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Dottorato di Ricerca in Analisi Economica, Giuridica e Statistica delle Politiche, dei Mercati e delle Imprese

Curriculum
Economia del Settore Pubblico
XV Ciclo

Unemployment and Youth Unemployment in the OECD: Empirical Evidence from the Beveridge Curve

Tesi di Dottorato

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Anno Accademico 2015/2016

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Introduction and Main Results

This thesis deals with the application of a well-known analytical tool, the Beveridge Curve, to the analysis of two samples of countries within the OECD. The novelty of the thesis mainly resides in the use of novel data-sets, the careful analysis of the impact of the Great Recession on the labour markets of the countries under scrutiny, and the application, in chapter 4, of a distance function approach to the joint modelling of youth and non-youth unemployment rates. The thesis must be seen as a monographic work, as there are considerable links between its four chapters.

The goal of chapter 1 is to introduce the search and matching approach to labour market analysis, trying to analyse its main properties and its recent developments. The job creation decision of firms and the behaviour of job-seekers are illustrated and the equilibria of the model in the unemployment-vacancy space and in the tightness-wage space derived. Some attention is devoted to the welfare evaluation of the matching model, which is shown to be socially efficient if and only if the Hosios condition is satisfied. Unfortunately, the private solution is usually unlikely to be efficient and the equilibrium unemployment rate can be either below or above its socially efficient value. The last part of the chapter deals with the analysis of the Beveridge Curve. Beyond the explanation of the main properties of the Curve, the analysis illustrates how the Beveridge Curve is able to capture the main facts regarding the cyclicality of the economy and the behaviour of the labour market over the cycle.

In chapter 2, the dynamics of unemployment in the OECD are analysed, obtaining comparable estimates of inflow and outflow rates for twenty OECD economies. These rates are used to estimate the equilibrium unemployment rate predicted by the standard search and matching model. The analysis reveals that the search and matching model provides a good description of unemployment patterns only if the economy is characterised by high rates of inflow and outflow. If this condition does not hold, the underlying theoretical model seems to be unable to replicate the dynamics of unemployment, showing large deviations from the steady-state. Although the steady-state approach proposed in the second chapter seems unsatisfactory in explaining variations in the unemployment rate, At any rate, since in the rest of the thesis aims at estimating econometrically the Beveridge Curve across OECD economies, the indicators developed in this chapter, the inflow rate in particular, will prove useful for that empirical evaluation.

Chapter 3 is dedicated to an econometric analysis of the Beveridge Curve, considering two different sets of countries, namely thirteen OECD economies and twelve European economies. This division is made necessary by the nature of the data about vacancies. The goal of this chapter is, first, to reassess the role of institutional variables, like unemployment benefits, employment protection legislation, active labour market policies, and union density on labour-market matching. Secondly, and more innovatively, it deals with the impact of the recent financial crisis on unemployment, with a view to understand whether the recent financial crisis has simply generated movements along the curve or shifts of the curve, eventually leading to long-lasting changes in the functioning of labour markets. The results obtained via the econometric estimates suggest that unemployment benefits rule the roost among labour-market institutions. The unemployment-vacancies trade-off is improved by a higher replacement rate and more strictness in the benefit provision protocol. Both these effects can be rationalised in terms of higher search efficiency. Moreover, the results suggest that the recent financial crisis has, as a whole, either left unchanged or improved the Beveridge trade-off. Further research is advisable for those countries that have consistently shown signs of improvement (mainly, Austria, Germany and Portugal), if useful policy advice must be delivered in this ambit.

Chapter 4 provides an extension of the Beveridge Curve framework to the analysis of youth unemployment in the OECD. In that chapter, besides considering the role of labour market institutions, a set of demographic and educational factors are taken into account, which are assumed to be relevant in explaining youth unemployment. In order to consider the young unemployed jointly with the rest of the unemployed workers, a distance function approach is applied, where youth and non-youth unemployment are jointly driven by vacancies and the other relevant variables. Although it has extensively been applied in empirical papers, especially in productivity analysis, this is, at least based on current knowledge, the first application of the distance function approach in the macro-labour literature. Application of this approach looks promising, but future research must aim to still improve the quality of the estimates and, hence, the quality of the inferences that can be drawn in the analysis of youth unemployment. At any rate, the evidence from this chapter too signals improving performance in recent years, especially for Austria, Germany and Switzerland, which calls for further research focusing on the labour markets of these countries.

