (at least in Germany) in the pre-crisis period employed significantly less workers than the growth in value added would typically warrant. This would mean that the slack in the industrial labour market was low, leaving less reason to reduce employment. Moreover, it is likely that the employment elasticities may be significantly lower in industry (excluding construction) than in other sectors, given the typically higher capital intensity of the manufacturing sector. Some corroboration for this view is provided in Anderton et al. (2014), who find that differences in employment elasticities across sectors help explain a large part of the unemployment reaction across the crisis.

The construction sector stands out as particularly important. Heavy job losses in the construction sector have been a common feature of many euro area labour markets since the start of the crisis. Across the euro area as a whole, construction employment declined by roughly 7% year-on-year — over twice the rate of contraction as in the economy as a whole — at the depths of the crisis; in some countries, losses were higher still (for instance in Spain where construction constituted almost 14% of employment in the pre-crisis period). Moreover, employment contractions have tended to be rather longer-lived in construction — as job losses began rather earlier than in other sectors and, in some countries have been particularly persistent, resulting in construction employment levels well below their pre-crisis peaks in several euro area economies. Part of the downsizing observed is likely to be permanent, reflecting some correction to previously over-expanded construction sectors in some euro area economies. Displaced construction workers are unlikely to be readily absorbed into other activities with ease. This, coupled with the generally low-skill nature of construction work, are clear prerequisites for the long lasting significantly positive

[24] The strong sectoral dimension of the recent crisis has been well documented. See, for instance, ECB (2012).

outward shift of the Beveridge curve (see Figure 7). This effect seems to fade out after roughly three years.

As the ensuing crisis began with the global credit crunch, the financial sector has been at the core of the crisis and, in many respects, a key driver of the observed adjustments across many euro area economies. At the depths of the crisis, both the financial services sector and business services sector suffered strong employment contractions. However, in general, the losses in these sectors were both shallower and shorter- lived than in construction. Moreover, given the typically higher average skill levels of those (formerly) engaged in these sectors, they were probably rather easier to re-deploy than their lower-skilled construction counterparts. These reasons are likely to explain why empirically the share of employment in finance and business services do not seem to have a significant impact on the position of the Beveridge curve.

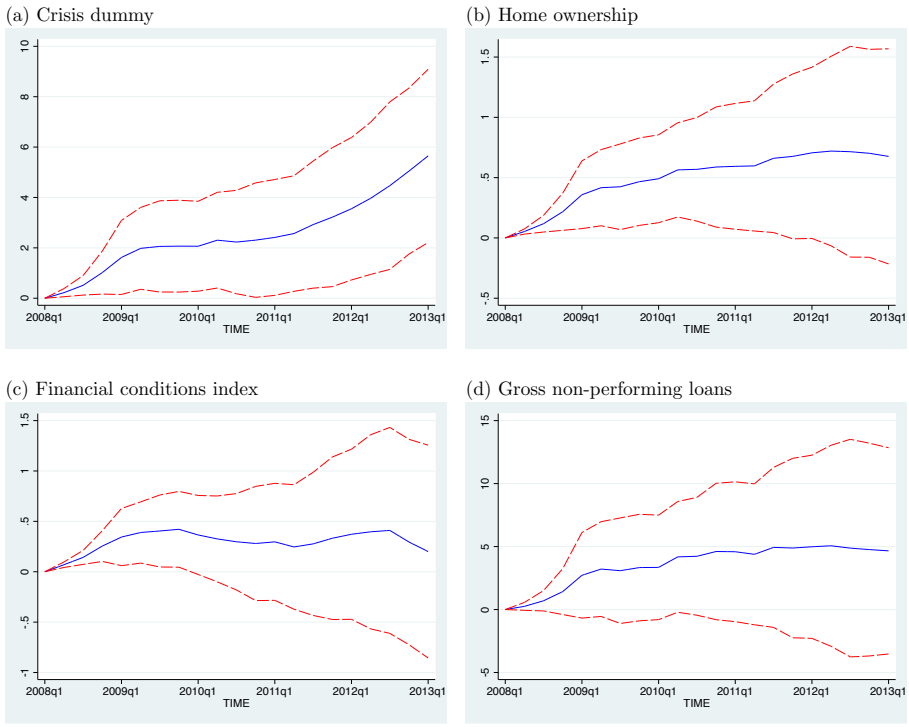
Finally, downsizing in the typically large public sectors of many euro area economies might be reasonably expected to lead to a potential outward shift of euro area Beveridge curves. However, for the period of this investigation, no such result is found. This is not to say that, in time, such a result will prove significant, but rather that, for many of the countries under investigation, significant downsizing of the public sectors did not occur till well into the second phase of the crisis, following the emergence of sovereign debt concerns in some euro area economies. As a result, the impact of public sector downsizing was not evident at the start of the crisis and is likely to have generated too few subsequent observations to yield robust empirical results.

