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Matching efficiency and the role of institutions in the European labour market

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Abstract

The matching efficiency of the labour market refers to its ability to bring together the demand and the supply of labor. The job matching capabilities of the labour market are a main determinant of the equilibrium rate of unemployment. The first chapter of the research provides the necessary theoretical foundations to properly understand the link between matching efficiency and the equilibrium rate of unemployment. The empirical background shows how the Beveridge curve model has been used to study the dynamics of the labour market. The research culminates in an empirical analysis examining the developments of matching efficiency and unemployment in the European labour market during the Great recession. The application focuses on investigating the influence of labour market institutions on the Beveridge curve position. The analysis of the European Beveridge curve shows evidence of an outward shift in the aftermath of the financial crisis. Furthermore a link between the strictness of employment protection law and the magnitude of the shift emerges from the data.

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1 Introduction

In this period of economic crisis everyday news present us with the severe adversities deriving from the high number of job losses experienced during the crisis and the present lack of job opportunities. At the beginning of 2000 the unemployment rate in Europe (EU28) was 9.1%, corresponding to above 20 million persons. After 2004 the figures started declining up to the lowest level of the twenty-first century of 6.8% at the end of 2007 (16.2 million persons). With the outbreak of the economic crisis in 2008 the situation worsened sharply leading to a highest peak of 11% in the first quarter of 2013 (26.6 million). Since then the unemployment level has started decreasing but it has remained substantially higher than the pre-crisis (9.8% at February 2015). The persistently higher level of unemployment has raised concerns on whether this increase it is a cyclical phenomenon or it has become structural. If the natural rate of unemployment has increased, the number of people who cannot find a job would keep being substantially higher than the pre-crisis level also once the economy has recovered. The costs in terms of material and psychological well-being imposed by unemployment on individuals are enormous. The study of the state and functioning of the labor market remains of vital importance for our society, because it can help us to design and implement policies to cope with the unemployment problem.

Unemployed attempt to trade their time, capacities and abilities on the labour market. Any market is the combination of buyers and sellers who want to trade a good or service. An exchange can be divided into three main steps: at first the buyer has to look for the seller that is selling the appropriate good and vice versa; once they have found each other they need to agree on a price at which the good can be traded, which price determines the surplus of the two parties; and finally they exchange the good. Complications at the two preliminary steps can prevent the agreement from being reached; even though a buyer and a seller that want to trade and who would both gain from the exchange exist. These same problems can be encountered in the labor market. The two main instruments macroeconomists have used to understand how the employer-employee exchange works are the Beveridge Curve and the Phillips curve. The former deals with the first step of the exchange: the searching and matching process. While the latter concerns the second step: the wage (price) agreement.

However, given the interconnection of the two steps, it is not entirely accurate to make a clear cut distinction: they rather complement each other in giving a portrait of the labour market functioning.

This paper investigates the first of these two phases: the searching and matching process, with a particular focus on the matching efficiency of the European labor market. The efficiency with which the labor market matches unemployed to unfilled vacancies depends on many elements, such as the degree of mismatch between the skills employers demand for and what workers offer, the location of job offers and unemployed, information available in the market about posted vacancies and available workers, behaviour of firms and unemployed when looking for each other and many others. The labor market is a very complex system involving millions of participants, everyone with different features, different objectives and different aims. The Beveridge curve and the underlying matching function are two instruments relying on a solid economic model that help us to simplify this intricate market and to understand the mechanisms underlying it.

The research is organized in three main chapters: the theoretical background, the empirical background and the empirical analysis. At first a literature review of the search-matching process is presented to shed light on the concept of matching efficiency of the labor market. The starting point for our investigation is the analysis of equilibrium unemployment carried out by Pissarides (2000) in the "*Equilibrium Unemployment Theory*". The three equilibrium conditions on which the Beveridge Curve (BC) is based are presented and thoroughly explained. It is only through a deep understanding of this theoretical passage that one can get a sense of the complex processes governing the creation of employment. The flow equilibrium condition, job creation condition and wage equation explain how people decide whether to look for a job or not, how wages are determined and how firms decide whether to post new vacancies or not. The Beveridge curve depicts the relationship between unemployment rates and job vacancy rates. It can provide powerful insights on how the labor demand, which is represented by the job vacancy rates, meets the labor supply, revealed by the unemployment rates. This first section lays down the theoretical underpinnings of the empirical analysis. In the second section of the theoretical background the examination will focus on the concept of matching function, on which the Beveridge curve is based. This mathematical expedient allows us to capture the impact of frictions in the labour

market on the equilibrium unemployment level, without making explicit all the elements causing interference to the matching process. Given the number of unemployed actively looking for jobs and the number of vacancies posted, the matching function expresses how many matches will be created for a given degree of matching efficiency of the economy, and thus which the equilibrium unemployment level will be. In the third section the attention is devoted to the other central topic of the investigation: the role of policy in influencing the labour market performance. First the investigation will examine how labour market institutions influence the equilibrium level of unemployment and matching efficiency. Secondly it investigates how they affect the response of unemployment to shocks.

The empirical background reviews the main studies that analyze the labour market functioning in the European Union by means of Beveridge curves. The first investigation by Nickell, Nunziata, Ochel and Quintini (2002) looks at developments between 1960s and 1980s laying the foundations for the following works. Bonthuis, Jarvis, Vanhala (2015), Hobijn & Şahin (2012) and Pissarides (2013) investigate unemployment developments in response to the 2007-2008 financial crisis. A high degree of heterogeneity in countries' responses emerges. The literature has been focused on identifying reasons why in the aftermath of the financial crisis unemployment has remained persistently high, even after vacancies have recovered. This increase in the level of unemployment for a given vacancy rate is an evident sign of declining matching efficiency. The main drivers of rising frictions in the labour market are identified to be sectoral mismatch, the housing crisis and some evidences also point to labour market institutions. Two of the papers also provide an insightful comparison between US and EU labour markets. The empirical background is a starting point for the analysis presented in the next chapter.

The empirical part drives forward the topic with a particular focus on the role played by labour market institutions during the crisis. At first the Beveridge curve is estimated for European countries classified by welfare regimes. Then an attentive study of the development of matching efficiency and unemployment during the global financial crisis is carried out. The investigation observes an outward shift in the European Beveridge curve, which is evidence of a deterioration in matching efficiency. It also confirms that responses to the downturn vary greatly from country to country. The main concern is that if the Beveridge curve shift is permanent, it is likely to result in an increase in the equilibrium rate of unemployment. The hypothesis that

heterogeneity is due to the presence of different labour market institutions is examined. The core of the empirical analysis evaluates the role of institutions in exacerbating the effect of shocks on the job matching capabilities of the labour market, and therefore on the equilibrium level of unemployment.

The need for economic analysis to keep on studying the functioning of the labor market appears clear when we remember that behind these models and behind numbers there are people's lives. The fear of becoming unemployed or of not being able to find a job is among the greatest burdens man carries along during his modern life. The costs of being unemployed encompass the privation of means to meet one's own subsistence needs, the defeating and self-destroying psychological costs that undermine mental well-being and often the exclusion from social life. Curbing unemployment remains therefore a central concern for policy makers. The economic analysis should continue studying the labour market to portrait an always clearer picture of its functioning. The ultimate aim lies in the identification of guidelines on how to improve the efficiency of the matching process and to reduce the equilibrium level of unemployment.

2 Theoretical background

2.1 The equilibrium unemployment theory: the three equilibrium conditions of the labour market and the Beveridge curve derivation

In the labour market the worker and the employer enter into a voluntary transaction: the employee gives away his labour in return for a salary. The parties are willing to trade because both benefit from the exchange. However many obstacles can hamper this process. Many frictions exist that prevent the employee-employer match to come about. First of all the labour market is made up of millions of independent agents. The first impediment to the creation of employment is the time it takes to the worker and the firm to find each other. Vacancies are posted through several channels and on the other hand a worker might adopt a set of different strategies to find the job he wants to apply for. Even if the appropriate worker for an unfilled vacancy exists, it might take one month as well as one year for the two to come together, but this might also never happen. This first class of problems is the result of congestion externalities, heterogeneities and imperfect information. Even if this first friction did not exist and there were perfect information, meaning that an employer would discover immediately if a suitable employee for the position he offers is on the market, there would still be employees that don't fit any vacancy and vacancies for which no employee is appropriate. In this case the unemployment and the unfilled vacancies result from mismatches in terms of skills or geographic location (the suitable employee might exist but in another market).

Frictions proper of the labour market and discrepancies of labour demand and labour supply induce a natural rate of unemployment, defined as the average rate of unemployment that would prevail in the absence of business cycle fluctuations (Brauer 2007). Therefore it is not the result of demand factors but rather of supply factors: it depends on structural features of the labor market and it changes slowly over time. The natural rate hinges on frictional and structural unemployment. The former reflects the normal time the unemployed spends in job search, while the latter concerns the mismatch between employers' labor demand and the skills and geographic location of the unemployed (Daly, Hobijn, Şahin, & Valletta 2012).

A major achievement in the study of equilibrium unemployment is *"The Equilibrium Unemployment Theory"* by Pissarides (2000). This key work explains how the employee-employer exchange takes place unveiling the factors influencing the efficiency with which the labour market matches unemployed to unfilled vacancies. In this section we go over Pissarides' analysis so as to provide a general model in terms of which we can think of the labour market matching process and of equilibrium unemployment. The review focuses on the three equilibrium conditions that constitute the pillars of Pissarides' theory. They point out the key role that the behaviour of workers and firms together with the degree of matching efficiency of the economy have in determining the equilibrium rate of unemployment.

The model relies on the following simplifying assumptions. A worker may be employed or unemployed but only the unemployed looks for a job (Pissarides show that if on the job search is included in the analysis results are pretty much the same). A firm with many jobs may have some of them filled and some of them unfilled; vacancies are posted only for unfilled jobs. Every period some of the jobs break up because of firms specific shocks: the previously employed enter in the unemployment pool. Firms and workers have full knowledge of the job-matching and job-separation processes. Each operates independently as an atomistic competitor with full rational expectations.

The flow equilibrium condition

The cornerstone of the whole model is the matching function, which gives the number of matches as a function of the number of unemployed and vacancies. It is assumed increasing in both its arguments, concave and homogeneous of degree 1.

$$mL = m(uL, vL) \tag{1}$$

This relation states that, given a certain number of unemployed workers to vacant jobs, how many pairs are formed depends on the matching efficiency of the labour market, which determines the function's shape. As it will be clearly explained in the second section of the theoretical chapter, the matching function captures all those factors and mechanisms that work in the labour market to bring together unemployed and vacancies to create new matches. This tool allows us to talk about matching efficiency without the need to explicitly take into account all the factors that govern it.

The matching function determines the rate at which vacant jobs become filled, which is given by the number of matches over the number of vacancies.

$$q(\theta) = \frac{m(uL, vL)}{vL} = m\left(\frac{u}{v}, 1\right) \tag{2}$$

By the homogeneity of the matching function, this rate reduces to a function of the v/u ratio that Pissarides defines as $q(\theta)$, where $\theta = v/u$.