Chapter 1. Introduction to Search and Matching Models

1.1 Introduction

The search and matching model, commonly known in the literature as the Diamond-Mortensen-Pissarides model (DMP), represents nowadays the workhorse for both theoretical and applied economists for the macroeconomic analysis of labour markets characterised by search frictions and uncoordinated trade.

Although the problem of frictions in the labour market was highlighted by the early works of Stigler (1962) and McCall (1970), the pioneering contributions in the search and matching theory - developed between the 1970's and the 1980's - were the ones of Mortensen (1970, 1972, 1982), Pissarides (1974, 1976, 1979, 1984), Diamond and Maskin (1979), Diamond (1982a, 1982b).

Unlike Walrasian labour markets, where agents are completely informed and there exist no trade, in the search and matching framework agents engage in a costly trading process, conditioned by uncertainty, asymmetric information and congestion from large numbers.

Moreover, a considerable amount of research (Pissarides, 1986; Blanchard and Diamond, 1990; Davis and Haltiwanger, 1992; Burda and Wyplosz, 1994; Yashiv, 2007b; Petrongolo and Pissarides, 2008), has investigated both the amplitude and the cyclical behaviour of workers transitions across the various states of the labour markets, with great focus on the flows in and out of unemployment.

What emerges from these papers is that modern labour markets, especially in the United States and Europe, are characterised by a high degree of activity, with large flows of workers between the states of unemployment, employment and inactivity, contemporaneous job creation and job destruction, high turnover rates and workers' reallocation across industries.

These dynamics are effectively captured by the search and matching model that is able to explain the process by which vacant jobs are matched to unemployment workers-giving rise to new employment opportunities-as well as the persistence of unemployment and the labour market fluctuations over the business cycle (Yashiv, 2007a). According to Pissarides (2000), the search and matching model performance evaluation is carried-out by comparing the latter with Hansen's (1970) business cycle model, showing to perform at least as well.

This chapter introduces search and matching models and, albeit introductive, covers the salient features of the search and matching theory: the role of information asymmetries in the market, the relevance of worker flows, the job creation decisions of firms, the search behaviour of unemployed workers, the wage determination and its impact on the equilibria predicted by the model.

The dynamics of the economy out of steady state are illustrated and, given the assumptions about the behaviour of vacancies and unemployment, it is shown that the economy always adjusts to the equilibrium.

The chapter also deals with the welfare evaluation of the search and matching model and shows that the private equilibrium maximises social welfare if and only if the Hosios condition holds. Other topics strictly related to the search and matching theory are explained in detail, like, for example, the Beveridge Curve, i.e. the negative relationship between vacancies and unemployment.

The remainder of the paper is organised as follows: section 1.2 discusses the basic approach of the search and matching theory, shows the main results reached by the literature and surveys the various papers concerning the matching function estimation, explaining the importance of such an econometric exercise for the validity of the theoretical results of the model. This initial part of the chapter ends by considering the search theory, the implications that follow from the concept of search equilibrium and the inclusion of this theory within the real business cycle framework.

In section 1.3 the matching function is introduced and it is shown how the model predicts a unique rate of unemployment for the economy. Section 1.4 discusses the job creation decisions of firms, section 1.5 explains how wages are determined in this framework. Section 1.6 is devoted to the evaluation of the equilibria while section 1.7 analyses the dynamics of the economy out of steady state. In section 1.8 the implications, in terms of social welfare, of the search and matching model are illustrated, showing that, in general, the efficiency condition does not hold. Section 1.9 introduces the Beveridge Curve, dealing with the distinction between movements along the curve and shifts of the curve and explaining the relationship existing between the Beveridge Curve and the matching function. Section 1.10 concludes.