As with the labour force characteristics, including these three sectoral composition indicators does not render the long term effect of the crisis dummy insignificant.

4.3 Financial conditions

In an attempt to assess the impact of financial variables on labour market outcomes, finally we regress observed Beveridge curves developments on rates of home ownership and a variety of financial variables as a first attempt to isolate the impact of the credit crunch itself on labour market outcomes.

Figure 8 shows that a high pre-crisis rate of home ownership appears to have a significant and positive effect on the position of the Beveridge curve. One explanation — in common to the findings of several US studies — is that,



Local projection (——), 95% confidence interval (- - -)

Figure 8: Financial conditions

following a sharp revaluation of asset prices (including domestic real estate) following the credit crunch and the bursting of construction bubbles in several euro area economies, homeowners in negative equity (or those whose homes were subsequently revalued to market rates lower than they had paid) were left unable (or unwilling) to move to a less severely hit areas.[25]

To attempt to evaluate the effect of pre-crisis financial conditions, we use the European Commission series of employers' perceptions of financial shortages in manufacturing (European Commissions' Surveys of Business Confidence (European Commission (2011a)) as a limit to business, inverted so as to provide an approximate metric of the ease with which credit can be procured (or alternatively, of financial slack).The local projections method using this indicator

[25]It is well documented that homeowners are unwilling to sell their house below the price at which they bought it even if it is considered the market price — see for instance Genesove and Mayer (1997, 2001); Ferreira et al. (2010) and Goetz (2013).

shows a positive and significant effect on the Beveridge curve, suggesting that over-heated financial markets before the crisis have tended to amplify the unemployment consequences of the downturn. One potential explanation is that firms that have received finance "too easily" may have "overhired" during the boom, and have thus been forced to rationalise more quickly during the downturn. However, the effect is not persistent.[26]

As with the previous two tests, including financial conditions in the local projections method does not fully explain the long term increase in unemployment. The unexplained effect of the crisis dummy is significant throughout our estimated period.

5 Conclusion

The labour market consequences of the recent crisis have been heterogeneous across countries and sectors in the euro area. Overall, there are risks that the rise in euro area unemployment over the crisis may become persistent both at the aggregate euro area level and for some of the member economies. Whether the high unemployment rates are due to cyclical factors and a lack of labour demand, or to structural factors such as labour market mismatches, has important policy implications. In this paper we find evidence for the latter.

We find a significant shift in the aggregate euro area Beveridge curve since the onset of the crisis, suggestive of a marked increase in labour market mismatch over the subsequent period. At country level, however, there is considerable heterogeneity. At the extremes, country level differences include significant outward shifts in the Beveridge curves for France, Greece and Spain, an inward shift for Germany, while the majority of euro area countries reveal no significant changes in the responsiveness of unemployment to vacancy developments over the course of the crisis. Our results find also some evidence of outward shifts in Italy and the Netherlands though for these countries the results are less unequivocal (given the lack of robust Beveridge curve specifications for these labour markets).

[26] Other variables considered included gross and net non-performing loans as proportion of total outstanding loans as well as arrears of mortgage payments. Neither seem to be an important indicator for the position of the Beveridge curve. It is likely that non-performing loans indicate a generally worsening of economic conditions resulting in a move along the Beveridge curve rather than a structural shift reflecting worsening labour market mismatch.