The matching function also determines the rate at which an unemployed worker moves into employment subsequently to a new match. This rate is given by the proportion of unemployed that every period finds a new job.

$$p(\theta) = \frac{m(uL, vL)}{uL} = m\left(1, \frac{v}{u}\right) = \theta q(\theta) \tag{3}$$

θ represents the relative number of traders and we will refer to it as the labor market tightness. It influences the speed and easiness with which an employer finds a new employee and an unemployed finds a new job. A large θ means there are few job seekers relative to the large number of vacant jobs. Job seekers have a large number of vacant jobs to choose from and it is therefore easier for unemployed to find a job, but more difficult for employers to fill vacancies: the labor market is tight for firms. Traders impose congestion externalities on each other.

Job-specific idiosyncratic shocks (reduction in productivity, fall in the relative price of goods, etc.) hit workers moving them from employment to unemployment at the exogenous rate λ. Therefore, the flow into unemployment during the small time interval Δt is given by the following equation:

$$\lambda(1 - u)L\Delta t \tag{4}$$

While the flow out of unemployment is given by

$$\theta q(\theta)uL\Delta t \tag{5}$$

The steady state is defined as that state of the economy in which the unemployment rate is constant: the flow out of unemployment equals the flow into unemployment.

$$\lambda(1 - u) = \theta q(\theta)u$$

$$u = \frac{\lambda}{\lambda + \theta q(\theta)} \tag{6}$$

The flow equilibrium condition expresses the equilibrium unemployment rate as a function of the labour market tightness. By the properties of the matching function this equation can be represented as a downward sloping convex to the origin curve in a tightness-unemployment space or in a vacancy unemployment space: this relation is called the Beveridge curve. When there are more vacancies unemployment is lower because the unemployed find jobs more easily. The equilibrium unemployment

rate is determined by the job creation rate $\theta q(\theta)$, which depends on the matching function and the market tightness, and the exogenous job destruction rate (λ). The central role of the matching function in shaping the unemployment rate at equilibrium highlights how important the degree of matching efficiency of an economy is. Indeed in the model it is the matching efficiency of an economy that, given the starting v/u level, determines the matching rate and consequently the equilibrium unemployment. Now the analysis will proceed by incorporating in the model at first firms' behaviour and afterwards workers' behaviour, to see how θ is determined.

The job creation condition

The simplified model assumes that each firm has one job and that firms' behaviour is governed by profit maximization. Firms will enter in the market until the profit gets equal to zero, meaning that at the equilibrium the profit from posting a new vacancy is zero. The present discounted value of a new vacancy is

$$V = -\delta pc + q(\theta)\delta J + [1 - q(\theta)]\delta V \tag{7}$$

Where $\delta = 1/(1+r)$, pc are the hiring costs, $q(\theta)\delta J$ is the expected value of a filled job (the probability that the job is filled times the value of the job J) and $[1 - q(\theta)]\delta V$ is the expected value of an unfilled vacancy. It follows that

$$(1-\delta)V = -\delta pc + \delta q(\theta)(J - V)$$

$$rV = -pc + q(\theta)(J - V) \tag{8}$$

In equilibrium $V = 0$, thus

$$J = \frac{pc}{q(\theta)} \tag{9}$$

The present discounted value of a job is instead

$$J = \delta(p - w) + (1 + \lambda)\delta J \tag{10}$$

$(p - w)$ is the net return earned: value of the product minus the wage. The other term represents the exogenous risk for the job of an adverse shock. By substituting r for δ we get

$$rJ = p - w - \lambda J \tag{11}$$

By substituting (9) into (11), we get the job creation condition

$$p - w - \frac{(r + \lambda)pc}{q(\theta)} = 0 \tag{12}$$

The marginal product of labor (p) has to be equal to the marginal cost of hiring an additional worker (the wage plus the expected capitalized value of the firm's hiring cost). This equation represents a negative relationship between θ and w. It can be represented as a downward sloping curve in the θ, w space. This downward sloping curve is the job creation curve and it represents a labour demand. The higher the wage that results from the employer-employee bargaining, the lower the profit for the firm of posting a new vacancy, and consequently the lower the number of vacancies that the firm will want to post for a given number of unemployed (θ). To fully characterize the equilibrium condition we know need to introduce in the model also the supply side of the labor market.

Wage determination

The following assumptions hold. The labor supply L is constant. Each worker has the same productivity p and same search intensity. W is the wage the worker earns when employed. z is what he earns when searching for a job, which encompasses unemployment benefits, return from self-employment and leisure activities. Every worker is either employed or searching for a job (no on-the-job search is allowed). The present-discounted value of the expected income stream of an unemployed worker is

$$U = \delta z + \theta q(\theta)\delta W + [1 - q(\theta)]\delta U \tag{13}$$

z is the income the unemployed receives in the current period. In the next period he expects to become employed with probability $\theta q(\theta)$ getting the wage W, and to remain unemployed with probability $[1 - \theta\, q(\theta)]$ getting again the income U. By substituting r we get

$$rU = z + \theta q(\theta)(W - U) \tag{14}$$

rU is the reservation wage of a worker. The present-discounted value of the expected income stream of an employed worker is

$$W = \delta w + \lambda\delta U + (1 - \lambda)\delta W$$

$$rW = w + \lambda(U - W) \tag{15}$$

w is the wage the employed worker receives in the current period. He expects to become unemployed with probability λ, getting the unemployed income U; and to remain employed with probability $(1 - \lambda)$, getting W. With discounting employed workers have a higher income than unemployed ($W > U$).

When a job match occurs a surplus is created. How it is shared among the employer and the employee depends on the wage w. The surplus that goes to the employer is given by $J - V$, while the part going to the employee is $W - U$. The model assumes that surplus is shared according to the Nash solution to a bargaining problem: the wage maximizes the weighted product of the worker's and the firm's net return from the job match.

$$w = \arg\max(W - U)^{\beta} (J - V)^{1-\beta} \tag{16}$$

β is the labor's share of the total surplus, in symmetric Nash bargaining solutions β=1/2. The first order condition gives

$$W - U = \beta(J + W - V - U) \tag{17}$$

By substituting in the FOC equation (9), (11) and (14), we get the wage curve equation

$$w = (1 - \beta)z + \beta p(1 + c\theta) \tag{18}$$

The wage curve represents a positive relation between wage and market tightness. It can be pictured as an upward sloping curve in θ, w space. The resulting wage maximizes the total surplus from the match. It depends on the labour share of the surplus (β) and on the bargaining power of the parties determined by the market tightness. The higher θ, the more vacancies there are relative to unemployed, the higher the bargaining strength of unemployed which has a positive effect on their wage.

The steady state equilibrium

To recapitulate, the three equilibrium conditions that have to be satisfied at the steady state are:

The flow equilibrium condition (BC)

$$u = \frac{\lambda}{\lambda + \theta q(\theta)}$$

The job creation condition (JC)

$$p - w - \frac{(r + \lambda)pc}{q(\theta)} = 0$$

The wage equation (WC)

$$w = (1 - \beta)z + \beta p(1 + c\theta)$$

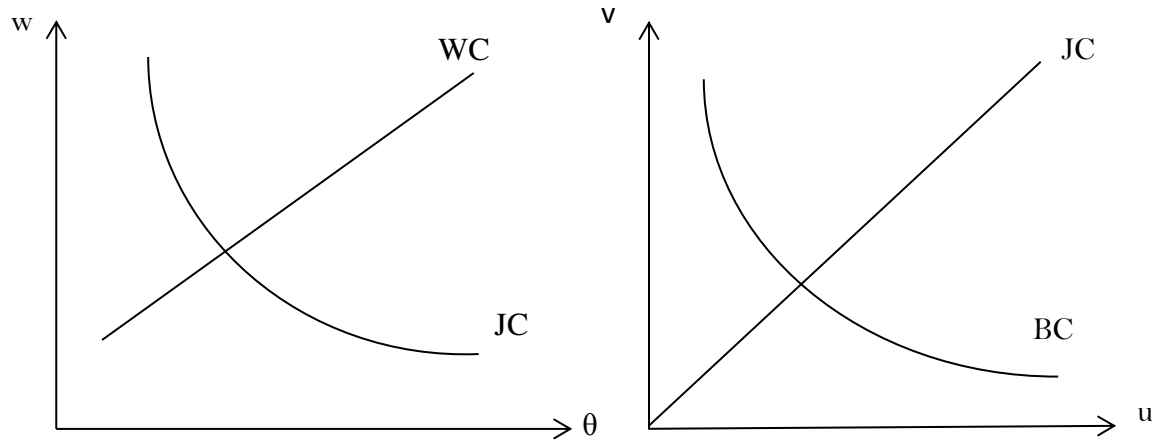

Figure 1. The steady-state equilibrium

Which are the dynamics that determine the equilibrium level of unemployment? The first figure shows how the level of θ in the market is determined. The initial level of tightness in the labour market shapes the bargaining positions of workers and firms, which regulate how the surplus from the match is shared and thus the wage. Once the wage is set firms decide how many vacancies to post determining the v/u ratio. The equilibrium v/u ratio is at the intersection of the JC and the WC. The prevailing level of θ is represented in the second graph by a straight line with slope v/u. The equilibrium level of the unemployment rate can be identified at the intersection of the JC and the BC curve. Given the ratio of vacancies to unemployed in the market (determined in the previous step), the matching efficiency of the labour market and the job destruction rate, the Beveridge curve determines the equilibrium levels of vacancy and unemployment rates.

The main finding of this section is that the equilibrium rate of unemployment can be derived by the intersection of two curves: the Beveridge curve, which incorporates all the features of the matching function therefore describing the job matching capabilities of the labor market; and the job creation curve, determined by firms' recruiting behaviour and hence among other elements by wage bargaining, the state of the economy (job separation rate, value of jobs) recruiting costs, interest rates (Daly, Hobijn, Şahin & Valletta, 2012). The analysis proceeds with a further investigation of the matching function.

2.2 The Matching function: a representation of frictions in the labour market

The attention is now drawn to the matching function because a clear understanding of the meaning of this basic tool, which has been only introduced in the first section, is essential to appreciate the fundamentals lying behind the Beveridge curve. The examination relies on the findings of an outstanding work in this matter, *Looking into the Black Box: a survey of the matching function* (Petrongolo & Pissarides, 2001).

In order to better comprehend the notion of matching efficiency and the value of the matching function, it might be useful to think at what would happen if there would be no mismatch in the labor market. In this unrealistic but simple scenario vacancies would meet immediately with unemployed. If all the workers were identical and all vacancies were demanding for this unique typology of worker; if there was perfect mobility, meaning that a worker would be willing to move wherever the vacant job is; and if furthermore perfect information was available on the market, then the number of matches would be given by $M = min(U, V)$.

However, many frictions that hinder the matching process exist. First of all the labor market is characterized by heterogeneities in terms of skills and locations: employers look for different kinds of workers and every worker is different from the other having diverse skills and abilities. There is no perfect mobility because a worker might not be willing to move outside a certain geographic area. Information imperfections prevent unemployed from learning about all job offers and about the features of the job and the other way around. Congestion from large numbers exist: the more are the workers looking for a job the more difficult it is for every one of them to find one, and the more the vacancies relative to the unemployed the more difficult it is for each employer to find a suitable worker. All these frictions result in a positive number of unemployed and vacancies at equilibrium.