1.2 The Basic Approach

In the introduction it has been stated that the search and matching model is, actually, the main macroeconomic model for the analysis of labour markets.

The main innovation introduced by the search and matching theory concerns the role of unemployment that, instead of being a disequilibrium phenomenon, is the outcome of a decentralised equilibrium that depends on the job creation decisions of firms and the search behaviour of unemployed workers, making the partition between the various types of unemployment (frictional, structural, cyclical, voluntary or involuntary), completely irrelevant, with the existence, in steady state, of a unique and stable rate of unemployment for the economy as a whole[1].

The persistence of unemployment is determined by the continuous flow of workers between the various states of the labour market. More precisely, although the matching process lead to the creation of new jobs-basically a flow of new hires-at the same time some jobs become obsolete and unproductive, giving rise to separations and, hence, to the flow of workers into unemployment.

So far, the main differences between the traditional Walrasian approach to the analysis of the labour market and the one developed by the search and matching theory have been underlined. According to Lagos (2000), while in the Walrasian environment trade occurs between an agent and the "market", in the search and matching framework, given the absence of an auctioneer and hence of coordination mechanisms, agents wishing to exchange labour services, engage in a costly and time-consuming trading process.

This trading process is a decentralised, uncoordinated and non-trivial economic activity (Pissarides, 2000), in the sense that it takes time and other resources to find a profitable match for both demand and supply.

Furthermore, such an activity is costly. While firms incur the costs of opening and advertising vacancies, interviewing potential candidates, unemployed workers spend time in order to acquire information about available vacancies and to apply for available jobs.

This costly and time-consuming trading process, that involves both firms-that open new vacancies-and job-seekers-unemployed workers who search for a job-is summarised through

[1] For a more detailed discussion, see section 1.3

an aggregate matching function, which relates the flow of new matches formed at any time *(m)*, to the stock of vacancies *(v)* and unemployed workers *(v)*.

Roughly speaking, the matching function can be thought of as the outcome of an investment process in which both demand and supply spend resources in order to generate mutually beneficial meetings.

Moving to its economic interpretation, it is possible to say that the matching function is equivalent to a simple aggregate production function that maps inputs into output.

While the typical production technology maps the stocks of capital and labour into a flow of physical output, the matching function maps the stocks of vacant jobs and unemployed workers into a flow of new hires.

As in the case of a typical aggregate production function, the matching function is assumed to be increasing, concave and linearly homogeneous. In econometric specifications, the most common functional form is the log-linear Cobb-Douglas[2] that seems to provide a suitable data approximation.

Within the literature, several contributions involve the estimation of matching functions, both at aggregate (Pissarides, 1986; Blanchard and Diamond, 1989; Van Ours, 1991; Burda and Wyplosz, 1994; Warren, 1995; Gross, 1996; Berman, 1997; Yashiv; 2000) and disaggregate level (Coles and Smith, 1996; Burgess and Profit, 1998; Anderson and Burgess, 2000), generally accepting the linear homogeneity hypothesis.

Understanding whether the matching function is characterised by constant or increasing returns to scale is a central question in the search and matching theory. As highlighted by Diamond (1982a) and Pissarides (1986) if the matching technology displays constant returns to scale then the theoretical prediction about the existence of a unique equilibrium unemployment rate is correct.

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[2]A typical Cobb-Douglas matching function is $m = \mu u^{\alpha} v^{1-\alpha}$, where μ>0 measures the efficiency of the matching process and $\alpha \in (0,1)$.
The terms $\alpha\ and\ 1-\alpha$ are the marching function elasticities with respect to u and v.
From the formula of elasticities, it is possible to obtain the following conditions: $\eta_{m,u} = \frac{\partial m}{\partial u}\frac{u}{m} = \alpha$ and $\eta_{m,v} = \frac{\partial m}{\partial v}\frac{v}{m} = 1-\alpha$

