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Did the crisis permanently scar the Portuguese labour market? Evidence from a Markov-switching Beveridge curve analysis

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Isabel Vansteenkiste **Did the crisis permanently scar the Portuguese labour market? Evidence from a Markov-switching Beveridge curve analysis**

No 2043 / April 2017

Abstract

In this paper we analyse to what extent the outward shift in the Portuguese Beveridge curve since 2007 has been due to structural or cyclical factors and how likely the outward shift will persist.

We do this by empirically estimating the Beveridge curve in a Markov-switching panel setting with time-varying transition probabilities for the US, Portugal and Spain using monthly data for the period 1986m1-2014m12. These time-varying transition probabilities are in turn determined by a set of structural indicators which could affect the matching efficiency in the labour market.

The results show that the sharp outward shift in the Portuguese Beveridge curve was to a large extent driven by cyclical factors. However, it was compounded by some structural factors, namely, the relatively high level of employment protection together with the relatively high minimum wage ratio and the relatively generous unemployment benefit system.

J.E.L. classification: C23, C24, J63, J64, J65.

Keywords: Beveridge Curve, Markov-Switching Model, Panel data, Labour market policies.

1 Non-technical summary

For many years, a key distinguishing feature of the Portuguese labour market has been its persistently high employment and relatively low unemployment, despite the high level of employment protection: according to the OECD, prior to the crisis, Portugal had an average unemployment rate of around 6.2%, significantly below other South European countries and even below the OECD average. At the same time, Portugal had the highest level of employment protection among the OECD countries.

This feature of the Portuguese labour market has been well-documented and analysed. The crisis has now seemingly brought about an end to this striking feature of the Portuguese labour market: between the second quarter of 2008 and the first quarter of 2013, the unemployment rate in Portugal soared, from 8.7% to 17.3%. As a result, Portugal now has the third highest unemployment rate among OECD countries; only the increases in Spain and Greece were more substantial.

These developments lead us to question whether the increase in the Portuguese unemployment rate during the crisis has been mostly of cyclical nature or whether the crisis has brought to the fore existing structural weaknesses in the Portuguese labour market. Answering these questions is particularly relevant from a policy perspective at this point since it can provide insights into the likelihood that Portuguese unemployment will return to pre-crisis levels. It can also help to understand which policies could support a reduction in unemployment.

We aim at shedding light on these questions in this paper by looking at the Portuguese labour market through the lense of the Beveridge Curve. The Beveridge Curve is one of the key relations macroeconomists have relied on to understand and study the dynamics in the aggregate labour market (see Blanchard and Diamond, 1989). The Beveridge curve depicts the empirical negative relationship between job vacancies and unemployment (i.e. higher unemployment is associated with lower job vacancies and vice versa). It is used to study dynamics in the labour market as the position of the economy on the curve gives an idea of the state of the labour market. For instance, a high level of vacancies and a low level of unemployment would indicate a tight labour market.

Generally, movements along a fixed Beveridge curve have been associated with cyclical factors, while shifts in the Beveridge curve (i.e. higher or lower unemployment rate for a given vacancy rate) have been interpreted as reflecting structural changes which affect the matching between jobs and unemployed workers (Bouvet, 2012). The most recent literature has however recognized that this depiction of cyclical movements along a fixed Beveridge curve is overly simplified as in recessions a cyclical shock will follow a counter-clockwise loop, with vacancies adjusting upwards more quickly than unemployment falls.

In the case of Portugal, looking at the recent developments through the lense of the Beveridge curve may be particularly relevant given that the exceptional change in the labour market dynamics has been clearly reflected in the dynamics of the Beveridge Curve. Prior to the crisis, the Portuguese Beveridge curve exhibited the well-known and well-documented negative relationship between the unemployment rate and the vacancy rate. Since 2007, the Beveridge curve has started to shift outwards strongly while at the same time also exhibiting a counter-clockwise movement. The exceptionality of the outward shift becomes even more striking when comparing the developments in the Portuguese Beveridge curve to the movements in the US Beveridge curve.

To understand whether the outward shift in the Portuguese Beveridge curve since 2007 is due to cyclical or structural factors, we empirically estimate the Beveridge Curve in a panel setting for three countries (Portugal, Spain and the United States) using monthly data from 1986m1-2014m12 by means of a time-varying Markov-switching model where we control for cyclical factors and allow the slope and intercept coefficients of the Beveridge curve to switch. The probability that such a switch can occur is in turn driven by a set of information variables which proxy for possible structural features of the economy. By means of this set-up we can gauge the factors underlying a regime (i.e. structural) shift. In addition the model informs us about the likelihood that such an outward shift may persist.

There have been other recent studies that have looked into the possible drivers of the shift in

the Beveridge curve. For instance Hobijn and Sahin (2012) also document the outward shift in the Portuguese Beveridge curve. They find that in the case of Portugal, but also Spain and the US the outward shift in the Beveridge curve during the Great Recession is due to skill mismatch from a housing bust and a disproportionate decline in the construction sector. Similarly Bonthuis et al. (2012) find that declines in the share of construction employment are an important factor explaining Beveridge curve shifts in the euro area.

Our empirical results confirm the negative, convex relationship between unemployment and vacancies. The results also confirm that during downturns, the Beveridge Curve shifts outwards. We find that in our preferred specification, our model has two regimes: in the first regime, we find a Beveridge curve which is more inward and steeper compared to our second regime. We allow the probability by which the model is in one of the two regimes to be time-varying and make it dependent on a set of information variables. We consider here a number of variables which, according to the existing theoretical and empirical literature, could cause the Beveridge curve to shift. These include: the minimum wage ratio, the degree of employment protection, the unemployment benefit duration, the replacement rate, an index proxying generosity of the unemployment benefit system, the union density, the degree of centralisation of the wage bargaining process, the tax wedge and the share of long term unemployed.

We find that it is more likely that the Beveridge curve shifts outward in case of a higher minimum wage ratio, in particular in combination with a higher degree of employment protection and a longer unemployment benefit duration and a more generous unemployment benefit system. Moreover, in such cases it is also more likely that the Beveridge curve remains outward. Such outward shifts are also more likely when the degree of union density is higher or the wage bargaining system is more centralised. At the same time, these variables seem not to affect the likelihood that the Beveridge curve remains outward, i.e. they do not lead to hysteresis.

When applying our estimation results to the current dynamics of the Portuguese labour market, we find that cyclical factors and the downsizing of the construction sector have been the most important factors contributing to the increase in the unemployment rate and the outward shift of the Beveridge curve. However, the reforms which were undertaken during the economic and financial assistance programme have dampened the increase in the unemployment rate (by around 3 pp). Looking ahead, our model would suggest that the relatively high minimum wage ratio, in combination with the high level of employment protection may hold back the full return of the unemployment rate to pre-crisis levels. This is especially the case when assuming that the construction sector downsizing is permanent.

2 Introduction

For many years, a key distinguishing feature of the Portuguese labour market has been its persistently high employment and relatively low unemployment, despite the high level of employment protection.

According to the OECD, prior to the crisis, Portugal had the highest level of employment protection among the OECD countries. At the same time, the average unemployment rate in Portugal stood at around 6.2%, significantly below that of the other South European countries and even below the OECD average (see Figure 1).

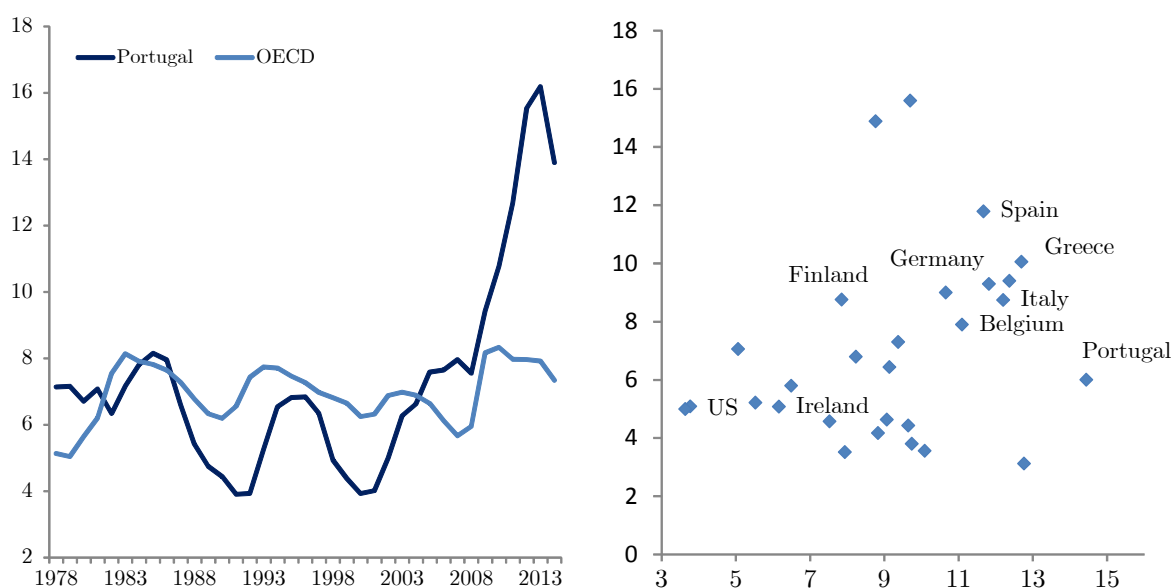


Figure 1: Unemployment rate in Portugal and the OECD between 1978-2014 (LHS) and the average unemployment rate (y-axis) and the average level of employment protection (x-axis) over the period 1998-2008 (RHS). Source: OECD