The results from a local projections analysis, designed to isolate the salient structural features influencing Beveridge curve movements, suggest that labour force characteristics — in particular, smaller proportions of lower-skilled workers and a higher proportions of women in the total labour force - significantly decrease the probability of an outward shift. Sectoral factors — particularly, the heavy employment losses in the construction sector - are important determinants of observed Beveridge curve shifts with long lasting effects. At a more structural level, this paper finds high incidences of home ownership rates also increase the likelihood of outward shifts in Beveridge curves following the onset of a negative shock.

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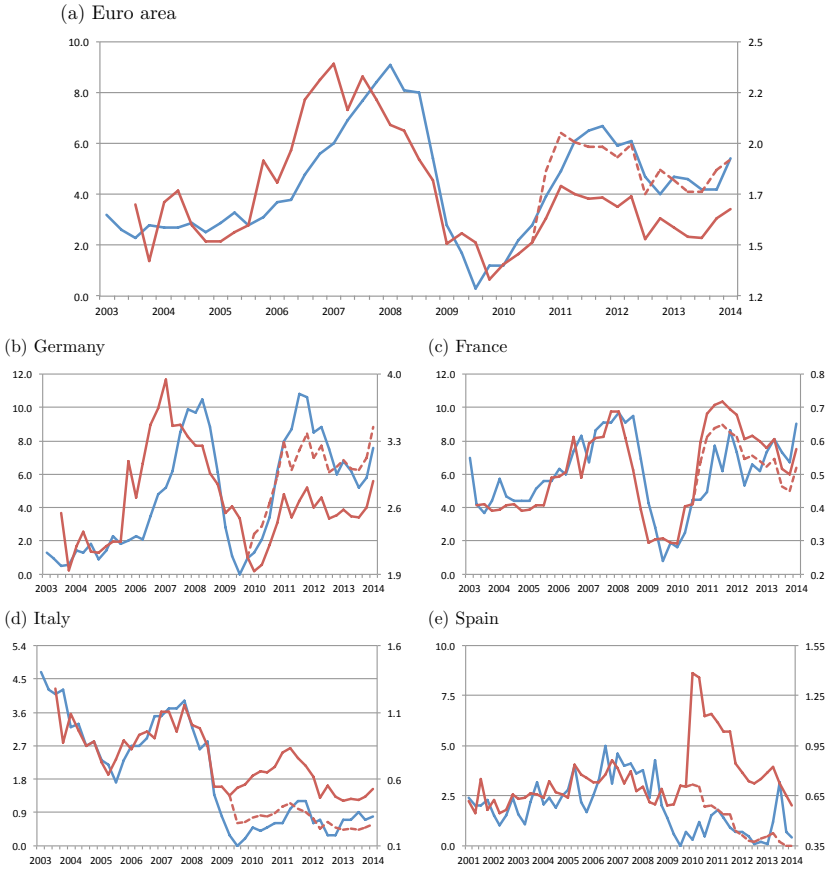
Appendix

Figure 9 shows the correspondence between the official Eurostat vacancy rates (red line) and national series behind EC's monthly surveys of employers' perceptions of labour shortages (blue line). We have allowed for breaks in the



Labour shortage (——), vacancy rate (——), vacancy rate rescaled after break (- - -)
Left y-axis: labour shortages (%); right y-axis: vacancy rate (%)
Sources: Eurostat, European Commission