If, on the other hand, the matching function displays increasing returns to scale, multiple and Pareto rankable equilibria exist and there is room for policy interventions whose goal is to move the economy from one equilibrium to another, possibly with lower unemployment.
Beside the traditional random search models, a different methodology has been developed by the literature: the stock-flow matching approach (Coles and Smith, 1998; Lagos, 2000; Gregg and Petrongolo, 2005).
These papers remove the hypothesis of random search and assume that there exists a systematic element in the search process, with agents directing their search behaviour. Unemployed workers are fully-informed about available vacancies and no search frictions arise.
When the job seeker enters the market, he surveys the whole stock of available vacancies, applying for the most suitable one. Those who do not find an adequate partner at the first stage and remain unmatched do not apply for previously advertised vacancies and have to wait for the flow of newly created vacancies.
At the second stage, the matching process takes place between the stock of unemployed workers and the flow of vacancies. In recent years, the effort of the literature was devoted in providing the *"black box"* (Petrongolo and Pissarides, 2001) with solid micro foundations, but, as pointed out by Pissarides (2000), *"there exist for it no micro foundation that dominates all others"*.
This introduction ends by considering the main properties of the search theory, its recent developments and the main implications that follow from the concept of search equilibrium. In view of the differences existing between the Walrasian economy and the search and matching theory, it is straightforward to conclude that, while the static Walrasian environment is a frictionless one, in the dynamic equilibrium unemployment theory trade frictions and asymmetric information are at the core of the analysis.
Modelling markets with frictions and understanding how they affect labour market outcomes is the major task of the so-called *search theory*. The main objective of the search theory can be summarised with the words of Mortensen and Pissarides (1999b): "*the central problem of the theory of markets with frictions is to find a useful way to make the behaviour of individual agents both individually rational and mutually consistent"*.

The search process is modelled relying on *theory of optimal stopping*, whose goal is to identify the time to take an action that maximises expected payoff, given the stochastic process previously observed. When supply and demand meet, they stop searching and the optimal stopping strategy is such that agents maximise the difference between the value of the realisation obtained from the meeting and the costs of search.

In the *search and matching* framework, trade is an uncoordinated and decentralised economic activity, neither costless nor instantaneous.

The matching between firms and workers is not instantaneous since the search process is characterised by the presence of frictions, like uncertainty about the arrival of good jobs for workers, the arrival of good job seekers for employers, the location of new jobs or mismatch between the skills required by demand and those offered by supply.

Another source of uncertainty is represented by the fact that *ex ante,* i.e. before signing a contract and start production, agents ignore the productivity deriving from the job match and learn it only in subsequent periods according to a typical Markov process. In the search and matching framework, particularly relevant are the so-called *congestion externalities*.

In order to understand how these externalities work and how they affect agents' wealth, two simple examples are provided, assuming two different situations, i.e. a marginal vacancy and a marginal worker who enters the labour market.

If a firm decides to open an additional vacancy, workers will be better off, since they have a higher probability of finding a job, but, at the same time, firms will be worse off, since the probability of filling a vacancy is now lower. Thus, a marginal vacancy causes a negative externality for firms and a positive externality for workers.

If a worker decides to enter the market, firms will be better off, since the higher is the pool of potential partners, the higher is the probability of filling a vacancy, while workers will be worse off since they face a lower probability of finding a job. The consequence is a positive externality for firms and a negative externality for workers.

Several implications follow from the concept of search *equilibrium.* Once a match is realised, agents split the surplus according to the prevailing bargaining rule, giving rise to *monopoly rents* for both employers and employees. The wage set through the bilateral bargain is such that it does not internalise the search externalities. This means that agents, in solving their optimisation problems, do not take into account the effects of their actions on other agents' wealth.

Since markets are incomplete, the resulting search equilibrium will be, in general, inefficient in the Pareto sense (Mortensen and Pissarides, 1999b). Moreover, the search equilibrium is consistent with unemployment.

As argued by Diamond (1982a), two conditions suffice for unemployment to exist: a) the economy must be populated by a multiplicity of agents; b) trade must be uncoordinated.