This feature of the Portuguese labour market has been well-documented and analysed. However, most cross-country aggregate studies have difficulties explaining why the Portuguese unemployment rate has been so low in the pre-crisis period, close to the US unemployment rate, and on average 2.4 times below the Spanish unemployment rate. The difference with the Spanish unemployment rate is striking since, aside from their similarities in history and culture, the labour market institutions of Portugal and Spain are very similar across a wide number of aspects, such as unemployment benefits, job security, union density and employer co-ordination. Overall, however, the answer explaining the difference in unemployment between Spain and Portugal and the similarities between Portugal and the United States remain inconclusive.¹

The crisis has seemingly brought about an end to this striking feature of the Portuguese labour market: between the second quarter of 2008 and the first quarter of 2013, the unemployment rate in Portugal soared, from 8.7% to 17.3%, implying that Portugal now has the third highest

¹Several studies have attempted to explain the difference in the unemployment rate between Spain and Portugal. Blanchard and Jimeno (1995) for instance conclude that the only difference between the two countries appears to be the unemployment benefit system (though that was more so in the past). Bover et al. (1998) find that there are important differences in wage flexibility between Spain and in Portugal: wage floors established by collective bargaining are set at a lower relative level in Portugal; firing costs are in practise higher in Spain and a de facto greater role of unions in pushing for higher and more uniform wage agreements in Spain. Blanchard and Portugal (2001) also suggest that differences in unemployment insurance, union power or simply a different set of shocks may be at the origin of the higher unemployment in Spain than in Portugal.

unemployment rate among OECD countries.² As a result, the unemployment situation in Portugal now looks much closer to Spain than to the United States.

These developments lead us to revisit the two long standing pre-crisis puzzles, namely: (i) of the divergence between the Spanish and Portuguese unemployment and (ii) of the similarities between the US and Portuguese unemployment rate. We focus on two key questions: first, to what extent did the crisis bring to the fore existing structural weaknesses in the Portuguese labour market and second, to what extent will the rise in the Portuguese unemployment during the crisis be or become structural in nature? Answering these questions is particularly relevant from a policy perspective since it can provide insights into the likelihood that Portuguese unemployment will return to pre-crisis levels. Moreover, it could help to understand which policies could support a reduction in unemployment.

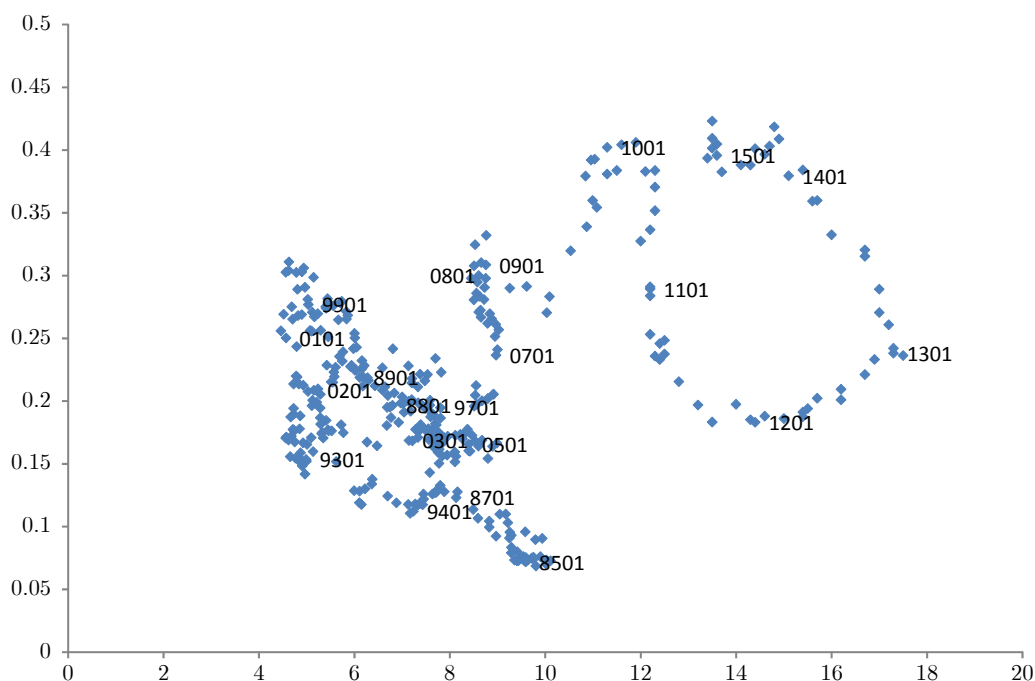


Figure 2: The Portuguese Beveridge Curve, 1985-2015 (monthly data). The x-axis shows the unemployment rate, the y-axis the vacancy rate.

We aim at shedding some light on these questions in this paper by looking at the Portuguese labour market through the lense of the Beveridge Curve. The Beveridge Curve is one of the key relations macroeconomists have relied on to understand and study the dynamics in the aggregate labour market (see Blanchard and Diamond, 1989). The Beveridge curve depicts the empirical relationship between job vacancies and unemployment, which in turn reflects the underlying process of job matching between employers and job seekers (Valletta, 1995).

In the case of Portugal, looking at the recent developments through the lense of the Beveridge curve may be particularly relevant given that the exceptional change in the labour market dynamics has also been reflected in the dynamics of the Beveridge Curve. As shown in Figure 2, between 1985-2007, the Portuguese Beveridge curve was rather well-behaved and exhibited the well-known and well-documented negative relationship between the unemployment rate and the vacancy rate. However, since 2007, the Beveridge curve has started to shift strongly outwards while at the same

²Several groups have been disproportionately affected: the young, the unskilled, those on temporary contracts and those displaced from strongly downsized sectors (such as construction). Reflecting this, youth and long-term unemployment have risen substantially (see Bonthuis et al., 2013). Youth unemployment rate reached a peak of almost 37% while share of long-term unemployed reached 60% in the summer of 2014, up from 47% prior to the crisis.

time also exhibiting a counter-clockwise movement. The exceptionality of the outward shift becomes even more striking when comparing the developments in the Portuguese Beveridge curve to the movements in the US Beveridge curve (see Figure 3). In Figure 3 the vacancy rate for Portugal has been adjusted by a factor of ten for readability (as on average vacancy rates are more than ten times lower in Portugal than in the US). However, apart from the significantly lower labour market flows in Portugal compared to the US (which has also been documented in Blanchard and Portugal, 2001), the Beveridge curves of Portugal and the United States were strikingly similar for both countries between 1985-2008. This changed however after 2008: whereas the financial crisis also resulted in an outward and counter-clockwise shift in the US Beveridge curve, this has remained within historical normalities and has been much more muted than in the case of Portugal.

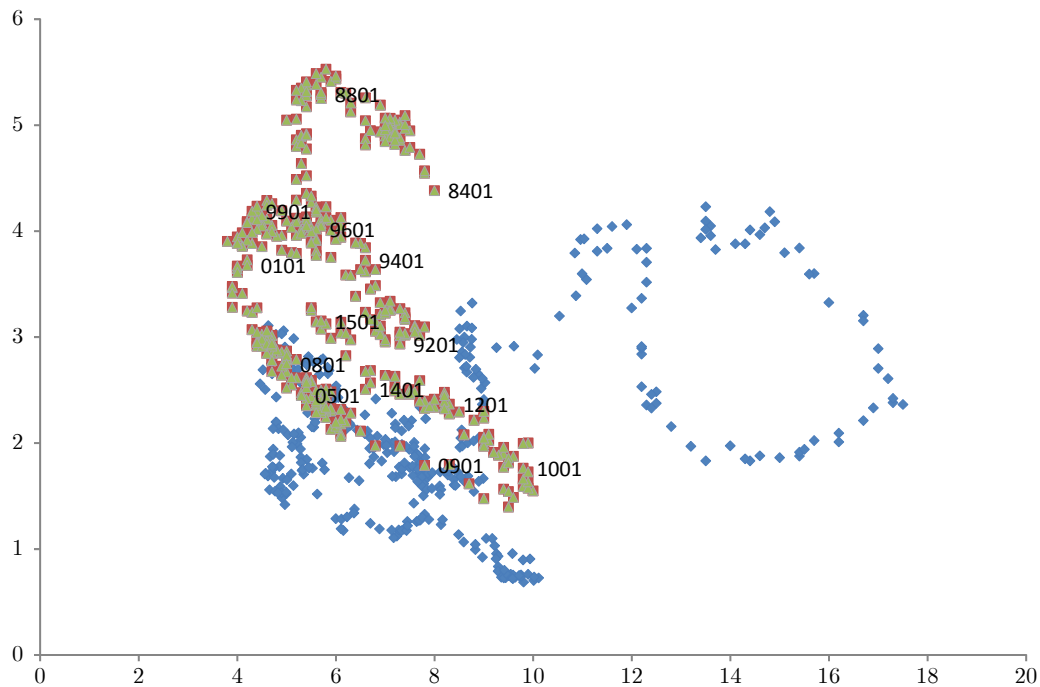


Figure 3: The Portuguese (blue) and US (green) Beveridge Curve, 1985-2015 (monthly data). The x-axis shows the unemployment rate, the y-axis the vacancy rate.