Figure 9: Vacancies versus labour shortages

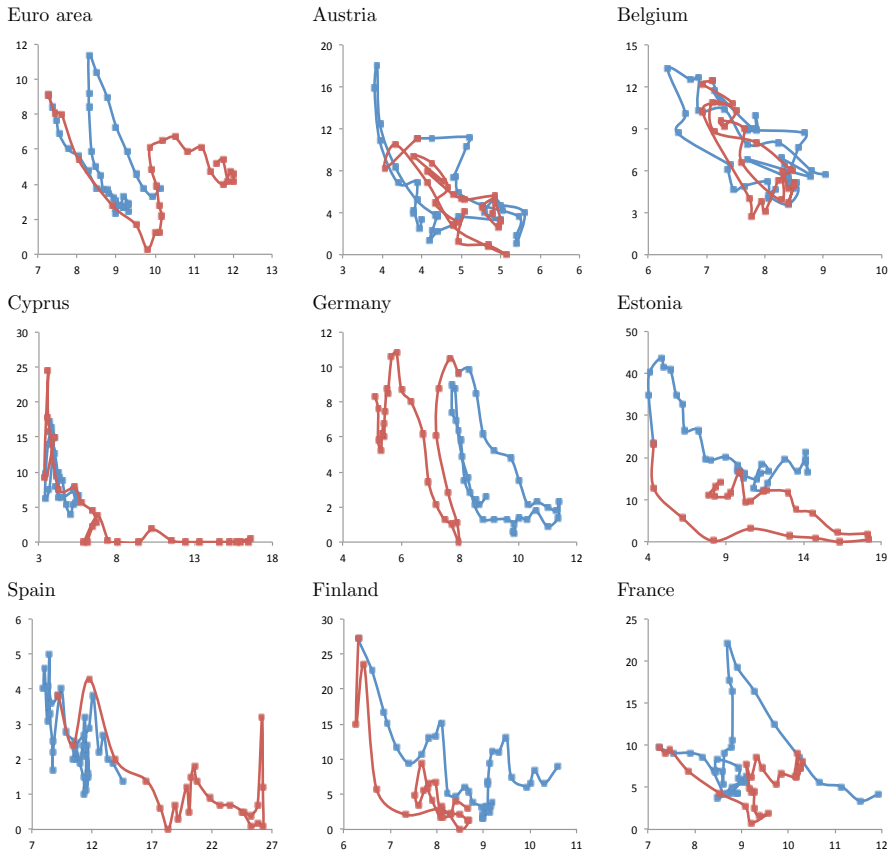
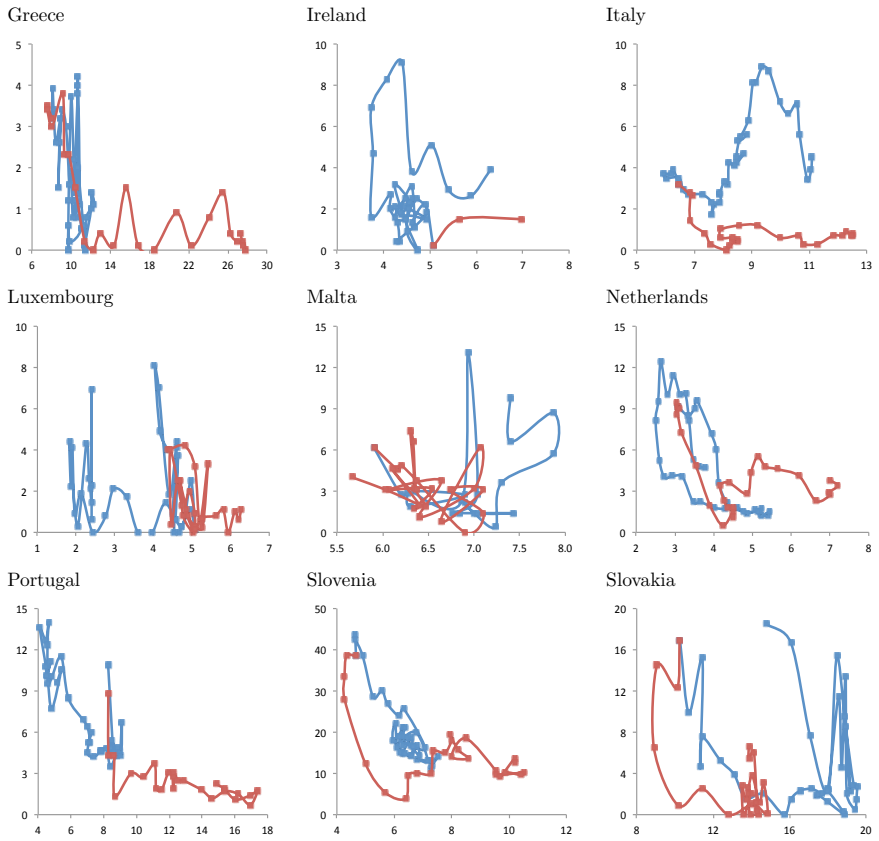