If these conditions hold, unemployment exists even if there is flexibility in both prices and wages and expectations are correct. In its recent development, the search theory has been embodied in RBC models (Merz, 1995; Andolfatto, 1996; Hagerdon and Manovskii, 2008), providing useful insights about the behaviour of labour market outcomes over the cycle.

The main innovation introduced by these contributions is the consideration that the search process is a mechanism able to propagate technological shocks in the economy, affecting both the volatility and the persistence of many labour market variables over the cycle (Merz, 1995).

By introducing search frictions in the neo-classical RBC model, the following results seem to be of particular interest: a) volatility is higher for labour productivity rather than for wages, b) labour productivity drives employment over the cycle, c) labour's share of income is not time-invariant and countercyclical, d) unemployment, employment and output show a strong degree of persistence.

1.3 The Matching Function: Theoretical Foundations

The goal of this and subsequent sections is to develop a simple search and matching model and, in order to achieve this goal, the approach proposed by Pissarides (2000) is taken.

In the Pissarides models, risk-neutral, infinitely lived firms and workers maximise their objective functions given the matching and the separation technologies and have rational expectations. Workers are identical in terms of productivity and search intensity, while each firm that enters the market is endowed with only one vacancies that has to be filled.

The model is specified in continuous time, entry in unemployment is exogenous, hours of work and the labour force are fixed and, for simplicity, normalised to unity.

The matching function is assumed to be increasing, concave and linearly homogeneous:

$$m = m(u, v) \quad (1)$$

$$\frac{\partial m}{\partial u} \geq 0\,; \frac{\partial m}{\partial v} \geq 0$$

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

$$m(0, v) = m(u, 0) = 0$$

where m is a scale parameter that measures the degree of mismatch in the economy.

From the matching function it is possible to derive a key variable in the search and matching framework, named the *market tightness*, denoted by θ.

$$\theta = \frac{v}{u} \quad (2)$$

As equation (2) suggests, the market tightness is the ratio of vacancies to unemployment and is a measure of workers relative bargaining power, i.e. a measure of workers' relative scarcity. The economic interpretation of θ is thus straightforward: the higher is θ, the higher is the workers bargaining power and the higher is the congestion in the market.

Given the properties of the matching function, it is possible to obtain the rate at which vacant jobs are matched with unemployed workers and the rate at which job seekers exit unemployment, both assumed to be drawn from a Poisson distribution.

The process that changes the state of vacant jobs is given by the following condition:

$$q(\theta) = m\left(\frac{u}{v}, 1\right) \quad (3)$$

with $q'(\theta) < 0$ and $q''(\theta) > 0$.

In a small interval, say δt, the probability that a vacant job is matched to an unemployed worker is $q(\theta)\delta t$ and the mean duration of a vacancy is $\frac{1}{q(\theta)}$.

In the same interval, the probability that a hiring firm will not find a suitable partner is $1 - q(\theta)\delta t$.

The elasticity of $q(\theta)$ is denoted by $\eta(\theta)$ and is a number between 0 and -1.

The rate at which unemployed workers exit unemployment is:

$$\theta q(\theta) = \left(1, \frac{v}{u}\right) \quad (4)$$

with $q'(\theta) > 0$ and $q''(\theta) < 0$.

The mean duration of unemployment is therefore $1/\theta q(\theta)$ and its elasticity is $1 - \eta(\theta) \geq 0$.

During an interval δt, the probability that an unemployed worker will not find a job is $1 - \theta q(\theta)\delta t$.

Both the terms $\theta q(\theta)$ and $q(\theta)$depend on the number of traders in the market, providing an example of a trading externality[3], due to the fact that price, in this setting, is not the only allocative mechanism.

Flows into unemployment are governed by job-specific idiosyncratic shocks that can depend on structural shifts in aggregate demand or productivity shocks. These shocks arrive at employed workers at a Poisson rate λ, where the latter is the job separation rate, assumed to be exogenous.