To understand whether the outward shift in the Portuguese Beveridge curve since 2007 is due to cyclical or structural factors, we empirically estimate the Portuguese Beveridge Curve by means of a time-varying Markov-switching model in which we control for cyclical factors³ and allow the slope and intercept coefficients of the Beveridge curve to switch. The probability that such a switch can occur is in turn allowed to be driven a set of information variables which proxy for possible structural features of the economy. This set-up allows us to gauge the factors underlying a regime (i.e. structural) shift. In addition the model can inform us about the likelihood that such an outward shift would persist.

There have been other recent studies that have looked into the possible drivers of the recent shift in the Beveridge curve. For instance, Hobijn and Sahin (2012) also document the outward shift in the Portuguese Beveridge curve. They find that in the case of Portugal, but also in the cases of Spain, and the US, the outward shift of the Beveridge curve during the Great Recession is due to skill mismatch from a housing bust and a disproportionate decline in the construction sector.⁴ Similarly Bonthuis et al. (2012) find that declines in the share of construction employment

³We control for cyclical factors as it has been shown that matching efficiency is a function of productivity and the reservation wage, the Beveridge curve becomes unstable over the business cycle. See section 4.1 for more details.

⁴Note however that the authors do not empirically estimate the impact of these factors but rather notice this as

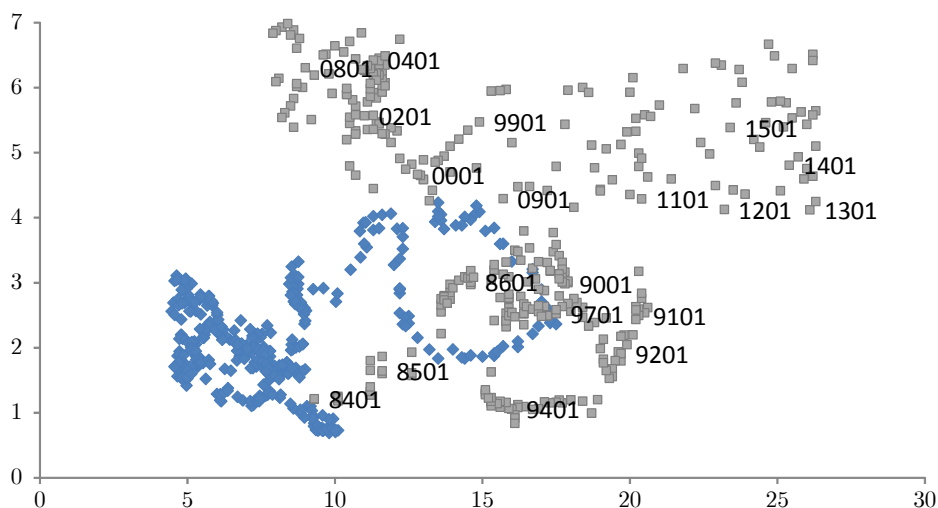


Figure 4: The Portuguese (blue) and Spanish (grey) Beveridge Curve, 1985-2015 (monthly data). The x-axis shows the unemployment rate, the y-axis the vacancy rate.

are an important factor explaining Beveridge curve shifts in the euro area.

The results of the paper confirm the long-standing finding in the literature namely that there exists a negative convex relationship between unemployment and vacancies. Moreover, we confirm that a cyclical downturn can temporarily cause an outward shift of the Beveridge curve. As regards structural drivers, we show that it is more likely that the Beveridge curve shifts outward when the union density is high, the wage bargaining system is more centralised and there is a cyclical downturn which disproportionality affects the construction sector. However, these factors do not cause hysteresis (i.e. that the Beveridge curve remains permanently outward). Instead, the Beveridge curve is more likely to remain outward in case of a long duration of the unemployment benefits and if the minimum wage ratio is high relative to the median wage. The latter is further compounded when there is strict employment protection legislation.

The rest of the paper is structured as follows: section 3 provides a brief discussion of the literature regarding the drivers and dynamics of the Beveridge curve. Section 4 describes the modelling approach and the data, Section 5 presents the estimation results while section 6 discusses the implications of the empirical findings for the Portuguese Beveridge curve. Section 7 concludes.

3 Literature Review: Drivers and Dynamics of the Beveridge Curve

3.1 The derivation of the Beveridge Curve

The Beveridge curve reflects the negative short-term relationship between unemployment and vacancies. The interest in the relation is related to its ability to identify the nature of shocks that hit the labour market (Arpaia et al, 2014). The position of the economy on the curve namely gives an idea of the state of the labour market. For instance, a high level of vacancies and a low level of unemployment would indicate a tight labour market. The modern day theories underlying the Beveridge Curve were developed in the 1970s and 1980s and are based on the search and matching model.⁵ The model was developed in the work of Peter Diamond, Dale Mortensen, and Christopher

a stylized fact for the countries where we have observed an outward shift in the Beveridge Curve during the Great Recession.

⁵The early literature of the 1950s and 1960s dealt with the curve in the context of exploring excess demand in the labour market and its influence on wage inflation (see for instance Dow and Dicks-Mireaux (1958), Lipsey (1960) and

Pissarides (see Pissarides, 2000, for a detailed exposition, and Yashiv, 2007, for a recent survey).

In the standard search and matching model, workers and firms engage in a costly search to find each other. The matching process assumes frictions (such as informational or locational imperfections) and can be formalised by a matching function. The rate of job matching or hiring, m , is in this case a function of the unemployment rate, u , the job opening (vacancy) rate, v , and a set of other, possibly unobserved influences on the matching process, denoted by z (see Valletta, 1995). Typically the matching function is assumed to be constant returns to scale and to be continuous non-negative increasing in both arguments, u and v :

$$m = m(u, v, z) \quad \text{where } m_u > 0 \text{ and } m_v > 0$$

The matching function summarises the effectiveness at which workers searching for job are brought together with employers searching for workers. In steady-state, a constant unemployment rate implies that the rate of job matching m equals a fixed rate of job separations s . The resulting equality is:

$$m(u, v, z) = s \tag{1}$$

Specifying the matching function as Cobb-Douglas (i.e. $m = Au^\gamma v^{1-\gamma}$) and with a constant separation (s) in steady state we can express the above equation as:

$$u = \left(\frac{s}{Av^{1-\gamma}} \right)^{\frac{1}{\gamma}} \tag{2}$$

Whereby the term A captures the matching efficiency. In this case, it is standard to interpret movements along a fixed downward-sloping Beveridge curve are associated with cyclical shocks, while shifts of the curve arise from structural factors.⁶ An upward movement along the Beveridge curve is typical of a negative shock to aggregate demand: fewer jobs (vacancies) and jobs are harder to find (higher unemployment rate). Inward and outward shifts instead are related to a change in the matching efficiency, whereby outward shifts imply a reduction in the efficiency and thus a deterioration of the labour market.

3.2 Structural factors causing the Beveridge curve to shift

There are a number of structural factors that could cause the Beveridge curve to shift. These shifts can for instance be due to the characteristics of the unemployed, changes in search efforts, search effectiveness (see Bouvet, 2012). However, shifts can also be due to changes in the job separation rate (s): a decrease in the job separation rate would result in an outward shift (i.e. for a given level of vacancies a higher unemployment rate is needed to equate inflows to outflows) (see Arpaia, 2014). This section provides a brief overview of the structural factors that could cause a shift in the Beveridge curve.

A first set of structural factors relates to government policies which may affect the incentives of workers to search for jobs. This includes for instance the generosity of the unemployment benefit system. The unemployment benefit system directly affects the readiness of the unemployed to fill vacancies. Changes related to the level of the benefits, the coverage, the duration and the strictness of the system could all lead the Beveridge curve to shift (see Nickel et al. 2001). However, also government policies which aim to increase the ability and willingness of the unemployed to take jobs (active labour market policies) could impact the efficiency of job matching.