The matching function captures the influence of frictions on the equilibrium level of unemployment. It summarizes "a trading technology between agents that eventually bring them together into productive matches" (Petrongolo & Pissarides, 2001). It is a convenient device that "partially captures a complex reality [...] with workers looking for the right job and firms looking for the right worker" (Blanchard

and Diamond, 1989). Given the number of vacancies and unemployed in the economy, how many matches are created depends on the matching efficiency of the labour market. The matching function gives the number of matches without explicitly accounting for all the frictions/factors that influence the matching efficiency. The simplest form is:

$$M = m(U, V)$$

It relates the flow of new hires to the stocks of vacancies and unemployment. As for the other aggregate functions used in economics, its usefulness depends on its empirical viability. Petrongolo and Pissarides' survey reports that most studies found a Cobb-Douglas approximation of the matching function with constant returns to scale fits the data well.

$$m_t = m_{0t}\, U_t^{\alpha}\, V_t^{1-\alpha}$$

A parallel can be drawn with the aggregate production function ($Y_t = A_t\, K_t^{\alpha}\, L_t^{1-\alpha}$), which expresses the relationship between inputs to production and output. It summarizes a production technology that is not made explicit, in the same way as the matching function summarizes a trading technology that is not made explicit. The matching efficiency of an economy is captured by the term m_0. As the Solow residual A captures all those factors explaining the variation in Y that are not part of input accumulation (K and L accumulation), m_0 captures all those factors that influence the number of matches apart from the number of unemployed and vacancies present in the economy. m_0 embodies the job matching capabilities of a labour market. While many studies have been conducted on the determinants of the Solow residual in the context of the production function, few researches have been carried out on the behavior and determinants of matching efficiency.

If we divide both sides of the equation by the labour force L, the matching rate can be expressed as a function of the unemployment rate and the vacancy rate.

$$m = m(u, v)$$

This can be written in log form as

$$ln(m) = ln(m_0) + \alpha ln(u) + (1-\alpha) ln(v)$$

This log-form representation also makes clear that the relation between unemployment and vacancies (Beveridge Curve) is negative.

How do we interpret movements and shifts of the Beveridge curve? Developments of vacancies and unemployment in opposite directions suggest the

economy is moving along the Beveridge curve because of cyclical changes in the aggregate demand (Blanchard and Diamond 1989), which moves the job creation curve. For instance a downward movement along the BC is the typical consequence of a negative shock to aggregate demand: the value of workers' products decreases, firms reduce their production thus demanding less workers (vacancies decrease) and unemployment increases. This circumstance can also induce an outward shift of the curve in the next period. This phenomenon is referred to as unemployment hysteresis: an increase in the actual unemployment rate induces an increase in the equilibrium unemployment rate. When the demand recovers unemployment keeps on being higher than the pre-shock level. Many explanations could exist for such phenomena, such as for instance the deterioration of skills of the unemployed, the increase in sectorial or geographic mismatch due to the concentration of job destruction in a specific industry or geographic area, changes in search efforts or search effectiveness. In general shifts of the Beveridge curve (i.e. higher or lower unemployment rate for a given vacancy rate) are caused by changes in structural factors that result in changes in the efficiency of the economy to match vacancies with unemployed (Bowden, 1980; Petrongolo and Pissarides, 2001). An outward shift implies a reduction of the matching efficiency, and thus, deterioration in the labour market functioning.

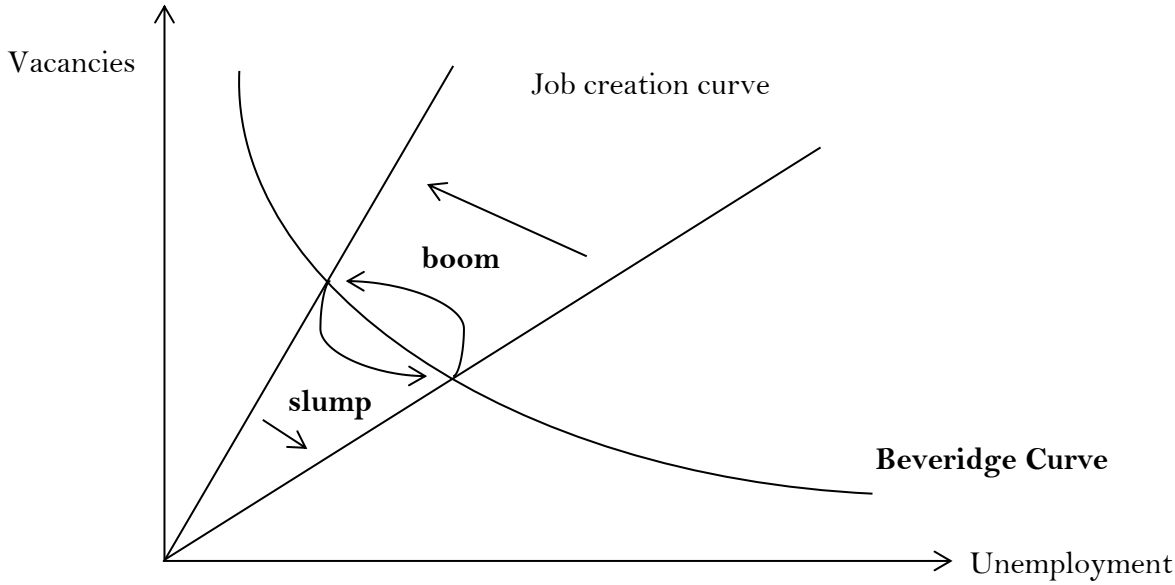

Figure 2 : Economic boom and economic recession in the Beveridge curve diagram

2.3 Determinants of labour market matching efficiency: the role of institutions

The factors that determine the degree of matching efficiency of the labour market encompass all those elements that influence the job matching capabilities of the labor market. As it has been said in the previous section, these determinants go from skills and geographic mismatch to firms and workers' search intensity during trade, information available to traders, technology to exchange this information and other similar elements. A significant role in shaping these characteristics of the trading process is played by policy. The most important labour market institutions that influence the behaviour of traders are: active labour market policies, unemployment benefits, the degree of centralization of bargaining, employment protection law and labour taxes (Nickell, Nunziata, Ochel & Quintini 2002). Many studies have shown the relevance of institutions in determining the equilibrium level of unemployment. Nickell, Nunziata, Ochel & Quintini (2002) found in their study on "*The Beveridge curve, unemployment and wages in the OECD countries form the 1960s to the 1990s*" that 55% of the increase in unemployment experienced during the period analyzed is due to institutional changes. Blanchard and Wolfers (2001) in their study "*The role of shocks and institutions in the rise of European unemployment: the aggregate evidence*" show that an account of the evolution of equilibrium unemployment based on the interaction between shocks and institutions do a good job of fitting the evolution of European unemployment.

In the first part of this section the main channels through which labour market institutions affect unemployment and the matching efficiency are explained. The analysis of how every labour market institution influences the equilibrium level of unemployment is carried out by means of the Pissarides (2000)'s model. In the second part it is investigated how institutions affect the response of unemployment to shocks.

We consider five policy instruments: unemployment benefits, the degree of centralization of bargaining, employment protection law, labour taxes and active labour market policies.

Unemployment benefits raise the income workers perceive when unemployed thus increasing their reservation wage and labour costs to employers. As labour costs increase, the profitability of a new job for employers decreases and the job creation line rotates downward: the equilibrium rate of unemployment rises. The figure below shows how in this circumstance in Pissarides' model the economy would move from point A to B. Furthermore unemployment benefits are likely to reduce workers'

incentives to quickly look for and accept a job offer. This mechanism result in a decline in matching efficiency.

The structure of wage determination can be essential in determining how the surplus from job creation is divided. In so far as centralized bargaining strengthens the workers' bargaining power, it will result in higher wages and a higher level of equilibrium unemployment as in the previous case (Nickell, Nunziata, Ochel & Quintini, 2002).

Employment protection laws have an ambiguous effect on equilibrium unemployment influencing both hiring and firing decisions. Pissarides (2011) discusses regulations that impose restrictions on employment dismissals. He analyzes the case in which restrictions take the form of taxes. On one hand the introduction of firing taxes tends to reduce job destruction. As firing taxes are introduced the employer aims to reduce job separations in order to pay less taxes. He will need to decrease the minimum productivity level at which workers are fired. As a consequence the average level of productivity decreases and wages decrease as well. On the other hand firing taxes reduce job creation. When the employer hires a person he takes into account the future possibility of paying the tax, and this decreases the profit he earns from job creation. In conclusion both the flow into and out of unemployment falls. The overall effect of employment protection law on unemployment is ambiguous. In the figure below it moves the economy from point D to C. Empirical work shows that the impact is usually small and it can go either way; but the size of the flows falls, there is less labor and job turnover, lower average labor productivity, and longer durations of both unemployment and employment (OECD 1999).

In the matter of labour taxes, the taxes that can impact on equilibrium unemployment are those taxes that introduce a wedge between the real product wage and the real consumption wage (Nickell, Nunziata, Ochel & Quintini, 2002). If the unemployed perceives a return which is not taxed, he will demand an higher wage for working after the tax is introduced (because the alternative activity becomes relatively more attractive non being taxed). In this case firms bear some of the tax burden themselves. This raises their wage costs, reducing their profits, and so leading to fewer jobs and more unemployment.

Some examples of active labour market policies (ALMP) are employment agencies or improvements in the information networks that bring employers and employees together. Because of the costs imposed on traders by search externalities

present in the labor market, the search efforts put in by the parties are too low at equilibrium (Pissarides, 2000). ALMP are necessary to fill this deficiency. A passive labour market policy is an income support policy that does not impose preconditions. These policies, such as for instance a generous unemployment insurance system with no preconditions, lessen workers' incentives to quickly look for and accept a job offer. As a consequence these policies lead to a Beveridge Curve shifted outward. On the contrary policies that intervene by supporting the unemployed during search and incentivizing them to put more effort in the search process can shift the Beveridge curve inward. In this case policies are called "active" and they improve the ability of the market in matching job seekers with free vacancies. They increase the rate of job matching for given vacancies and unemployment.

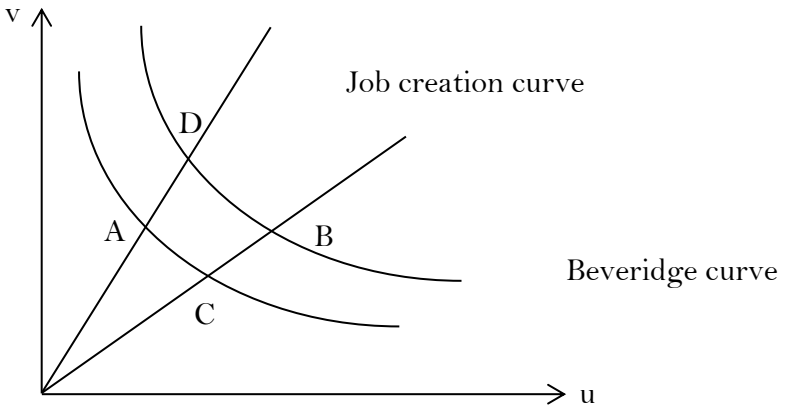

Figure 3 : Labour market institutions and the Beveridge curve

After having examined how labour market institutions affect the Beveridge Curve and equilibrium unemployment, we will now examine how institutions shape the effects of shocks on unemployment. Blanchard and Wolfers (2000) identify two main channels. First of all institutions affect the direct impact of shocks on unemployment: how the economy moves along the BC during a fall in aggregate demand. Secondly they affect the persistence of unemployment in response to shocks: They can cause an adverse shift of the BC and a decline in matching efficiency.