During an interval δt, $\lambda(1-u)\delta t$ workers enter unemployment and $m\delta t$ workers find a job, with the latter condition that can be written as $\theta q(\theta)\delta t$, that is the transition probability of unemployment.

The law of motion of unemployment is driven by the following first-order differential equation:

$$\dot{u} = \lambda(1-u) - \theta q(\theta)u \quad (5)$$

Equation (5) is decreasing in u, since its derivative is negative, i.e. $\frac{\partial \dot{u}}{\partial u} = -\big(\lambda + \theta q(\theta)\big) < 0$.

The negative sign of the derivative, that represents the speed of convergence, ensures the stability of the differential equation. Equation (5) states that the variation over time of unemployment is given by the difference between the exogenous flow of separations and the number of job matches.

In steady state, the time variation of unemployment must be zero. Setting $\dot{u} = 0$, the previous condition can be written as follows:

$$\lambda(1-u) = \theta q(\theta)u \qquad (6)$$

This condition simply states that, in steady-state, flows in and out of unemployment are completely balanced, offsetting each other.

[3] According to Petrongolo and Pissarides (2001), given the two matching function elasticities η_u *and* η_v, the terms $\eta_u - 1$ and $\eta_v - 1$ are, respectively, measures of the negative externalities caused by workers and firms and high elasticities values signal few congestion in the market and more positive externalities.

From equation (6), it is possible to get a steady-state rate of unemployment as a function of the two transitions rates:

$$u = \frac{\lambda}{\lambda + \theta q(\theta)} \qquad (7)$$

The steady-state condition has a deep economic meaning, since it states that, for any given values of λ and θ, there exist a unique and stable rate of unemployment for the economy as a whole.

The latter condition defines a negative and convex[4] relation in the vacancy-unemployment space or in the tightness-unemployment space. Such a downward-sloping condition is known, in the literature, as the Beveridge Curve.

Condition (7) can be derived in terms of flows, i.e. in terms of job creation and job destruction. Since the number of new hires is $m(u, v)$, the job creation rate is defined as the ratio between the number of jobs created to employment, namely $\frac{m(u,v)}{1-u}$. On the other hand, the job destruction rate is the ration between job destroyed, $\lambda(1-u)$, to employment, $1-u$.

In equilibrium, these two rates can be equated, allowing us to write the steady state condition as follows:

$$\lambda = \frac{\theta q(\theta) u}{(1-u)}$$

1.4 Job Creation

When the two sides of the market meet and form a contract, job creation takes place. Firms that enter the market are assumed to be small and have only one vacant job. The working hours are fixed to unity while wages depend on some observable variables.

[4] In order to check for the convexity of the Beveridge Curve, the signs of the first and second-order partial derivatives of u with respect to θ must be considered.

$$\frac{\partial u}{\partial \theta} = -\frac{\left(q(\theta) + \theta q'(\theta)\right)\lambda}{(\lambda + \theta q(\theta))^2} < 0$$

$$\frac{\partial^2 u}{\partial \theta^2} = -\frac{\left(\lambda + \theta q(\theta)\right)\left[\left(2q'(\theta) + \theta q''(\theta)\right)\lambda - 2(q(\theta) + \theta q'(\theta)\right]}{(\lambda + \theta q(\theta))^3} > 0$$

After the meeting, firms and workers agree to sign an employment contract that specifies a wage rule and that can be broken, by any of the two sides of the market, in any time. When the job is filled and the employment contract signed, firms borrow capital and produce output that is sold in a competitive market.