Another set of factors relate to the strictness of the employment protection legislation. Past studies have however concluded that the overall impact of changes in such legislation on the Beveridge curve is mostly an empirical question. Whereas there is consensus that stricter employment

Bowden (1980)). A key difference between the search and matching model and the early literature is its derivation of vacancies and unemployment as equilibria, rather than disequilibria, phenomena.

⁶Meanwhile, it has been shown that this depiction of the Beveridge curve may be too overly simplistic. More details are provided in section 4.1.

protection will lead to lower inflows into unemployment, there is less consensus regarding the impact on the efficiency of job matching. Strict employment protection legislation may deter firms from hiring new workers, thereby reducing the efficiency of job matching but at the same time it can also lead to an increased professionalisation of the personnel function with firms (see Daniel and Stilgoe, 1978).

Shifts in the Beveridge curve could also be explained by the institutional structure of wage determination which have a direct impact on wages and indirectly influence the efficiency of job matching or the separation into unemployment. There are a number of institutional settings which could be relevant in this case. They relate to the union power in wage bargains, union coverage and the degree of coordination of wage bargains (see Nickell and van Ours (2000)). Generally, greater union power and coverage can be expected to exert upward pressure on wages, hence raising equilibrium unemployment, but this can be offset if union wage setting across the economy is co-ordinated.⁷ Finally, as regards minimum wage legislation, Nickell and van Ours (2000) point out that there is little consensus on the effect of such legislation on unemployment, but that in countries where the minimum wage is not adjusted for young workers, it leads to higher youth unemployment rates.

Shifts in the Beveridge curve can also be explained by changes in the composition of the pool of unemployed (Börsch-Supan, 1991; Wall and Zoega, 2002), as this might affect job search efficiency. The impact of long-term unemployment is referred as unemployment hysteresis (Blanchard and Summers, 1987). Owing to human capital deterioration, long-term unemployed workers might experience lower search effectiveness and a lower ability to be matched with a vacant job. Samson (1994) also argues that the proportion of women and young people (between 16 and 25 year-old) in the labor force are relevant because these two groups of workers have lower levels of attachment to their jobs; an increase in their ratios in labor force would raise both the unemployment rate and the vacancy rate, thus causing an outward shift of the Beveridge curve.

Finally, skill mismatch has been found to be an important factor causing the Beveridge curve to shift. Studies like Şahin et al. (2011) and Hobijn (2012) find that the shift in the occupational mix of job openings is more important than the cross-industry composition for the observed decline in match efficiency. Studies that analyzed industry-level vacancy yield data from JOLTS, like Davis, Faberman and Haltiwanger (2012) and Barnichon et al. (2012), have found that a large part of the apparent decline in aggregate match efficiency is due to the construction sector, which has a vacancy yield that is 2.5 times the average. A shift in the composition of job openings away from construction might thus result in a decline in measured aggregate match efficiency even if that of each of the underlying industries does not decline.

4 Empirical model and data

4.1 The Beveridge curve as a Markov-switching Model with Time-Varying Transition Probabilities

In this paper, we use a Markov-switching approach to determine endogenously which and how shift factors can affect the Beveridge curve. In the empirical literature, in its simplest form, assuming constant returns to scale, the theoretical Beveridge curve equation, as represented in (2) has been translated into the following specification:

⁷In the above-mentioned equation (1) this should at prima facie not influence the position of the Beveridge curve. However, if we use a model of the Beveridge curve which endogenises the rate of separation into unemployment or the rate of job destruction (see Mortensen and Pissarides, 1994), this no longer applies. For example, if union power raises the share of the matching surplus going to wages, this will tend to raise the rate of job destruction and shift the Beveridge curve to the right. The same thing will also happen if factors such as the co-ordination of wage bargaining reduce the extent to which wages at the firm level can fluctuate to offset idiosyncratic shocks and stabilise employment at the firm level. So while co-ordination can reduce overall wage pressure, which tends to lower equilibrium unemployment, it may raise the rate of idiosyncratic job shifts which will tend to shift the Beveridge curve to the right and have an offsetting effect.

$$u_{i,t} = \alpha + \beta v_{i,t} + \gamma v_{i,t}^2 + \varepsilon_t \quad (3)$$

In the empirical literature, there have already been several attempts to determine the underlying factors that cause shifts in the Beveridge curve (in particular, those that shift α). To this end, some studies have based themselves on visual inspections or quadratic time trends (Blanchard and Diamond, 1989; Layard et al., 1991). Others have done so by augmenting the basic Beveridge curve specification by a range of shift parameters (see for instance Valetta, 2005; Bonthuis, 2013 or Bouvet, 2012). Bouvet (2012) also considered threshold effects in the empirical relationship between the unemployment and vacancy rate. However, due to the small sample, the author exogenously imposed these thresholds.

We use the Markov-switching approach to determine the factors that shift the Beveridge curve. Markov-switching models represent time series models with a latent variable component where an unobserved Markov process drives the observation-generating distribution. Such models have been first applied to economics and financial econometrics after the seminal work of Hamilton (1989). Since then a number of extensions have been made to the basic Markov-switching model one being the time-varying transition probability Markov-switching model. In this variant, transition probabilities are allowed to vary with a number of information variables.⁸ The advantage of this approach is that the probabilities of shifting from one curve to another are determined endogenously by the value of selected shift factors. No prior information regarding the dates or the sizes of the states is required. There could be asymmetries in the persistence of the states and we do not impose that the coefficients should be either significant or insignificant. Moreover, we do not impose which information variables should affect the transition probabilities and in which way

In our case, the approach has the added advantage that it can not only pin down which factors shift the Beveridge curve, but it also can provide insights into the factors that cause such shifts to persist. The latter is particularly relevant as several papers in the literature have for instance documented that unemployment spells can have deleterious effects on the search-effectiveness of the unemployed (see for instance Jackman et al, 1991). Our methodology allows to uncover which factors cause hysteresis. The approach of estimating the Beveridge curve as a Markov-Switching model with time-varying transition probabilities was also followed in Dutu et al. (2015) who make use of the model to estimate the shift factors of the Beveridge Curve in New Zealand. Our model is however broader in that a wider variety of shift factors are considered and is applied in a panel setting, thereby increasing the country coverage.

Concretely, in our empirical estimations, the Beveridge curve takes the following functional form:

$$u_{i,t} = \alpha(S_t) + \beta(S_t)v_{i,t} + \gamma v_{i,t}^2 + \delta C_{i,t} + \theta D_i + \varepsilon_t \quad \text{where } \varepsilon_t \sim N(0, \sigma_{\varepsilon t}^2) \quad (4)$$

whereby $u_{i,t}$ stands for the unemployment rate of country i at time t , $v_{i,t}$ stands for the vacancy rate of country i at time t while $v_{i,t}^2$ represents the square of the vacancy rate. Compared to equation (3) we have augmented our model with $C_{i,t}$ which stands for the output gap and D_i stands for the country fixed effects. Akin to Bouvet (2012) we augment the Beveridge curve equation by including the output gap to check for the effect of business cycles on the stability of the Beveridge curve. In the traditional theoretical Beveridge curve model one would not control for the business cycle. In such models, movements along a fixed Beveridge curve would namely be associated with cyclical factors, while shifts in the Beveridge curve (i.e. higher or lower unemployment rate for a given vacancy rate) are interpreted as reflecting structural changes which affect the matching between jobs and unemployed workers (Bouvet, 2012). However, in the more recent literature, this depiction

⁸Examples of this extension show up in many fields of research. Researchers have used time-varying transition probability models to examine output seasonality in a time-varying transition probability model (see Ghysels, 1994), to study business cycle fluctuations (Filardo, 1994), interest rate dynamics (Gray, 1996), bubbles and asset pricing (Schaller and van Norden 1996), oil price developments (Vansteenkiste, 2011) and exchange rates (Diebold, et.al. 1994, Engel and Hakkio 1994).

of cyclical movements along a fixed Beveridge curve has been recognized as overly simplified. Under the assumption that vacancies adjust to shocks more quickly than does unemployment⁹, the return to an initial Beveridge curve equilibrium after a cyclical shock will follow a counter-clockwise loop, with vacancies adjusting upwards more quickly than unemployment falls (Bowden 1980, Blanchard and Diamond 1989). Hence, to be able to distinguish between cyclical and structural drivers of movements in the Beveridge curve we control in our estimation for cyclical factors through the inclusion of the output gap.

In equation (4) we present a specification whereby both the intercept (α) and slope coefficient of the vacancy rate (β) are regime-dependent.¹⁰ They are depending on S_t , which is an unobservable regime variable. As regards the regime switches, It is assumed to follow an irreducible ergodic Markov-switching process whereby the transition probabilities $p = P[S_t = 0 \mid S_{t-1} = 0]$ and $q = P[S_t = 1 \mid S_{t-1} = 1]$ vary across time and depend on a set of information variables Z_t . In our specific case, we consider a number of structural control variables (Z_t) which could cause the regime switches (such as inter alia the minimum wage, the level of employment protection, the generosity of the unemployment benefit system, the degree of centralisation of the wage bargaining process, the duration of the employment benefits, the replacement rate of the unemployment benefits, the share of women and young in the labour force, the share of long term unemployed in the unemployment rate, the tax wedge and the union density).