Institutions mainly affect the level of unemployment through their effect on wages. Indeed during shocks labour market institutions such as collective bargaining or wage indexation clauses can prevent wages from falling as aggregate demand falls, leading firms to fire more workers. The reasoning behind institutions' influence on the persistence of unemployment is similar. "*Take an adverse shock which leads to higher unemployment. The normal adjustment mechanism is then for unemployment to put pressure*

down on wages until unemployment has returned to normal. To the extent that some labor market institutions reduce the effect of unemployment on wages, they will increase the persistence of unemployment in response to shocks." (Blanchard & Wolfers, 2000).

The effect of downward wage pressure on unemployment is a powerful adjusting mechanism of the economy. Labour market institutions alter nature, composition of unemployment and the welfare system. The analysis will now explain how these alterations can modify the downward wage pressure.

Many studies claim that stricter labour market institutions generally increase the duration of unemployment. Indeed the introduction of unemployment benefits raise the income an unemployed receives, making the circumstance of being unemployed relatively more attractive than it was before and reducing its incentive to look for a new job. Higher duration tends to reduce downward wage pressure (increasing unemployment). "*In wage equations long-term unemployment is usually found to have a very small (or zero) effect in reducing wage pressure. This can be seen from data on exit rates from unemployment: exit rates decline sharply as duration increases. Equally, aggregate time series show that, for a given level of unemployment, vacancies increase the higher the proportion of unemployed who are long-term unemployed*" (Layard, 1997). Therefore higher duration increases the number of vacancies for a given level of unemployed leading to an outward shift of the BC and a higher level of equilibrium unemployment. The labour market matching efficiency has decreased.

Most often shocks hit stronger less skilled workers and young. Labour market institutions can reduce the downward pressure of these two significant categories of unemployed on wages. The problematic policy rules and institutions in this matter are minimum wages, which not only magnify the effects of the shocks on less skilled but furthermore prevent them from exercising pressure on compensation; and collective bargaining agreements, which usually represent prime age workers, limiting the burden of youth unemployment on wages.

Lindbeck (1995) also explored another channel through which more generous welfare systems can result in higher equilibrium unemployment subsequently to shocks. Before the shock occurs there might be a stigma attached to the class of the unemployed and little awareness of the unemployment insurance system. After a substantial part of the population experiences unemployment this ignorance

disappears. Countries that have particularly generous welfare systems find themselves with individuals taking benefit of it without necessarily needing it.

In conclusion labour market institutions are clearly a major factor affecting the degree of matching efficiency and the equilibrium level of unemployment. They not only affect their levels but also how they change in response to adverse shocks in the economy. Many studies have been conducted on the direction of their influence. Others have dealt with their role in interacting with shocks to give rise to the long-run increase in the European equilibrium unemployment rate from the 1960s. In the empirical analysis the investigation will delve deeper into the role of institutions. In a first part the empirical study will examine how unemployment and matching efficiency of the European labour market reacted to the Great Recession. In the second part the link between labour market institutions and countries' responses to the crisis is investigated.

3 Empirical background

Before delving into the empirical analysis, this chapter presents a review of empirical works who studied the European labour market by means of Beveridge curves. They highlight which are the factors that are found to influence the position of the European Beveridge curve, matching efficiency and the unemployment rate. They cover a period going from the 1960s to the aftermath of the recent financial crisis.

3.1 Nickell, Nunziata, Ochel and Quintini (2002)

The first study that is reviewed is Nickell, Nunziata, Ochel and Quintini (2002). It examines the labour market functioning in a group of OECD countries from the 1960s to the 1990s. They analyze shifts in Beveridge curves, real wages and unemployment and explain them by institutional changes and macroeconomic shocks.

First of all they derive Beveridge Curves for their sample of countries. Outward shifts of the curve are identified by graphical inspection for every country, except Norway and Sweden. The level of unemployment for any given level of vacancy has increased in most of the European countries between 1960s and mid 1980s: this change is a clear sign of declining matching efficiency and of an increasing presence of frictions in the European labour market. However a distinction can be made between two groups: those whose Beveridge curves kept moving outward (Belgium, Finland,

France, Germany, Japan, Norway, Spain, Sweden and Switzerland) and those who showed a trend reversal (Canada, Denmark, Netherlands, the UK and the US).

In the next step of the investigation Nickell et al. estimate a pooled cross country BC by regressing unemployment on the previous year unemployment, the vacancy rate, the inflow rate and institutional variables. The purpose of this regression is to ascertain whether a link between labour market institutions and the worsening conditions of the European labour market exist. Indeed, coefficients on institutions prove to be statistically significant. The main findings are that countries with higher benefit duration or higher union density show a BC more shifted to the right, while those having stricter employment protection law to the left. In order to get a clearer picture of the situation, the authors also make a direct regression of unemployment on institutional variables. According to this second examination employment protection law, employment taxes, union density, and unemployment benefits all are associated with a higher level of unemployment. The most striking result of the research is that changes in labour market institutions explain 55% of the rise in European unemployment from the 1960s to the 1990s.

It appears unequivocal that labour market institutions play a central role in shaping the European unemployment developments. The conclusions reached by Nickell et al. confirm most of the reasoning outlined in the theoretical chapter on the relationship between equilibrium unemployment and institutions. Unemployment benefits not only increase workers' bargaining power during wage negotiations, but they also reduce search incentives of the unemployed. This mechanism is likely to reduce matching efficiency. Nickell et al. seems to confirm this association by finding out that countries with higher unemployment benefits reacted to the 1970s and 1980s recessions with a more severe outward shift of the Beveridge Curve. Union density is also positively related to workers bargaining power, and again countries with higher union density showed Beveridge curves more shifted to the right.

What might appear as surprising is the result concerning employment protection law. In the theoretical literature the effect of employment protection law on unemployment is deemed to be ambiguous: on one hand it reduces layoffs but it also tends to reduce new hires. According to the reviewed study, countries with stricter employment protection law show a higher level of unemployment on one hand, and a Beveridge curve more shifted to the right on the other hand. A possible explanation could be that stricter regulations increase unemployment but at the same time they

decrease vacancies. Indeed the channel through which we would expect employment protection law to increase unemployment is that less people are hired; as a consequence fewer vacancies are posted. Another possible explanation can be found in Bonthuis, Jarvis, & Vanhala (2013), who suggest that stricter employment protection law might favor matching efficiency by pushing employers to potentiate their hiring departments. Hiring the right worker is more important if firing him becomes costly. After having evaluated Nickell et al.'s main findings, the next study of the empirical review can be presented.

3.2 Bonthuis, Jarvis, Vanhala (2015)

Bonthuis, Jarvis, Vanhala (2015) realized a study of the Euro area Beveridge curves at the aggregate and country level over the past 25 years. This publication follows and updates Bonthuis, Jarvis, Vanhala (2013). In this first paper the authors identified the countries for which there had been a Beveridge curve outward shift following the 2007-2008 financial crisis. In a second step they attempted to recognize possible determinants of these shifts by means of a probit model. They regressed a dummy variable taking the value of one for the countries who experienced the shift and zero otherwise on a series of possible shifters. Their aim was clearly to identify those variables that increased the probability of an outward shift of the Beveridge curve in response to the recession. Their results are not reported since the updated investigation is definitely more valuable.

In the latter they study Euro area Beveridge curves movements from 1990s to nowadays. Their reference period follows the one Nickell, Nunziata, Ochel and Quintini (2002) have studied. They find evidence of an outward shift in the 1990s. This episode is reverted over the course of the first decade of the European Monetary Union, when the labour market shows signs of improvement: during the middle years of 2000 the Beveridge Curve shifts inward. This development is likely to be an effect of the reforms countries were undergoing after the entrance in the EMU.

Most of the examination focuses on analyzing labour market's developments following the 2007-2008 financial crisis. A graphical inspection of the Euro area Beveridge curve evidently shows an outward shift of the Beveridge curve, however at country level heterogeneous responses are observed. For instance, in Germany there has been a very small decline in unemployment as vacancies have dropped during the crisis. Afterwards as vacancies have recovered, unemployment has actually decreased:

the Beveridge curve shifted inward. Labour market conditions improved and matching efficiency rose. On the contrary, in France the crisis had a very strong adverse effect. The post-crisis unemployment remained substantially higher than the pre-crisis level.

In the second part of the research, the authors investigate possible reasons behind the shifts by means of the local projection method developed by Jordà (2005). The first features of the labour market they take into account are labour force characteristics. According to their analysis, higher pre-crisis proportions of low-skilled workers in the labour force seem to produce a significant and persistent outward shift of a country's BC. The main explanation they point out is that sectors with many low-skilled workers were particularly hit during the crisis (construction and to a lesser extent manufacturing). At the same time an high share of women tend to shift the BC inward. The reasoning justifying this finding is that the crisis hit mainly male-dominated sectors. For instance the public sector, where women are stronger, has been less hit. A further explanation is that economies with many working women are less prone to fall in a severe consumption crisis, because a two-earner family suffers less from unemployment risk.

Sectoral mismatch is identified as another main shifter. This phenomenon occurs when displaced workers from a shrinking sector are not able to find another job in an expanding sector. The main driver of this increasing mismatch is the fall in construction sector employment, which declined by 7% per year (twice the contraction of the whole economy). Employment in finance and business services does not have a significant effect on the BC position.

The last set of variables examined regard financial conditions. High pre-crisis rates of home ownership shift outward the BC. Homeowners in a particularly hit area are not willing to move to a region offering more possibilities, especially if their house lost value because of the housing crisis (house-lock effect). The ease with which credit was procured also appears to shift the BC outward. The likely explanation being that firms who received finance too easily over-hired previously to the crisis; this over-hiring forced them to fire more workers in the recession.

Summing up the variables linked to the outward shift of the Beveridge curve and to the persistence of higher unemployment are labour force characteristics, the size of the construction sector, the rate of home ownership and the pre-crisis easiness of credit procurement. The observed decline in matching efficiency can be traced back

mainly to an increase in the mismatch between labor supply and labour demand, and to a low mobility of workers.