Figure 10: Beveridge curves for euro area countries over EMU

vacancy series according to the changes of methodology described on the Eurostat website (dashed red line). Despite (i) the differences in the methods used in the compilation of the various series, (ii) the lack of seasonal adjustment in the Eurostat series and (iii) the rather narrower sectoral coverage of the employers' perceptions (manufacturing only, as opposed to whole economy for Eurostat), the two series produce nevertheless a similar pattern.



X-axis: unemployment rate, y-axix: Labour shortages. 1999-2007 (——), 2008-2014 (——)

Figure 10 Cont.: Beveridge curves for euro area countries over EMU

Table 2: Beveridge curve estimation

Dependent var.: U_t	(1) EA	(2) AT	(3) BE	(4) CY	(5) DE	(6) EE
U_{t-1}	1.742***	1.008***	0.878***	1.348***	1.967***	1.182***
	(0.101)	(0.113)	(0.026)	(0.152)	(0.105)	(0.145)
U_{t-2}	-0.919***	0.005		-0.085	-1.332***	-0.200
	(0.202)	(0.157)		(0.273)	(0.191)	(0.235)
U_{t-3}	0.364	-0.094		-0.342*	0.332***	-0.131
	(0.221)	(0.156)		(0.184)	(0.103)	(0.154)
U_{t-4}	-0.537***	-0.517***				
	(0.201)	(0.157)				
U_{t-5}	0.307***	0.449***				
	(0.098)	(0.108)				
LS_t	-0.014**	-0.020***	-0.061***	0.013	-0.035***	-0.031**
	(0.007)	(0.008)	(0.010)	(0.022)	(0.011)	(0.015)
LS_{t-1}				0.014	0.022**	
				(0.025)	(0.011)	
LS_{t-2}				-0.021		
				(0.023)		
LS_{t-3}				0.024		
				(0.024)		
LS_{t-4}				-0.041**		
				(0.020)		
D_t^{emu}	-0.076***	0.023	-0.023	-0.056	0.017	-0.685
	(0.027)	(0.060)	(0.057)	(0.293)	(0.032)	(0.447)
D_t^{cri}	0.152***	0.037	0.048	0.576	-0.091**	0.562
	(0.037)	(0.045)	(0.059)	(0.389)	(0.041)	(0.425)
$Cons.$	0.425***	0.632**	1.029***	0.357*	0.277***	1.414***
	(0.109)	(0.248)	(0.215)	(0.204)	(0.100)	(0.407)
$Obs.$	98	74	98	48	91	54
$Adj - R^2$	0.994	0.860	0.951	0.989	0.996	0.963
$P(\sum U \geq 1)$	0.000	0.006	0.000	0.010	0.004	0.000
$P(\sum LS \geq 0)$	0.037	0.009	0.000	0.678	0.068	0.043
$P(\frac{\sum LS}{1-\sum U} \geq 0)$	0.013	0.013	0.000	0.323	0.018	0.007