Based on this set-up, the transition probabilities of the model become $p(Z_t), 1 - p(Z_t), q(Z_t), 1 - q(Z_t)$. The function form of p and q in this context are usually modelled as a logistic function:

$$p(Z_t) = \frac{e^{\delta_p^0 + \delta_p^1 Z_t}}{1 + e^{\delta_p^0 + \delta_p^1 Z_t}}$$

$$q(Z_t) = \frac{e^{\delta_q^0 + \delta_q^1 Z_t}}{1 + e^{\delta_q^0 + \delta_q^1 Z_t}}$$

A number of methods have been used to estimate this model. A standard approach is to use both conditional maximum likelihood estimation and filtering methods (as for instance in Gray, 1996). However, the conditions that justify this approach are non-trivial. In general, the Z_t variables that enter the transition probability functions must be contemporaneously conditionally uncorrelated with the unobserved state S_t . If this condition is not met in a particular empirical application, other methods need to be employed to deliver estimators with the typical desirable properties (see Filardo, 1998). One such alternative method is presented in Filardo and Gordon (1998) where a Bayesian method is adopted, using the simulation estimation techniques of Gibbs sampling.

4.2 Data

In order to analyse the above presented model, we need to choose the relevant variables. In our case, we will estimate the Beveridge curve in a Markov-switching panel setting for the United States, Portugal and Spain. We chose this set-up given that Portugal has both with the United States and Spain elements in common while in other aspects they are significantly different. In the case of the United States, Portugal exhibits a very similar unemployment rate until the onset of the crisis. At the same time, at the institutional level, characteristics are very different. In the US, wage bargaining takes mostly place at the firm level whereas in Portugal at the sectoral level. In the US, employment protection is among the lowest in the OECD whereas in Portugal it is among the highest. By contrast in the case of Spain, Portugal shares commonalities in the areas where

⁹Theoretically it has been shown that the Beveridge curve becomes unstable over the business cycle in models where the matching efficiency is a function of productivity and the reservation wage (see for instance Pissarides, 1985 and Börsch-Supan, 1991).

¹⁰It should be noted that in the theoretical literature, shifts only would occur to the intercept, whereas shift to the slope due to structural factors are not considered. To be closer to the existing theoretical literature, we also estimate the model whereby we only allow shift to occur in α . The main messages derived from those estimations do not vary for those presented in the paper.

it differs significantly from the US, while the unemployment rates are widely different. Moreover, we chose these three countries since we were able to obtain a wide number of relevant variables for them over a long time period and at a monthly frequency (1986m1-2014m12).

TABLE 1. Average values of key variables over period 1986m1-2008m3

	Portugal	United States	Spain
Unemployment rate	6.73	5.53	14.34
Vacancy rate	0.20	3.65	3.92
EPL	4.09	0.25	3.02
Unemployment benefit duration	98.82	30.39	104.00
Replacement rate	0.77	0.60	0.80
Overall generosity of the unemployment benefit system	10.22	10.21	10.68
Union density	25.56	13.89	15.62
Degree of centralisation of the wage bargaining process	2.49	1.00	2.16
Minimum wage as a ratio to median wage	0.52	0.35	0.44
Active labour market policies (as % of GDP)	0.51	0.18	0.65
Labour force participation rate	49.92	66.40	63.16
Share of long term unemployed	44.63	15.97	43.20
Share of youth unemployed	17.43	11.65	30.35
Share of construction in total employment	10.50	7.70	10.24
Tax wedge	48.58	32.70	50.68

See Annex I for a detailed description of the data sources.

Besides the basic ingredients of the Beveridge Curve (namely the unemployment and vacancy rate), we have collected data for a large number of variables which could cause shifts in the Beveridge curve. These variables aim at covering those factors which are mentioned in the literature review above.

A first set of variables relate to the generosity of the unemployment benefit scheme. We consider in this paper three indicators: (i) the unemployment benefit duration¹¹, (ii) the replacement rate and (iii) an aggregate score of the generosity of the unemployment benefit system, as constructed in the comparative welfare entitlements dataset and explained in Scruggs (2014). All series are calculated for a notional average production worker in the manufacturing sector who is 40 years old and has been working for the 20 years preceding his/her job loss (see Scruggs, 2014).

Next we also consider a number of indicators that proxy the institutional structure of wage determination. Here we consider the union density (i.e. the ratio of wage and salary earners that are trade union members, divided by the total number of wage and salary earners), the minimum wage relative to the median wage for full-time workers and the degree of wage bargaining centralisation. The latter is taken from the CEP-OECD institutions data set and is based on Ochel (2000). The measure is an index with a range $\{1, 3\}$ where 1 = company/plant level bargaining; 2 = sectoral level; 3 = central level.

To consider the strictness of the employment protection legislation in the three countries, we make use of the OECD EPL indicator. The OECD has three synthetic indicators of the employment protection. One for regular employment, one for individual and collective dismissals and one for temporary employment. Each of the indicators is an index with a range $\{0, 6\}$ with 0 representing the least and 6 the most restrictive. We create an aggregate EPL index by taking a simple average of the three subindicators.

We also included a measure to proxy for the role of active labour market policies from the OECD. The measure shows the spending on active labour market policies as a % of GDP.

In addition we consider a number of series which capture the population of unemployment or the labour force. First, we look at the share of long term and youth unemployed. However we also consider the share of construction in total employment.

¹¹In our case, this shows the weeks of benefit entitlement excluding times of means-tested assistance.

Finally we also consider the impact of the tax wedge on labour. An increase in the tax wedge is supposed to discourage the search for both the unemployed and the firms. The series we use come from the OECD and are defined as the ratio between the amount of taxes paid by an average single worker (a single person at 100% of average earnings) without children and the corresponding total labour cost for the employer.

Detailed information regarding the construction of the data series can be found in Annex I. A summary of the average values of the variables is shown in Table 1 and Table 2. As can be seen in the table, Portugal stands out compared to Spain and the United in a number of areas. First, the vacancy rate is much lower in Portugal, which broadly reflects the overall lower labour market flows observed in Portugal. Second, as noted already in the introduction, the employment protection legislation is very high, although coming down since the start of the crisis. Third, union density has historically been very high in Portugal and fourth, the minimum wage relative to the median wage is relatively high in Portugal. Unemployment benefit duration was much longer in Portugal compared to the United States prior to the crisis, however after the reforms which took place in the United States, durations are now largely comparable. Finally, whereas pre-crisis the share of the youth unemployment was relatively low in Portugal, the share of long-term unemployed has always been the highest among the three countries. Since the crisis, these shares have further increased.

TABLE 2. Average values of key variables over period 2008m4-2014m12

	Portugal	United States	Spain
Unemployment rate	13.02	7.91	21.33
Vacancy rate	0.31	2.27	5.39
EPL	3.05	0.25	2.38
Unemployment benefit duration	100.68	99.44	104.00
Replacement rate	0.72	0.58	0.77
Overall generosity of the unemployment benefit system	10.55	10.63	11.48
Union density	20.17	11.19	17.63
Degree of centralisation of the wage bargaining process	2.00	1.00	2.38
Minimum wage as a ratio to median wage	0.57	0.37	0.41
Active labour market policies (as % of GDP)	0.57	0.13	0.75
Labour force participation rate	52.08	64.18	74.85
Share of long term unemployed	51.31	36.17	41.92
Share of youth unemployed	31.28	15.93	45.55
Share of construction in total employment	7.28	7.16	7.31
Tax wedge	56.29	30.96	52.31

See Annex I for a detailed description of the data sources.

5 Estimation results and model testing

Tables 3 and 4 below present our main estimation results and Figure 7 in Annex C shows the historical smoothed regime probabilities. We present the results for the specification in which all coefficient estimates (for both the explanatory and information variables) are statistically significant. We have also tested various alternative specifications of the model. This includes formally testing the null hypothesis of no Markov switching and testing a model with three regime switches versus the null hypothesis of a two regime Markov switching model. Such formal tests have been proposed by Hansen (1992), Hamilton (1996), Garcia (1998), and Carrasco, Hu, and Ploberger (2014) (see Hamilton, 2005 for details). We rely on the proposal by Carrasco et al. (2014) which is the optimal test. A detailed and clear exposition of the test can be found in the appendix of Hamilton (2005). In tables 3 and 4 below we present the results of a two regime Markov switching model as our model test results provide overwhelming support for the two regime Markov-Switching model as opposed to a linear model or a model in which three regime switches are allowed.

The model results show the outcome of a specification whereby the intercept coefficient and the slope coefficient for the vacancy rate are allowed to switch. The other coefficient estimates are time-invariant.