3.3 Hobijn & Şahin (2012)

Hobijn & Şahin (2012) examine Beveridge curve movements in 14 OECD countries. They make use of a new methodology to derive and analyze the BC. The conventional procedure entails a direct estimation from actual unemployment and vacancy rates. Instead they build fitted Beveridge curves as the steady-state relationship between unemployment and vacancy rates at which the change in unemployment equals zero. This occurs when the employment growth rate equals the growth rate in the labor force. The former can be expressed as the difference between the hiring rate (new hiring as a percentage of employment) and the separation rate (separations as a percentage of employment). Both hires per vacancy and the separation rate depends on the u/v ratio, which has been defined in the theoretical chapter as the tightness of the labour market. Summing up, at the steady state the growth rate of the labor force equals the hiring rate minus the separation rate. Separation rate and hiring rate can be written as a function of the u/v ratio. The fitted Beveridge curve is given by the combinations of u and v for which the equality holds. In order to find them one needs to first identify: the growth rate of the labor force, how the separation rate depends on the v/u ratio and how the hiring rate changes as the u/v ratio changes. To derive the latter the authors estimate a Cobb Douglas matching function following Petrongolo & Pissarides (2001).

This new methodology has a main advantage: by studying labor turnover measures it becomes easier to identify what, in terms of the dynamics of the labor market, is driving deviations from the curve. However some important assumptions are made: the labor market tends to be close to its steady state; the growth rate of the labor force is relatively constant; there are no major changes in match efficiency; and the elasticities of fires and hiring (with respect to the u/v ratio) do not change over time. If one of these parameters change a new estimation taking them into account is necessary.

In a first stage the fitted BC is built for the United States for the years 2000-2007. Actual observations fit well the estimated curve. The main findings are that the relationship remains stable from 2000 to 2007 and also during the first recession years (2007-2008). However from 2009 vacancies recover and unemployment remains high.

The Beveridge curve shifts outward due to a decrease in matching efficiency (hires per vacancies) and to a decrease in the separation rate (mainly less people quit their jobs to find a new one).

The authors recognize the main drivers behind the large fall in matching efficiency. In the first place it comes the significant loss of jobs in the construction sector. The home lock effect, if existent, is deemed to be very small. Also the increase in unemployment benefit duration explains part of the decrease in match efficiency, since it reduces unemployed search incentives.

For the other European OECD countries, data on separation and hiring rates are not available. In order to compute the variables necessary to estimate the fitted BC, the authors use annual data on employment by job tenure, which is likely to decrease the degree of accuracy of the data.

For most countries the fitted BC computed for the years before the crisis (2000-2007) fits the data very well. In all countries, apart from Germany, Belgium, and Japan, post-recession observations are to the right of the fitted BC. Shifts are identified for Spain, UK, Sweden and Portugal. In Spain, UK and Portugal this is associated with a reduction in the degree of matching efficiency, while in Sweden this is associated with an increase in the separation rate. According to the authors' analysis the main reasons are the high job losses in the construction sector for Spain, UK and Portugal, while for Sweden the new reforms that increased unemployment benefits. Some similarities are evident with the US. Spain, UK, Portugal and the US were the countries most severely hit by the housing crisis, while in both US and Sweden unemployment benefit duration increased.

Aiming to gain some more insights from the historical context, Hobijn & Şahin (2012) investigate the shifts prior to the 2000s. Increases in unemployment following the 1970s and 1980s recessions were generally larger than during the Great recession, and also the Beveridge curve shifted out more than during the Great recession. Countries with the biggest movements were Spain, Belgium, Japan, France and Germany. Reference is made to Nickell et al. (2001). The latter identified two main reasons for these shifts. The first is the change in the composition of the pool of unemployed, partly because of the entrance of the baby-boomers and partly because of the displacement of a large number of workers due to the depth of the recessions of the 1970's and 1980's. The US is the only country whose BC moved back after this rightward shift. This raises the following concern. Why in the EU countries BCs

didn't shift back? A likely explanation can be found in Blanchard and Wolfers (2000). The more rigid European institutions interacted with shocks making the increase in unemployment persistent.

According to Nickel et al. (2001) it's not only the level but the change in institutions that matter: those who increased unemployment benefits saw a more severe outward shift. Nickel and Van Ours (2000) point out that changing institutions can also account for backward shifts in the UK and the Netherlands. They both decreased unemployment benefits and moved to cooperative wage bargaining.

Hobijn & Şahin (2012) claim the US outward shift is likely to revert sooner than Europeans. US workers are more mobile across industries and occupations (Hobijn 2012) and high unemployment benefits are likely to be reverted as crisis finishes.

This study reinforces the causal link between the job losses in the construction sector and the decrease in the overall level of matching efficiency. In both the European and US labour market the mismatch between labour supply and demand increased. It also confirms the relevance of labour market institutions in influencing Beveridge curve movements, with a particular focus on unemployment benefits.

3.4 Pissarides (2013)

Pissarides (2013) studies unemployment developments in US and European countries during the crisis. As it has been already pointed out many times, when a country is hit by a recession unemployment increases and vacancies decrease. The typical pattern is a downward movement along the Beveridge Curve. The author distinguishes three possible scenarios that could follow 2-3 years after the beginning of the crisis. In the first scenario vacancies keep decreasing and unemployment increases: there is a structural problem behind the recession. The economy moves further down on the Beveridge curve. Another possibility is that vacancies increase and unemployment decreases. The problem was only cyclical. In the third case vacancies might increase while unemployment remains stable. The economy starts recovering at the end of the downturn but it shows structural problems.

In a section of its work Pissarides estimates Beveridge curves for US, UK and Germany. At first UK and US cases are compared. Before the crisis the UK Beveridge curve was more shifted inward, thus having a higher efficiency in the matching process. Then as the recession started both moved down on their BCs. Afterwards

some years UK remains pretty stable in this new position downward on the BC. It shows macroeconomic rigidity: no new vacancies and unemployment remains high. On the other hand the US shows its typical macroeconomic flexibility: new jobs are created right after the top of the recession has passed. However its economy is also characterized by micro rigidity: new vacancies are not filled and unemployment remains high.

For what concerns the German Beveridge curve, the case is completely different. A structural improvement leads to an inward shift before the crisis. In the 2003 Germany started a series of reforms with the aim of rendering its labour market more flexible and strengthen active labour market policies. The main changes made to render the market more flexible are: relaxing employment protection law, reducing labour costs especially on low-wage earners, reducing unemployment benefits for the long-term unemployed. These modifications together with enhanced employment services lead to an improvement of labour market matching efficiency. In contrast with US and UK experiences the recession in Germany has been a purely cyclical phenomenon with no structural consequences. In 2009 vacancies recovered and unemployment decreased.

This review of empirical studies lay down the foundations for the last chapter, the empirical analysis. They introduced us to Beveridge curve dynamics in the European labour market. Two main findings have to be highlighted. The first one is that according to the presented investigations the financial crisis of 2007-2008 resulted in an outward shift of the European Beveridge curve. The authors tried to find out which are the main causes of the shift. A central role in decreasing the job matching capabilities of the labour market is played by the housing crisis. The concentration of job loss in the construction sector led to two main consequences. On the one hand a mismatch between the skills demanded by employers and those supplied by unemployed emerged. On the other the house-lock effect gave rise to geographic mismatch.

The second important finding is that a link exists between labour market institutions and the Beveridge curve. The most influential institutions are employment protection law and unemployment benefits, or rather changes in the unemployment benefit system. According to Nickell et al. (2002) the former tends to

shift the Beveridge curve inward and according to Hobijn & Şahin (2012) and Pissarides (2013) the latter tends to shift it outward.

4 Empirical analysis: European labour market developments in the aftermath of the financial crisis

After having provided an empirical background of studies concerning the Beveridge curve of the European labour market, the empirical analysis contributes to the reviewed literature by exploring the issue from a new perspective. In the following sections the investigation will delve deeper into the analysis of European Beveridge curve with a particular focus on the role of institutions. The empirical study will examine how unemployment and matching efficiency of the labour market evolved in the European countries during the Great Recession and whether they have been influenced by labour market institutions.

4.1 Data description

Before delving into the empirical analysis, this section is devoted to present the data and their sources. The examination applies to seventeen European countries (Austria, Belgium, Czech Republic, Germany, Denmark, Greece, Spain, Finland, France, Hungary, Italy, Netherlands, Poland, Portugal, Sweden, Slovak Republic, United Kingdom). The choice of which countries to include depends mainly on data availability: countries who lacked data for certain variables were excluded from the sample. The dataset contains quarterly data from 2000 to 2014. The two most important variables at the center of the analysis are unemployment rates and vacancy rates, whose main characteristics are summarized in the following table.

Table 1 : Unemployment rate and Labour shortages data

				Quantiles				
Variable	n	Mean	SD	Min	.25	Median	.75	Max
Unemployment rate	1032	8.97	4.42	3.10	6.15	8.00	10.00	27.80
Labour shortages (vacancy rate proxy)	1054	6.59	6.83	0.00	1.90	4.30	9.00	43.30

Unemployment rates are taken from the OECD Labour force statistics database. In the same database vacancy rates can be found, however the vacancy series has a limited coverage in time and a low degree of comparability across states. An alternative time series is used as a proxy for vacancy rates: the perception by employers of labour shortages as limits to business (European Commission, 2011a). Its longer time dimension allows for significance testing in the econometric specifications. This series is taken from the European Commission's Monthly Confidence Surveys, specifically the one related to manufacturing employers. During the survey firms are asked whether they perceive their current business as being limited by labour. If a business feels its current production as being limited by labour, it is likely to post new vacancies so as to hire more labour in the subsequent period. This series has been used to estimate the Beveridge Curve relation by many studies, such as Bonthuis, Jarvis & Vanhala (2013), which contains research underlying the Structural Issues Report "Euro area labour markets and the crisis" (ECB 2012); European Commission (2011c); ECB (2002) and others. Bonthuis, Jarvis, & Vanhala (2013) draw Beveridge Curves by means of the two alternative data series (Eurostata vacancy rates and Labour shortages perceptions by businesses) concluding they lead to highly similar estimations of the Beveridge Curve, given the high correlation coefficient between the two series of 0.74 (ECB 2012). Data on real GDP growth rate are taken from the quarterly national accounts database by the OECD; they are growth rates over the previous quarter.

The labour market institutions taken into account in the study are: employment protection law, the degree of centralization of bargaining, unemployment benefits, tax wedge and the expenditure on active labour market policies. Data on the above regulations are taken from OECD databases. A brief presentation of these variables and of how they are constructed is now provided.