Cont. Table 2: Beveridge curve estimation

Dependent var.: U_t	(7) ES	(8) FI	(9) FR	(10) GR	(11) IE	(12) IT
U_{t-1}	1.612***	2.208***	1.300***	1.337***	1.279***	0.992***
	(0.077)	(0.108)	(0.092)	(0.130)	(0.128)	(0.016)
U_{t-2}	-0.684***	-1.894***	-0.407***	-0.080	0.045	
	(0.068)	(0.262)	(0.085)	(0.230)	(0.204)	
U_{t-3}		0.996***		-0.300**	-0.257	
		(0.319)		(0.140)	(0.204)	
U_{t-4}		-0.534**			-0.075	
		(0.259)			(0.128)	
U_{t-5}		0.175*				
		(0.100)				
LS_t	-0.047	-0.008**	-0.012***	0.014	-0.022	-0.033***
	(0.041)	(0.004)	(0.004)	(0.056)	(0.023)	(0.012)
LS_{t-1}	-0.027			-0.121**	-0.017	
	(0.044)			(0.055)	(0.024)	
LS_{t-2}	0.040				0.022	
	(0.044)				(0.023)	
LS_{t-3}	-0.086**					
	(0.041)					
D_t^{emu}	-0.376***	-0.261***	-0.177***	0.145	0.007	-0.175***
	(0.103)	(0.079)	(0.047)	(0.167)	(0.188)	(0.063)
D_t^{cri}	0.769***	-0.022	0.153***	0.526***	0.118	0.259***
	(0.163)	(0.041)	(0.048)	(0.176)	(0.129)	(0.078)
$Cons.$	1.217***	0.673***	1.112***	0.339*	0.035	0.140
	(0.260)	(0.190)	(0.223)	(0.201)	(0.284)	(0.167)
$Obs.$	98	90	98	61	74	98
$Adj-R^2$	0.997	0.998	0.972	0.996	0.997	0.981
$P(\sum U \geq 1)$	0.000	0.000	0.000	0.001	0.359	0.315
$P(\sum LS \geq 0)$	0.033	0.023	0.003	0.070	0.510	0.009
$P(\frac{\sum LS}{1-\sum U} \geq 0)$	0.001	0.002	0.000	0.024	0.357	0.323

Cont. Table 2: Beveridge curve estimation

Dependent var.: U_t	(13) LU	(14) MT	(15) NL	(16) PT	(17) SI	(18) SK
U_{t-1}	1.690***	0.732***	1.703***	1.432***	0.957***	1.738***
	(0.103)	(0.101)	(0.076)	(0.093)	(0.116)	(0.125)
U_{t-2}	-0.703***		-0.761***	-0.497***	-0.387**	-0.987***
	(0.200)		(0.074)	(0.089)	(0.161)	(0.246)
U_{t-3}	0.139				0.435***	0.501*
	(0.212)				(0.160)	(0.265)
U_{t-4}	-0.437**				-0.370**	-0.448*
	(0.199)				(0.170)	(0.247)
U_{t-5}	0.297***				0.285**	0.160
	(0.103)				(0.122)	(0.131)
LS_t	-0.001	0.013	-0.010*	-0.045**	-0.031***	-0.015
	(0.008)	(0.008)	(0.006)	(0.017)	(0.008)	(0.015)
D_t^{emu}	0.040	-0.220	-0.070*	0.060	0.217	-0.017
	(0.032)	(0.217)	(0.038)	(0.078)	(0.202)	(0.176)
D_t^{cri}	0.004	0.191	0.081**	0.193	0.142	
	(0.041)	(0.198)	(0.038)	(0.124)	(0.233)	
$Cons.$	0.039	1.927***	0.301***	0.431***	0.493**	0.522
	(0.043)	(0.730)	(0.088)	(0.142)	(0.223)	(0.468)
$Obs.$	98	56	98	98	69	61
$Adj - R^2$	0.992	0.672	0.990	0.992	0.962	0.981
$P(\sum U \geq 1)$	0.204	0.011	0.000	0.001	0.008	0.102
$P(\sum LS \geq 0)$	0.934	0.943	0.090	0.011	0.000	0.306
$P(\frac{\sum LS}{1-\sum U} \geq 0)$	0.467	0.923	0.025	0.001	0.007	0.121

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1
Sample period: 1990Q1-2014Q1

Table 3: Poolability test

Start sample	All EA	Significant BC	Sign. BC excl. SI & EE
1990	F(160,792) = 2.55	F(100,526) = 2.47	F(80,474) = 2.47
	0.00	0.00	0.00
1999	F(160,435) = 1.73	F(100,277) = 1.28	F(80,232) = 1.28
	0.00	0.06	0.29

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