When we look at the coefficient estimates for the explanatory variables as shown in Table 3 from this two regime Markov-switching model, we confirm, consistent with theory and other empirical studies, the well-documented evidence of a negative convex relationship between the unemployment rate and the vacancy rate. In both regimes we namely find that the slope coefficient of the Beveridge curve is negative. In addition, the convexity of the relationship is confirmed by the positive and statistically significant coefficient for the squared vacancy rate variable. The negative coefficient for the output gap also confirms that the Beveridge curve tends to shift outward in a cyclical downturn (as suggested by Blanchard and Diamond (1989) and recently demonstrated for the US by Diamond and Sahin, 2014).

When looking at the difference in results between the two regimes, we find that in the regime whereby the Beveridge curve shifts outward (i.e. has a higher intercept coefficient), the curve also flattens, as the negative slope coefficient for the vacancy rate becomes smaller.

TABLE 3. Estimation results of the Markov-switching model

Coefficient estimates		
	Regime 1	Regime 2
Constant	16.61**	13.54**
Vacancy rate	-0.23**	-1.65**
Squared vacancy rate	0.08*	
Output gap	-0.4**	
Variance estimates		
σ^2	6.84**	1.41**

Estimates for equation (4). * denotes significance at 10%, ** at 5% level.

Next we can consider the estimation results for the information variables. These are the coefficient estimates for the variables driving the time-varying transition probabilities. The results are shown in Table 4.

The results in Table 4 show the coefficient estimates for the information variables for the equations for the two transition probabilities:¹² column 2 shows the impact of these information variables on the probability that the Beveridge curve remains outward (which we will call henceforth the "outward regime"). The results from this equation are thus indicative of the factors that may contribute to hysteresis. Column 3 shows the impact of the information variables on the probability that the Beveridge curve remains inward (i.e. the "inward regime").

Considering first the impact of the information variables on the probability of remaining in the outward regime (column 2), we find a stastically significant impact from the minimum wage ratio as well as the interaction between the minimum wage ratio and the degree of employment protection. In more details, the results show that a higher minimum wage relative to the median wage implies it is more likely the Beveridge curve remains in the outward regime. This is in line with the theoretical and empirical literature which shows that a higher minimum wage complicates the matching process in the labour market. A higher EPL ratio per se would not have such an effect as the coefficient estimate is insignificant, thereby confirming the inconclusive findings in the existing literature. However, our results do show that overall, a higher degree of employment protection has durably a detrimental effect on the job matching process if it occurs in conjunction with a high minimum wage ratio (as suggested by the statistically significant interaction term).

¹²It could be argued that the evolution of some of the structural variables is endogenous to the developments in unemployment and the Beveridge curve. For instance, authorities could decide to reform certain aspects of the labor market in response to a worsening matching efficiency in the labor market. To mitigate these potential problems, we include structural variables with one time lag. Moreover, we conducted granger causality tests between the structural variables and the unemployment rate. The results showed that we could not reject the null that the unemployment rate does not Granger cause the different structural variables.

Our results also show that a more generous unemployment benefit system and a longer duration of unemployment benefits makes it more likely to remain in the outward regime. Several recent studies which looked into the impact of extending the duration of unemployment benefits during the Great Recession in the US also reach the conclusion that it reduces the job search intensity, thereby contributing to a more outward shifted Beveridge curve (see for instance Nakajimo, 2012 for a theoretical exposition and Ghayad, 2013 for an empirical approach). In our estimations, we also checked the significance and importance of other characteristics of the unemployment benefit scheme (such as the replacement rate or an index proxying the overall generosity of the unemployment benefit system). The variable measuring the overall generosity of the unemployment benefit system was also statistically significant, whereas the replacement rate was not.

TABLE 4. Estimation results of the transition probabilities

	p(1,1)	q(1,1)
constant	-5.75**	-20.36**
minimum wage ratio	2.16*	-3.60*
EPL	-4.60	5.66
EPL* minimum wage ratio	9.44**	-10.42**
Centralisation of wage bargaining	2.73	-1.57**
Unemployment benefit duration	0.08*	-0.06*
Generosity of the unemployment benefit system	1.25**	-0.75*
Union density	-0.28	-0.27*
(lagged) share construction in employment	-0.01**	0.01

* denotes significance at 10%, ** at 5% level.

Finally, our results also suggest that a disproportionate contraction in the construction sector increases the probability that the Beveridge curve remains outward. The impact of developments in the construction sector on the Beveridge curve was also confirmed by Hobijn and Şahin (2012) and is in line with the finding that a shift in the composition of job openings away from construction results in a decline in measured aggregate match efficiency (see section 3). Our findings would suggest that if the downsizing in the construction sector is permanent, then it is less likely that the Beveridge curve shifts back. Such a finding may imply that it may be more difficult to re-allocate workers from the construction sector towards other sectors in the economy.

Now we can also consider the impact of the information variables on the probability of remaining in the inward regime (Table 4, column 3). Here we find that for the EPL, minimum wage ratio, unemployment benefit duration and generosity of the unemployment benefit system, the results are the mirror image of the other equation. However, the results also suggest there are some additional variables which have an impact on the likelihood to remain in the inward regime while not causing hysteresis. More concretely, the results show that a more centralised wage bargaining system and higher union density makes it more likely that the Beveridge curve shifts outwards. From the theoretical perspective, this can be explained as both variables exert a direct impact on the wage determination and thereby affect the Beveridge curve as they impact the job separation rate into unemployment (see Mortensen and Pissarides, 1994). For example, if union power raises the share of the matching surplus going to wages, this will tend to raise the rate of job destruction and shift the Beveridge Curve to the right. The same thing will also happen if factors such as the co-ordination of wage bargaining reduce the extent to which wages at the firm level can fluctuate to offset idiosyncratic shocks and stabilise employment at the firm level (see Nickell et al, 2001).

An alternative specification is also shown in Annex B which includes the long term unemployment rate as an information variable. In this case, however, some other information variables become insignificant and are dropped from the specification (namely EPL, the interaction between the minimum wage ratio and EPL and the share of construction in total employment). The coefficient estimates for the Beveridge curve for this model specification are broadly similar, and so is the evolution of the smoothed probabilities. We prefer the specification presented in Table 4 since

the long term unemployment rate, as included in the alternative specification, may be caused by some of the information variables considered in the regression. The share of long term unemployed provides nevertheless the best summary proxy for the possible impact of hysteresis effects on the Beveridge curve and we therefore also present in Annex B this alternative specification. As Table A2 shows, a higher share of long term unemployed increases the probability that the Beveridge curve remains outward shifted, or differently formulated, makes it less likely that the Beveridge curve shifts back inwards. The remainder of the estimation results are broadly the same, except that in the results in Table B2 the unemployment benefit duration only affects the probability that the Beveridge curve remains outward but has no statistically significant effect on the probability that the Beveridge curve shifts outward.

6 Implications of the empirical results for the Portuguese Beveridge Curve

What are the implications of our empirical findings for the outlook of the Portuguese Beveridge Curve and the unemployment rate?

In Figure 5 (LHS) below we depict the marginal effect of the cyclical component and the decline in the construction sector on the unemployment rate in Portugal according to our model estimates.¹³ The Figure shows the evolution of the actual unemployment rate and compares it to the model estimate of the unemployment assuming the the share of the construction sector in total employment and the cyclical position of Portugal would have remained unchanged compared to January 2008. As can be seen, these two factors explain an important part of the increase in the Portuguese unemployment rate during the crisis. In Figure 5 (RHS) in turn, we can see the marginal impact of the reforms which were implemented during the financial assistance programme for Portugal. The reforms which are included in the counterfactual analysis are: the change to the unemployment benefit system (duration and replacement rate), the changes to the employment protection legislation and the changes in the wage bargaining system. Overall these changes have had an important impact on the evolution of the Portuguese unemployment rate. In fact, in the absence of these reforms, the model would suggest that the unemployment rate would have been significantly higher, reaching above 20%.

Another important variable which drives in our model the evolution of the Beveridge curve, and hence the unemployment rate, is the evolution of the minimum wage ratio. In the case of Portugal, at the outset of the programme, a broad-based agreement was reached to freeze the minimum wage at EUR 485 per month. The minimum wage remained at that level until October 2014, when it was increased to EUR 505 per month. However, between 2008 and 2011 the minimum wage had been increased a number of times, which resulted in an important upward drift in the ratio of the minimum wage to the median wage over that period. The increase in the minimum wage ratio over that period contributed to an increase in the unemployment rate of around 2 pp. Since the start of the economic and financial assistance programme, the minimum wage ratio has been fluctuating around a more stable trend, to then increase again in October 2014, following the decision to increase the minimum wage. Figure 6 shows the marginal effect of the movements in the minimum wage ratio assuming an unchanged ratio compared to January 2008 (LHS) and compared to May 2011 (RHS). As can be seen, in the Figure on the RHS, the impact of the minimum wage ratio since the start of the economic and financial assistance programme has been marginal on the evolution of the unemployment rate in Portugal.