Table 2 : Labour market institutions data

				Quantiles		
Variable	n	Mean	SD	.25	Median	.75
Employment protection law	952	2.48	0.65	2.17	2.37	2.80
Trade union density	912	32.26	20.82	17.72	23.56	36.09

Unemployment benefits (net replacement rate of 5 years)	884	34.21	8.42	15.29	36.00	47.07
Tax wedge (as % of labour costs)	1020	43.69	6.24	31.09	42.59	48.84
Expenditure on labour market policies (in million euro)	864	5074.63	5785.28	53.61	2551.68	7420.51

The conditions of employment protection regulation in every country are summarized by the OECD index of employment protection law, which is a synthetic indicator of the strictness of regulation on dismissals and the use of temporary contracts. The annual data corresponds to the regulation in force on the 1st of January of that specific year. In order to take into account the centralization of bargaining the analysis will refer to the data on trade union density, which is computed as the ratio of wage and salary earners that are trade union members divided by the total number of wage and salary earners. For what concerns unemployment benefits, data used in the analysis report net replacement rates, the proportion of net income in work that is maintained after job loss, over a five year period following unemployment. The generosity of unemployment benefits depend on the family condition of the worker, for instance a one-earner married couple will be guaranteed a higher net replacement rate than a single with no children. The data that is used it the average over the different families' categories replacement rates. 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. The average tax wedge measures the extent to which tax on labour income discourages employment. This indicator is measured in percentage of labour cost. Labour market policies are public interventions targeted at groups of persons with difficulties in the labour market. They can be divided in three categories: covers the costs of the public employment service (PES) together with any other publicly funded services for jobseekers; LMP measures (categories 2-7), which covers activation measures for the unemployed and other target groups including the categories of training, job rotation and job sharing, employment incentives, supported employment and rehabilitation, direct job creation, and start-up incentives; and LMP supports

(categories 8-9), which covers out-of-work income maintenance and support (mostly unemployment benefits) and early retirement benefits (Eurostat). The examination will consider only the first two categories, since out of work support is already captured by the unemployment benefits variable. All these institutional variables have an annual frequency. In order to use them with quarterly variables of unemployment, vacancies and GDP growth rate the assumption that they remain constant during the year is made. This assumption can be deemed to be realistic for two main reasons: institutions do not change sharply and furthermore it takes time before a change in regulation affects the labour market functioning.

Now that the data have been described and their sources presented, it is possible to proceed towards the core of the analysis.

4.2 European Beveridge curves by welfare regimes

Following the outbreak of the 2007-2008 global financial crisis, the European economy started to contract, falling into what has been called by economists the Great recession. Ireland was the first country to fall in a recession on the second quarter of 2007 ("Quarterly National Accounts database" Eurostat). In May 2008 Eurozone industrial production experienced the most severe one-month contraction since the exchange rate crisis in 1992, declining by 1.9 percent (Evans-Pritchard, 2008).

The recession pushed the labour market into a prolonged period of stress, up to the highest unemployment peak of 11% in the first quarter of 2013. In order to better appreciate how employment reacted to the economic crisis the European Beveridge curve is derived.

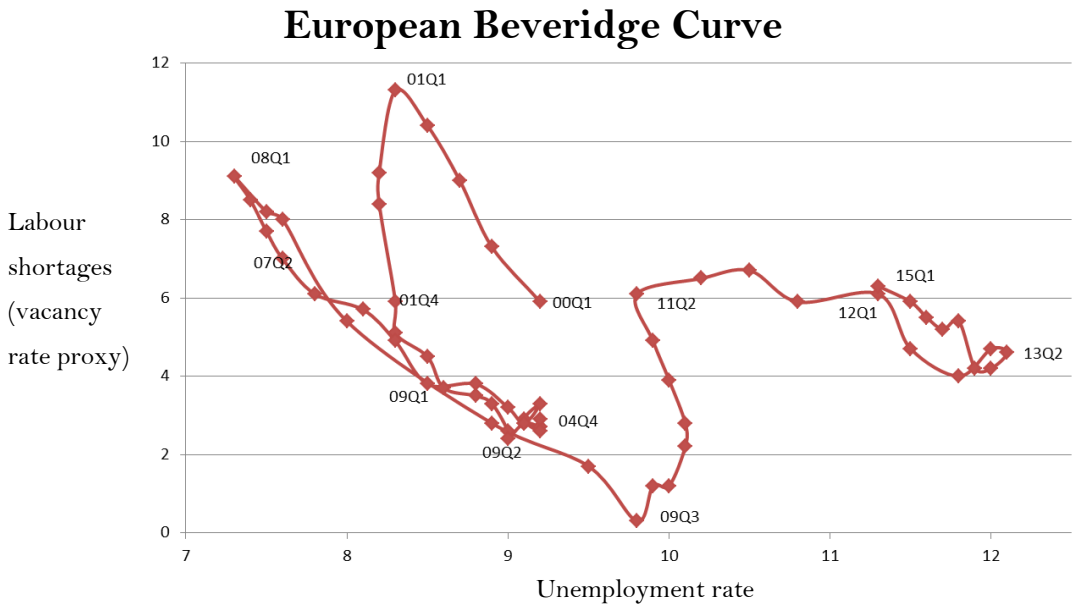

Figure 4 : the European Beveridge curve

The graphical inspection of the European Beveridge curve suggests that in the first years following the crisis (2008-2009) the economy moved along the BC: the unemployment rate increased and the vacancy rate decreased. As explained in the theoretical chapter an economy is expected to move downward on the Beveridge curve during economic downturns and upward during economic booms. From the end of 2009 vacancies started to recover but the unemployment rate did not start decreasing. An outward shift seems to have occurred: the unemployment rate for a given level of vacancy rate has increased. This is a sign of structural problems in the European labour market. The degree of matching efficiency deteriorated: a given level of vacancies and unemployed result in a lower number of matches than before the crisis. There can be many structural issues behind this. They can be mainly of three types: less willingness to accept job applicants by firms; less willingness to accept job offers by unemployed workers; or more mismatch, namely less good combination of characteristics of vacant jobs and workers (such as skill and geographic mismatch) (Pissarides, 2013).

In order to have a clearer overview of the situation, Beveridge curves are derived for the different welfare regimes identifiable within the European Union. Countries are grouped according to a classification widely used in the literature that is explained in Ferrera (1996) and similarly in Gaullie and Paugman (2000). By welfare regime it is meant a "system of public regulation that is concerned to assure the protection of individuals and to maintain social cohesion by intervening in the

economic, domestic and community sphere" (Gallie and Paugman, 2000). The Gaulie and Paugman's classification distinguishes countries on the basis of their system of welfare provision in the labour market by public authorities. Countries can be traced back to four welfare models: the sub-protective, the liberal, the employment centered and the universalistic model. The first category provides very little support to unemployed, both in terms of unemployment benefits and of active labour market policies. The second system provides a higher level of protection for the unemployed, even if still low. However a basic difference can be outlined between the two models: while in the sub-protective regime there is a clear absence of any plan or state attempt to provide support to labour market actors, in the liberal figure there is a precise state will not to provide support to workers. The state want individuals to be fully responsible for their actions and not to depend on social assistance. In the employment-centred and universalistic regimes public authorities' support reach a larger number of citizens and with a larger scope. However different principles underlie the two schemes. In the employment-centred view, subsidies and active help shall be provided on the basis of personal participation, in order not to undermine workers' incentives. Those employees who worked more or with a higher degree of continuity receive more support. Because of this eligibility criteria, coverage is not complete. Instead the universalistic approach tries to provide coverage to the greatest number of labour force actors. It achieves complete coverage; it offers higher financial compensation and a more ambitious active labour market policy. By analyzing data on the proportion of unemployed who receive benefits, the average expenditure on benefits per unemployed person, and finally expenditure on active labour market policies Gaullie and Paugman (2000) classify European countries in the previously described categories. It is important to note that countries are not expected to perfectly reflect the model, but every country is deemed to be closer to one of them.

By making use of Gaullie and Paugman (2000)'s classification and of Ferrara (1996)'s, countries in our sample can be classified as follows.

Table 3 : Countries classification by welfare regime

Labour market welfare regimes	
Sub-protective / Southern countries	Italy, Spain, Portugal, Greece
Liberal	United Kingdom, Ireland
Employment-centred / Continental countries	France, Belgium, Netherlands, Germany, Austria, Czech Republic, Hungary, Poland, Slovak Republic
Universalistic / Northern countries	Denmark, Sweden, Finland

The empirical analysis proceeds by estimating the Beveridge curves for these four welfare regimes.

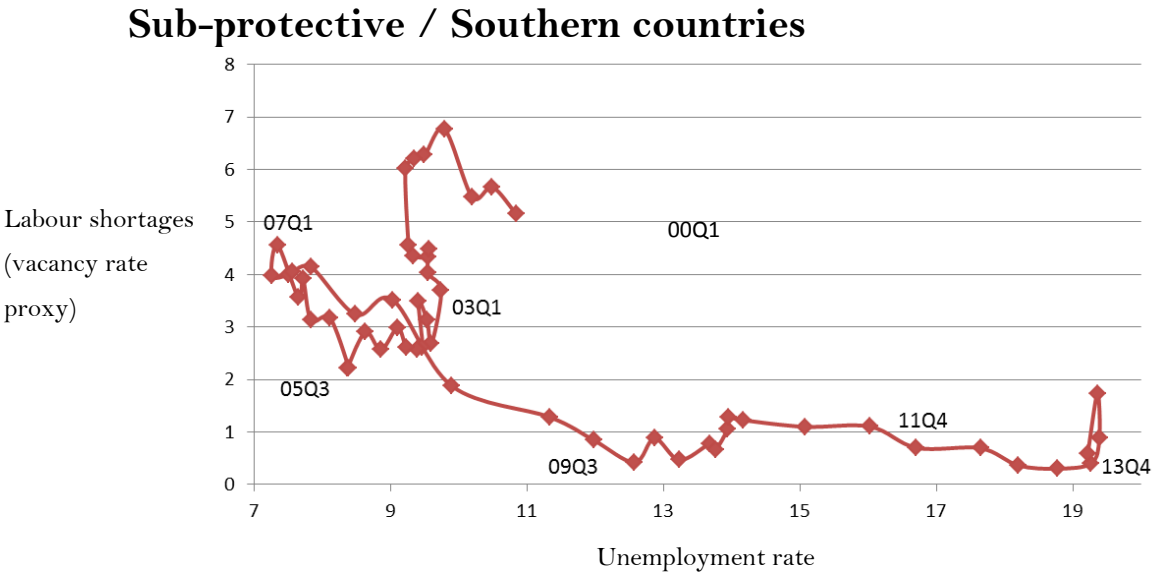

Figure 5 : Beveridge curve for southern countries

Southern countries' Beveridge curve shows a pattern similar to the European BC: from the first quarter of 2000 to the first quarter of 2007 the BC seems to have shifted towards the origin, resulting in an higher level of matching efficiency. Then from 2007 the economy started moving downward along the BC. Vacancies decreased and unemployment increased. From 2010 onwards, the unemployment rate kept increasing while the vacancy rate remained at the same level. Therefore the unemployment rate for a given level of vacancies increased. However, from the graphical inspection it is not clear cut whether the BC shifted outward or whether the economy is just moving along the flattest part of the BC.

It follows the estimation for liberal countries.