¹³Note that the model estimates included country fixed effects which we incorporate in the results shown in this section. To arrive at the model based counter-factual estimate of the unemployment rate we weight the model based unemployment rate in each regime with the filtered probability of being in each regime. The latter is dependent on the shift factors.

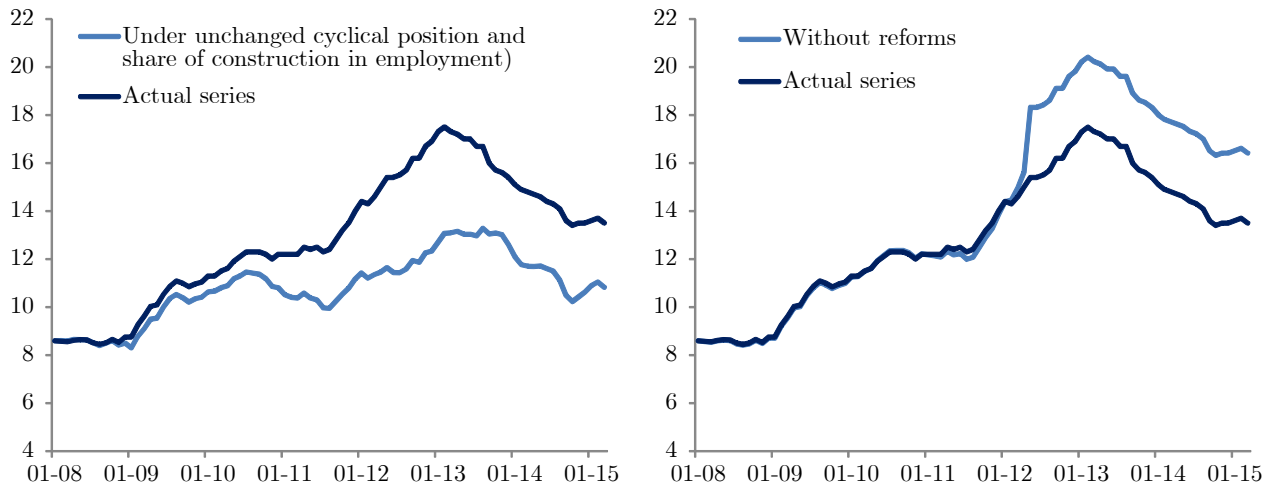


Figure 5: The evolution of the Portuguese unemployment rate compared to the evolution in case the cyclical position and the share of construction in total employment would have remained at their January 2008 value (LHS) and compared to the evolution assuming no reforms would have taken place after January 2008 (RHS).

Besides considering the marginal impact of a number of variables on the recent evolution of the Portuguese unemployment rate, we can also use the model to look at the probability that the Beveridge curve, which according to our model estimates is currently at a higher probability in the outward shifted regime, shifts back and that the unemployment rate returns to the pre-crisis low levels. Based on the latest data included in our model estimates (2014m12), the probability that the Beveridge curve shifts inwards stands around 40%. The probability that the curve shifts back is importantly held back by the high minimum wage ratio in combination with the still high levels of EPL. Moreover, assuming that the contraction of the construction sector is permanent, this will also hold back the return of the unemployment rate to pre-crisis lows. However, the reduction in the unemployment benefit duration, the overall generosity of the unemployment benefit system and the EPL ratio, which were all altered under the economic and financial assistance programme, have all increased the likelihood that the Beveridge curve shifts back and that unemployment returns to its pre-crisis lows.

7 Concluding remarks

In this paper we analysed the determinants of the Beveridge curve for a panel of three countries, namely the US, Portugal and Spain, over the period 1986m1-2014m12 using a Markov-switching panel model with time-varying transition probabilities. Our model estimates confirm the long-standing finding in the literature in that there exists a negative convex relationship between the unemployment and vacancy rate. Moreover, we confirm that a temporary outward shift of the Beveridge curve can be caused by cyclical factors. In our estimations, we find that our preferred model specification allows for the existence of two regimes, one where the Beveridge curve is more inward shifted and steeper and another where the Beveridge curve is flatter and more outward shifted. Our estimation results also suggest that it is more likely that the Beveridge curve shifts outward when the union density is high, the wage bargaining system is more centralised and there is a cyclical downturn which disproportionality affects the construction sector. However, these factors do not cause hysteresis (i.e. that the Beveridge curve remains outward shifted). Instead, the Beveridge curve is more likely to remain shifted outward in case of a long duration of the

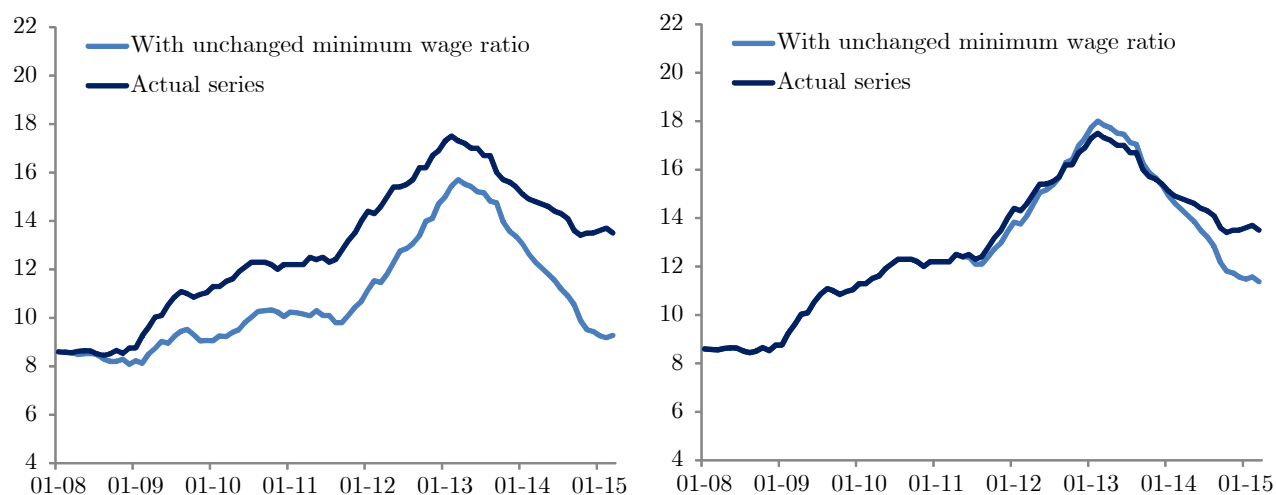


Figure 6: The evolution of the Portuguese unemployment rate compared to the evolution in case the minimum wage would have remained unchanged since 2008m1 (LHS) and since 2011m5 (RHS).

unemployment benefits and if the minimum wage is high relative to the median wage. The latter is further compounded when there is strict employment protection legislation.

In the case of Portugal we find that the outward shift in the Beveridge curve, as we have observed it since 2008, has been mostly driven by the depth of the cyclical downturn, the contraction in the construction sector and the relatively high minimum wage compared to the median wage.

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Appendices

A Data sources

UNEMPLOYMENT RATE

Definition: number of unemployed persons as a % of number of persons in the labour force.

Units and frequency: Percentage (%), source provides monthly data.

Source: Global financial data for all countries.

VACANCY RATE

Definition: Number of vacancies (defined as a paid post that is newly created, unoccupied, or about to become vacant) as a % of number of persons in the labour force.

Units and frequency: Percentage (%), source provides monthly data.

Source: Portugal and Spain: OECD for unfilled job vacancies; United States the data was constructed as described in Valetta (2005) based on JOLTS (BLS) and the help-wanted index (conference board). The calculation of the labour force series is explained below for the three countries is explained below.

LABOUR FORCE

Definition: Number of persons holding or seeking a job among the working age population.

Units and frequency: Number of persons, source provides monthly data.

Source: Portugal: OECD (derived from the number of unemployed and unemployment rate available); Spain: Eurostat (derived from the number of unemployed and unemployment rate available); United States: BLS.

OUTPUT GAP

Definition: The output gap was derived as the cyclical component from applying a bandpass filter to the quarterly GDP series.

Units and frequency: Deviation from trend, monthly series by cubic spline interpolation from the quarterly series.

Source: Global Financial Data for the real GDP series.

EPL

Definition: unweighted average of the EPL for temporary contracts, collective dismissals and individual dismissals.

Units: Unweighted average of 3 indexes ranging each between 0-6 (a higher index indication a higher degree of employment protection).

Source: OECD and author. The monthly data was created by the author by looking up the month the changes to the index were triggered.

DURATION

Definition: The duration of the unemployment benefits for a notional average production worker in the manufacturing sector who is 40 years old and has been working for 20 years.

Units and frequency: weeks. Series are available on annual basis, the author created the monthly series by looking up the month changes were triggered.