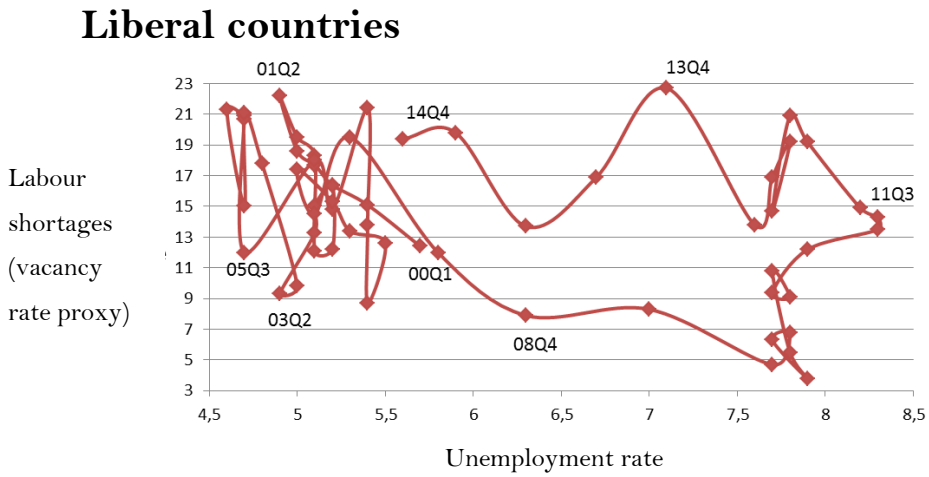

Figure 6 : Beveridge curve for liberal countries

Between 2000 and 2007 it is difficult to recognize patterns in the movements of unemployment and vacancies. Instead it can be noted that from the beginning of the crisis (first quarters 2008) unemployment increased sharply and vacancies decreased. Then in 2010 vacancies started to recover but unemployment remained high, starting decreasing only after the third quarter of 2011. The decline in unemployment brought the British economy close to the pre-crisis picture.

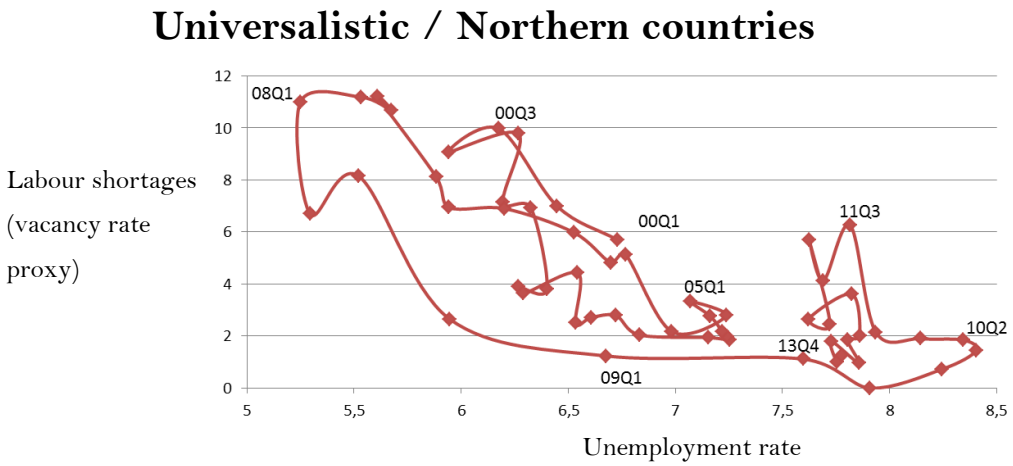

Figure 7 : Beveridge curve for northern countries

For what concerns northern countries it seems possible to recognize an inward shift of the BC between 2005 and 2008, being the level of unemployment for any vacancy rate lower than the values for 2000-2004. Then from 2008 the economy started moving downward on the BC with increasing unemployment and a decline in the vacancy rate. From 2010 vacancy rates have alternated periods of increase to periods of decline, but the unemployment rate has remained substantially higher than the pre-crisis level suggesting a possible outward shift of the BC.

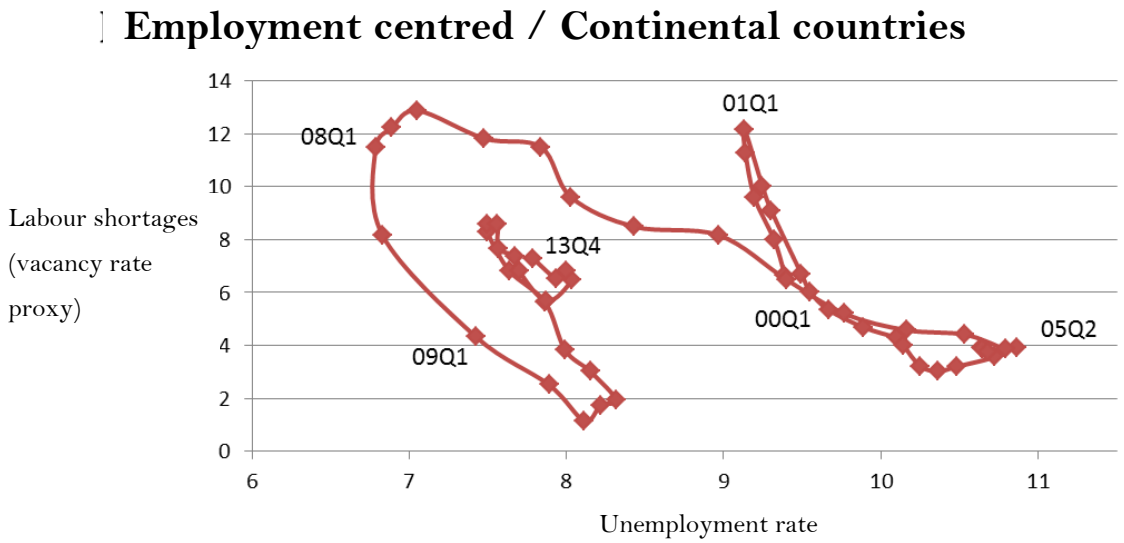

Figure 8 : Beveridge curve for continental countries

Continental countries show an unusual unemployment-vacancy pattern. They have experienced a pronounced inward shift from 2005 onwards, with the unemployment rate for an vacancy rate at a clearly lower value than before 2005. From 2008 the economy moved downward along the BC. As in most of the other clusters, after 2010 vacancies recovered and but unemployment kept being higher than pre-crisis levels suggesting an outward shift.

This analysis showed that there is a certain degree of heterogeneity at the country level in the unemployment-vacancy patterns. In the continental and northern countries an outward shift in the Beveridge curve appears clear cut, while in the Southern and liberal countries the picture is more uncertain.

4.3 Regression analysis: Beveridge curve shift and labour market institutions

The main finding from the analysis of data on unemployment vacancies is that the degree of matching efficiency in the European labour market worsened after the crisis. For a given level of vacancies the ability of the labour market to bring together demand and supply of labor decreased, resulting in a higher number of unemployed people for any level of vacancy rates. However this is what results at the aggregate level from the picture of data for the whole European economy. When we look at welfare regimes' Beveridge curves we see an heterogeneity of reactions to the crisis. Which factors can be the cause of such heterogeneity of unemployment experiences? Which factors affected the way matching efficiency changed in every country? The

studies reviewed in the empirical background point out the skill mismatch caused by the contraction of the construction sector as a main determinant. However this element alone does not explain the whole story. This chapter will focus on analyzing the role of institutions in this matter. Understanding how institutions affect economic agents' behaviour and how they interfere in the normal functioning of markets is a crucial issue for economists. Identifying the effect of institutions on such important economic variables as unemployment is a necessary step to draw guidelines for policy makers. Indeed as they design institutions to achieve different goals such as citizens' welfare and redistribution, they might unconsciously affect the outcome of the labour market, for instance increasing the unemployment level.

The empirical analysis investigates whether the set of labour market institutions of a country influenced its degree of matching efficiency during the crisis. Did countries with stricter labour market institutions experienced a higher increase in the unemployment rate for a given vacancy rate? Does matching efficiency worsen more in countries with stricter labour market institutions?

We can try to answer these questions by means of a regression analysis. Three different regressions are performed. Each of them aims to bring to light a different perspective on how the labour market reacted to the crisis. A first regression is carried out to understand how institutions affect the Beveridge curve position.

$$u_{it} = \alpha_i + \beta_1 u_{i(t-1)} + \beta_2 LS_{it} + \beta_3 {LS^2}_{it} + \Sigma_j \beta_j Inst_{jit} + \Sigma_k \beta_k LS_{it} * Inst_{kit} + \varepsilon_{it}$$

The term $u_{i(t-1)}$ is included because of the high degree of persistence of unemployment: the unemployment rate (u_{it}) strongly depends on the previous year unemployment rate ($u_{i(t-1)}$). LS_{it} represents the vacancy rate proxy (labour shortages index). ${LS^2}_{it}$ is the variable LS_{it} squared; it inserted to capture non-linearities in the unemployment-vacancy relationship. The coefficients β_2 and β_3 tell us how unemployment changes for a one unit change in the vacancy rate. The institutional variables are included in the regression in order to see how institutions influence the level of unemployment for a given vacancy rate, and so how they affect the position of the Beveridge curve and the degree of matching efficiency of an economy. The coefficients β_j show whether the Beveridge curve for countries with stricter institutions is shifted outward (if it shows a positive sign) or inward. The coefficients

β_k indicate whether there is a relationship between institutional variables and the slope of the Beveridge curve (that is the responsiveness of unemployment to a change in vacancy).

The second regression moves the focus on how the crisis affected the BC position. Did the level of unemployment for a given vacancy rate increase during the crisis? Did matching efficiency worsened?

$$u_{it} = \alpha_i + \beta_1 u_{i(t-1)} + \beta_2 LS_{it} + \beta_3 LS^2{}_{it} + \Sigma_j \beta_j Inst_{jit} + \Sigma_k \beta_k LS_{it} * Inst_{kit} + \beta_4 CRI_{it} + \beta_5 CRI * LS_{it} + \varepsilon_{it}$$

CRI is a dummy variable taking the value 1 starting from the first two consecutive quarters of negative real GDP growth rate after the third quarter of 2007. The value remains 1 up to the end of the series. Therefore the crisis is considered to start in different periods in every country. A positive coefficient β_4 would confirm that after the crisis there has been an outward shift of the Beveridge curve: the unemployment rate for any given level of the vacancy rate has increased. The coefficient β_5 wants to capture whether after the crisis there has been a change in the slope of the Beveridge curve, which is a change in the responsiveness of unemployment to vacancies.

The third regression investigates whether the set of labour market institutions of a country influenced the movements of its Beveridge curve in reaction to the crisis.

$$u_{it} = \alpha_i + \beta_1 u_{i(t-1)} + \beta_2 LS_{it} + \beta_3 LS^2{}_{it} + \Sigma_j \beta_j Inst_{jit} + \Sigma_k \beta_k LS_{it} * Inst_{kit} + \beta_4 CRI_{it} + \beta_5 CRI * LS_{it} + \Sigma_n \beta_n CRI_{it} * Inst_{nit} + \Sigma_m \beta_m CRI * LS_{it} * Inst_{mit} + \varepsilon_{it}$$

Did countries with stricter labour market institutions experience a more severe outward shift in the Beveridge Curve? Did they experience a more severe decline in matching efficiency?

These questions can be answered analyzing the coefficients β_n and β_m. A positive β_n for the institution n would mean that the higher the level of the institutional variable n, the more severe the outward shift of the BC has been. A positive β_m would mean that an higher level of the institutional variable m tends to make the BC steeper, therefore decreasing the responsiveness of unemployment to a given change in vacancy (if the vacancy rate increases by one unit the unemployment rate after the crisis would decrease by a lower amount that it would have had before the crisis).

The empirical analysis proceeds by presenting the results of the above regressions and drawing some conclusions. The following abbreviations are used: "epl" for employment protection law indicator, "taxw" for tax wedge, "unben" for unemployment benefits, "centr" for centralization of bargaining and "lmp17" for expenditure on active labour market policies.

Unemployment developments during the crisis

Dependent variable: unemployment rate	(1)	(2)	(3)
Unemployment rate in the previous quarter	0.987 (39.80)**	0.978 (50.58)**	0.977 (58.46)**
Labour shortages (proxy vacancy rate)	-0.119 (2.47)*	-0.079 (1.84)	0.090 (2.75)*
Labour shortages squared	0.002 (3.95)**	0.001 (2.66)*	0.001 (2.17)*
Strictness of employment protection law	-1.053 (2.83)*	-0.789 (2.15)*	-0.481 (1.63)
Tax wedge	-0.022 (0.63)	-0.006 (0.20)	0.012 (0.53)
Centralization of bargaining (trade union density)	0.006 (0.33)	0.044 (1.99)	0.047 (2.68)*
Unemployment benefits (net replacement rate)	0.002 (1.22)	0.008 (3.85)**	0.011 (2.68)*
Expenditure on active labour market policies	0.000 (0.59)	0.000 (0.45)	-0.000 (1.25)
LS*epl	0.018 (2.35)*	0.013 (1.61)	-0.008 (1.61)
LS*taxw	-0.000 (0.55)	-0.000 (0.34)	-0.002 (3.15)**
LS*centr	0.000 (2.41)*	0.000 (2.24)*	0.000 (1.47)
LS*unben	0.000 (1.72)	0.000 (0.30)	-0.000 (0.11)
LS*lmp17	0.000 (1.00)	0.000 (1.10)	0.000 (0.64)
CRI		0.462 (4.51)**	3.827 (4.81)**
CRI*LS		-0.019 (3.07)**	-0.251 (3.90)**
CRI*epl			-0.375 (2.56)*
CRI*taxw			-0.048 (3.76)**
CRI*centr			-0.003 (0.85)

CRI*unben			-0.002
			(0.60)
CRI*lmp17			-0.000
			(1.67)
CRI*LS*epl			0.016
			(1.14)
CRI*LS*taxw			0.004
			(4.02)**
CRI*LS*centr			0.000
			(0.12)
CRI*LS*unben			0.000
			(0.01)
CRI*LS*lmp17			0.000
			(1.56)
Constant	3.746	0.719	-1.010
	(2.25)*	(0.49)	(0.77)
R2	0.98	0.98	0.98
N	784	784	784

* p<0.05; ** p<0.01

The first column shows results of the first basic regression. The statistically significant and negative coefficient of the LS term confirms the presence of a negative relationship between the vacancy rate and the unemployment rate. For what concerns institutions the only significant coefficient is the one of the employment protection law index. Its negative sign suggests that countries with a stricter employment protection law have a Beveridge curve more shifted towards the origin: a lower level of unemployment for any given level of vacancy rates (higher matching efficiency). The same conclusion applies to the tax wedge, however its coefficient is not statistically significant. Centralization of bargaining and unemployment benefits show instead positive coefficients: the higher the trade union density and the higher the unemployment benefits, the higher is the rate of unemployment for any given vacancy rate. But again they are not statistically significant. The expenditure on active labour market policies do not show to have any effect on the unemployment rate and on the BC position. The interaction terms between the LS variable and the institutions represent the influence of the institutional variables on the slope of the Beveridge curve. Given the values are all zeros, we can conclude that labour market institutions do not affect the slope of the BC.

The first most important result of this initial regression is the negative and statistically significant coefficient of the LS variable, which confirms the downward sloping shape of the BC. Institutional variables seem to have an effect on the position of the BC but not on its slope. However, the only statistically significant coefficient is

the one of the employment protection law index, which suggests it tends to move the BC towards the origin. This is the same conclusion reached by Nickell, Nunziata, Ochel and Quintini (2002). A possible explanation is now provided. As it has been said in the theoretical chapter, the effect of employment protection law on unemployment is ambiguous, but it reduces both the flows into and out of unemployment. If the flow into unemployment has to decrease, employers have to hire fewer workers. But if they want to hire fewer workers, they will post fewer vacancies. If the level of vacancies for a given level of unemployment decreases, the Beveridge curve shifts inward. Another possible explanation can be found in Bonthuis, Jarvis, & Vanhala (2013), who suggest that stricter employment protection law might favor matching efficiency by pushing employers to potentiate their hiring departments. Hiring the right worker is more important if firing him becomes costly.

The second column adds the CRI dummy variable and the interaction term between CRI and the LS variable. The coefficient of CRI confirms the statistical significance of the shift of the BC after the crisis. It suggests that the unemployment level for any given level of vacancy rate has increased with respect to the pre-crisis situation. This result is in line with the other empirical studies such as Bonthuis, Jarvis, Vanhala (2015) and ECB (2012). The CRI*LS term shows instead a positive and again significant coefficient: the responsiveness of the unemployment rate to the vacancy rate has increased (flatter slope of the BC). This result also proves to be in line with Bonthuis, Jarvis, Vanhala (2015)'s investigation. They build Beveridge curve elasticities for the main Euro area countries for two periods: from 2002 to the start of the crisis and from the start of the crisis to 2013. Elasticities are defined as the absolute value of the percentage change in unemployment for a given percentage change in vacancies. These indices show that the reaction of unemployment to changing labour shortages during the crisis was much larger than during the pre-crisis period. The results of the second regression validate the conclusion drawn from the graphical interpretation of the European BC: after the crisis the European BC experienced an outward shift and the degree of matching efficiency of the economy worsened.

The third regression examines whether the labour market institutions of a country influenced the magnitude of the shift of its Beveridge Curve. The coefficients of the CRI and CRI*LS terms remain of the same sign as before and they are still statistically significant. All the interaction terms CRI*Institutions show a negative

sign: the stricter the labour market institutions the lower the BC shift. However most of the terms are not significant. The lack of significance might reflect an absence of correlation, as well as a lack of sufficient variation in the data. Furthermore a certain degree of oversimplification exists in the data, which might not be able to summarize the complex differences between countries regulations in terms of labour market. All negative coefficients would go against the main result achieved by Blanchard and Wolfers (2000). According to their study stricter labour market institutions tended to exacerbate the long-run effect of shocks on European unemployment. A series of negative coefficients would mean the opposite: a lower shift of the BC and a lower equilibrium rate of unemployment. The only two significant coefficients are those of the interaction between the CRI variable and employment protection law and the tax wedge. According to the regression analysis, those countries having stricter employment protection law and a higher tax wedge experienced a lower increase in the unemployment rate for any given value of the vacancy rate. The attention will now focus on the influence of employment protection law on Beveridge curve shifts, since this factor has been identified in the literature as an important determinant of the Beveridge curve position.

The main result of the empirical analysis is that countries with stricter employment protection law experienced a lower shift of the Beveridge curve. Bonthuis, B., Jarvis, V., & Vanhala, J. (2013) support the thesis that strong employment protection law potentially leads to stickiness in the Beveridge curve relationship "with worker shedding taking place in downsized sectors, but employers reluctant to hire in expanding sector". As economic conditions worsen, vacancies decrease but fewer workers are fired than in a circumstance with a looser regulation on employment dismissals. If firms have to pay taxes when firing a worker they will fire fewer workers. As a consequence as the crisis began, unemployment increased more in countries with a looser regulation on employment dismissals. As Pissarides (2013) reports the cause of the below-averages increases in unemployment in 2009 in Greece, Portugal and Italy was exactly the excessive employment protection that kept unemployment artificially low in the first stages of recession. This phenomenon led to a lower increase in the level of unemployment in countries with a stricter regulation in the initial phase, resulting in a less severe shift of the Beveridge curve. However, this condition should last only in the first years of recession. After some time the recession goes on, employers will find so unprofitable to keep excess labour that they will fire

worker even if restrictions on dismissals are in force. Unemployment should finally increase also in countries with stricter employment protection. The findings by Nickell, Nunziata, Ochel, and Quintini (2002) confirm that stricter employment protection law tends to shift the Beveridge curve to the left. However, their assertion refers to the normal state of the economy, while this study deals with Beveridge curve response to the crisis. The most likely justification for the negative sign of the CRI*epl coefficient is that it captures the first phenomenon described: the stickiness conferred on the Beveridge curve by strict employment protection law. Further explanations for the fact that countries with stricter employment protection law experienced a reduced outward shift of the Beveridge curve should be explored.

5 Conclusion

The Beveridge curve is a useful tool to simplify the complex labour market functioning and analyze its developments. By studying its movements and shifts it is possible to reconstruct the dynamics that at an aggregate level drive unemployment changes.

The application of a search and matching model to real data on the European labour market response to the crisis provides valuable insights on unemployment dynamics. The usefulness of the matching framework is not in analyzing the recession per se, because during a downturn unemployed do not find a job mainly because there are no job openings and not because they cannot be matched. It is rather useful to study the recovery and to understand whether unemployment will go back to its previous level or it will remain at the new higher level. The most significant result of the study is the estimated outward shift of the European Beveridge curve in response to the crisis. Also once the economy started to recover and vacancies increased, unemployment remained persistently high. This decline in matching efficiency is likely to result in a higher equilibrium level of unemployment. The investigations reviewed in the empirical background point to a main driver behind this loss of matching efficiency: the substantial contraction of the construction sector led to increased skill and geographic mismatch.

The second important finding of the research concerns labour market institutions. Understanding how institutions affect economic agents' behaviour and how they interfere in the normal functioning of markets is a crucial issue for economists. Identifying the effect of institutions on such important economic variables as unemployment is a necessary step to draw guidelines for policy makers. The empirical background reinforces the idea of a link between labour market institutions and the Beveridge curve position. The reviewed literature identifies employment protection law and unemployment benefits as two main shifters of the Beveridge curve. The performed regression analysis confirms that employment protection law is an important determinant of the Beveridge curve position. It emerges that countries with stricter regulations on dismissals experienced a smaller shift in the Beveridge Curve in the aftermath of the crisis. A main explanation has been provided for this. Strict employment protection law induces stickiness in the Beveridge curve relation.

When there are restrictions on dismissals, employers react more slowly to changes in labour market conditions. As the recession hit the European economy, countries whose employers were subject to strict regulations fired less workers. The empirical analysis shows that as vacancy rates increased in 2009, unemployment did not start decreasing. In countries with stricter employment protection law, unemployment has increased less with respect to the pre-crisis level. Consequently their shift in the Beveridge curve is of a lower magnitude. The validity of this argument depends on how long is the effect of employment protection law in restraining employers firing decisions. This effect does not last for an indefinite amount of time. If it lasts more than 1-2 years, it means that strict regulations restrained employers from massive firing until 2009, when vacancies started to recover. In this case the explanation could account for the reduced Beveridge curve shift. However, if the length of the phenomena is shorter, another interpretation has to be found. Further research is needed in order to fully comprehend the link between employment protection law and the Beveridge curve shift.

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