Source: Comparative welfare entitlements dataset; details on the dataset can be found in Scruggs (2014).

REPLACEMENT RATE

Definition: The ratio of the income received when unemployed to the income received when employed. This is calculated for a notional average production worker in the manufacturing sector who is 40 years old and has been working for 20 years.

Units and frequency: ratio; Series are available on an annual basis, the author created the monthly series by looking up the month changes were triggered.

Source: Comparative welfare entitlements dataset; details on the dataset can be found in Scruggs (2014).

OVERALL GENEROSITY OF THE UNEMPLOYMENT BENEFIT SYSTEM

Definition: Index constructed as described in Scruggs (2014) which provides an aggregate score of the generosity of the unemployment benefit system.

Units and frequency: Index; Series are available on an annual basis, the author created the monthly series by interpolation based on the movements over time in the replacement ratio and the unemployment benefit duration.

Source: Comparative welfare entitlements dataset; details on the dataset can be found in Scruggs (2014).

UNION DENSITY

Definition: The ratio of wage and salary earners that are trade union members, divided by the total number of wage and salary earners.

Units and frequency: ratio; Series are available on an annual basis, the author created the monthly series using the cubic spline interpolation method.

Source: OECD.

DEGREE OF CENTRALISATION OF THE WAGE BARGAINING SYSTEM

Definition: Index with a range of $\{1, 3\}$ where 1 = company/plant level bargaining; 2 = sectoral level; 3 = central level.

Units and frequency: Index; Series are available on an annual basis, the author created the monthly series by looking up the month where changes have occurred to the wage bargaining system.

Source: CEP-OECD institutions data set.

PARTICIPATION RATE

Definition: The labour force participation rate is defined as the ratio of the labour force to the working age population.

Units and frequency: %; Series are available on an annual or quarterly basis, the monthly series were created by cubic spline interpolation.

Source: Portugal: Pinheiro (1995) Series longas da economia Portuguesa Pos II Guerra Mundial (annual) and INE (quarterly from 1994Q4); Spain: ; United States: BLS.

SHARE OF LONG TERM UNEMPLOYED

Definition: Share of long term unemployed (more than 1 year) to total unemployed

Units and frequency: %; Series are available on an annual or quarterly basis, the monthly series were created by cubic spline interpolation

Source: Portugal: OECD (annual) and Eurostat (from 1998Q1); Spain: OECD (annual); United States: BLS (monthly)

SHARE OF YOUTH UNEMPLOYED

Definition: Share of youth unemployed (15-24) to youth labour force.

Units and frequency: %; Series are available on an annual, quarterly or monthly basis, conversion to the monthly series was created by cubic spline interpolation

Source: Portugal: Pinheiro (1995) Series longas da economia Portuguesa Pos II Guerra Mundial (annual) and INE (monthly from 1998m2); Spain: Servicio Publico de Empleo Estatal and OECD (monthly series); United States: OECD (monthly).

SHARE OF CONSTRUCTION SECTOR IN TOTAL EMPLOYMENT

Definition: Share of employment in construction sector relative to total employment

Units and frequency: %; Series are available on an annual, quarterly or monthly basis, conversion to the monthly series was created by cubic spline interpolation

Source: Portugal: Pinheiro (1995) Series longas da economia Portuguesa Pos II Guerra Mundial (annual), Eurostat (1995Q1) and INE (2005m1); Spain: INE (quarterly); United States: OECD (monthly).

ACTIVE LABOUR MARKET POLICIES

Definition: Expenditure on active labour market policies as a % of GDP

Units and frequency: % of GDP; Series are available on an annual basis, conversion to the monthly series was created by cubic spline interpolation

Source: OECD.

TAX WEDGE

Definition: The tax wedge is defined as the ratio between the amount of taxes paid by an average single worker (a single person at 100% of average earnings) without children and the corresponding total labour cost for the employer.

Units and frequency: %; Series are available on an annual basis, the author created the monthly series using the cubic spline interpolation method.

Source: OECD.

MINIMUM WAGE AS A RATIO OF MEDIAN WAGE

Definition: Minimum wage relative to median wage for full-time workers.

Units and frequency: %; Series are available on an annual basis, the author created the monthly series using the cubic spline interpolation method.

Source: OECD.

B Estimation results for alternative model specification including the long term unemployment rate

TABLE A1. Estimation results of the Markov-switching model

Coefficient estimates		
	Regime 1	Regime 2
Constant	4.65**	1.59**
Vacancy rate	-1.30**	-0.38**
Squared vacancy rate	0.12**	
Output gap	-0.6**	
Variance estimates		
σ^2	4.3**	1.2**

Estimates for equation (4). * denotes significance at 10%, ** at 5% level

TABLE A2. Estimation results of the transition probabilities

	p(1,1)	q(1,1)
constant	-4.09**	-6.10**
long term unemployment rate	0.02**	-0.01
minimum wage ratio	9.08**	-0.61**
Centralisation of wage bargaining	0.24	-0.11*
Unemployment benefit duration	0.03**	-0.04
Generosity of the unemployment benefit system	0.06**	-0.10
Union density	-0.09	-0.07*

* denotes significance at 10% level. ** at 5% level. .

C Smoothed regime probabilities of the Markov-switching model

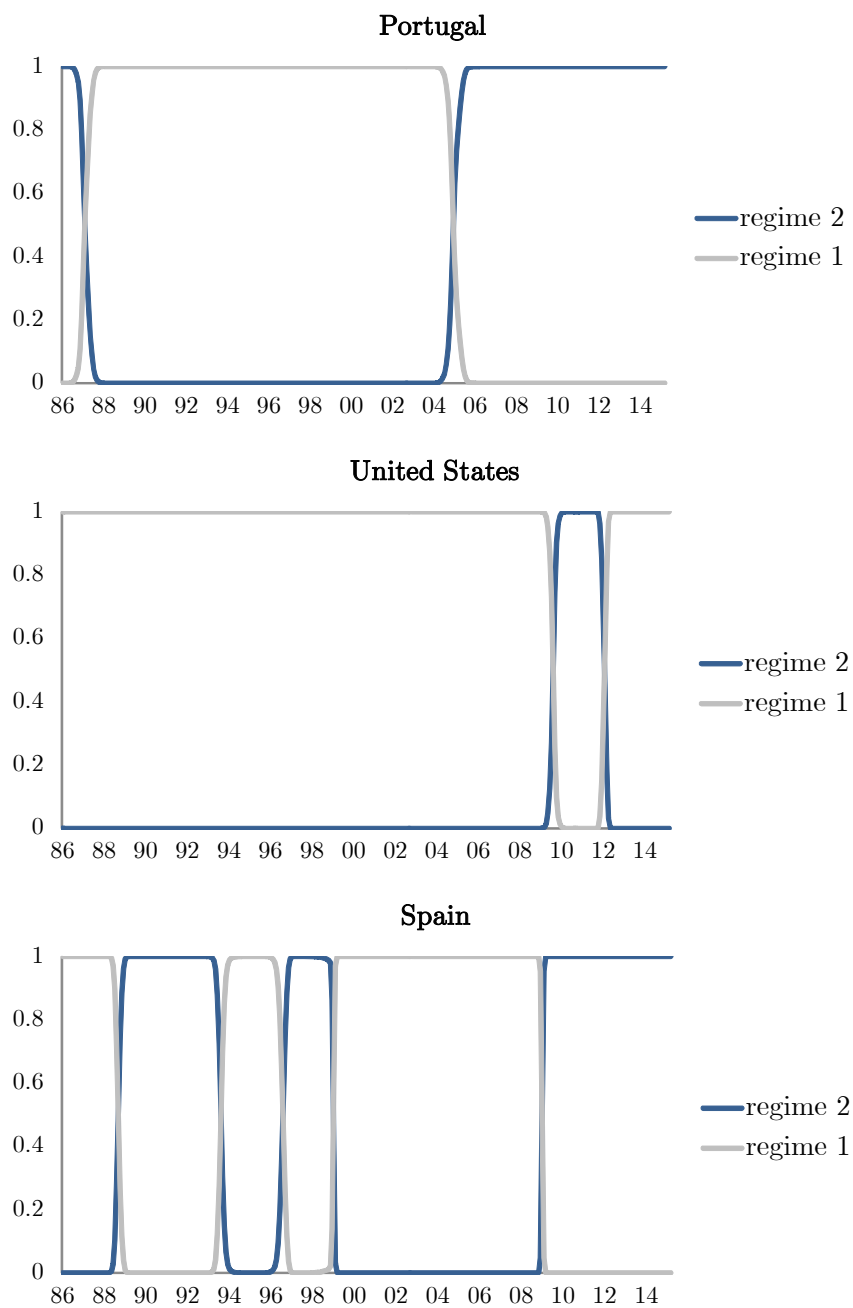


Figure 7: Historical smoothed regime probabilities of the Markov-switching model as presented in Table 3.

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