The flow value of job's output is constant and equal to $p > 0$. When the job is unfilled, firms incur a fixed hiring cost $pc > 0$ and workers fill vacant jobs at a rate $q(\theta)$. The number of new jobs created by the firm is driven by the profit maximisation and optimality requires that, in equilibrium, the marginal gain from an additional vacancy is null, implying that, in this framework, profit maximisation is equivalent to the so-called *free-entry condition.*

Let J *and* V be, respectively, the present-discounted value of expected profit from a filled vacancy and the present-discounted value expected profit from a vacant job. Assuming that the cost of capital equals the interest rate r, V satisfies the following Bellman equation:

$$rV = -pc + q(\theta)(J - V) \quad (8)$$

The Bellman equations define an asset pricing condition in which the evaluation of an asset is equal to expected cost. Under the assumption of perfect capital markets, this condition states that the capital cost of the asset is equal to its return. In this specific case, the return of the asset is given by the cost of a vacant job,$-pc$, plus the rate at which vacant jobs are filled, $q(\theta)$, multiplied by the difference between the values of the filled and the unfilled vacancy.

The maximisation problem requires that firms open new vacancies up to the point in which the marginal gain from the vacancy is zero, implying that, in equilibrium, firms do not supply additional vacancies.

Setting $V = 0$ in equation (8), it is possible to derive a condition for J:

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

Equation (9) states that firms will create jobs until the point in which the expected profit of a new job is equal to the cost of hiring. Similarly, the capital cost of J satisfies the following Bellman condition:

$$rJ = p - w - \lambda J \quad (10)$$

where p is output, w is the wage and λ is an exogenous shock which determines the loss of the job.

Substituting equation (9) into (10), it is possible to obtain the *job creation condition*:

$$p - w - \frac{(r+\lambda)pc}{q(\theta)} = 0 \quad (11)$$

The job creation condition defines an optimality condition for labour demand and states that firms hire labour force until the point in which the value of a newly created job is equal to its expected cost.

From a geometrical point of view, the job creation condition can be depicted in the θ, w space and, under the assumptions about $q(\theta)$, it is possible to infer that it is downward-sloping[5].

1.5 Wage Determination

This section deals with the analysis of workers' behaviour who affect equilibrium through the bargaining process that leads to wage determination.

The discussion begins by deriving the expected values of unemployment and employment, respectively denoted by $U \; and \; W$.

The flow value of unemployment satisfies the following Bellman equation:

$$rU = z + \theta q(\theta)(W - U) \quad (12)$$

where z represents the income that the agent gets from unemployment insurance, irregular jobs or other activities.

The value of unemployment is given by the value of unemployment, z, plus the job-finding rate multiplied by the change of state $W - U$.

Equation (12) represents, simultaneously, the reservation wage and the unemployed worker's permanent income.

Similarly, since workers get a wage w when employed and flow into unemployment at the exogenous rate λ, the market evaluation of employment is:

$$rW = w + \lambda(U - W) \qquad (13)$$

The employment is valued the wage received by the worker plus the separation rate λ multiplied by the change of state from unemployment to employment.

Assuming that $W \geq U$, workers have no incentive to quit the job and this holds only if $w \geq z$.

[5] See Figure 1 of Section 1.5

The two previous conditions can be solved in terms of z, w and the two transition rates:

$$rU = \frac{(r+\lambda)z + \theta q(\theta)w}{r+\lambda+\theta q(\theta)} \quad (14)$$

$$rW = \frac{\lambda z + [r+\theta q(\theta)]w}{r+\lambda+\theta q(\theta)} \quad (15)$$

As long as $w \geq z$, the permanent incomes employed workers are greater with respect to the ones received by unemployed job seekers.

The employment contract between demand and supply defines a wage w_i in each period and since the matching process leads to some monopoly power, agents have to split the surplus derived from the match, according to the Nash bargaining rule.

Given the wage w_i, the expected returns of a filled position and employment are:

$$rJ_i = p - w_i - \lambda J_i \qquad (16)$$

$$rW_i = w_i - \lambda(W_i - U) \quad (17)$$

The optimal wage, determined from the Nash bargaining solution is the w_i such that the joint weighted agents wealth attains its maximum:

$$w_i = argmax\ (W_i - U)^{\beta}(J_i - V)^{1-\beta} \quad (18)$$

where $\beta \in [0,1]$ and is a measure of the workers relative strength[6], i.e. a measure of the degree of asymmetry in the bargaining process (Yashiv, 2004). The first-order condition for a maximum implies that:

$$W_i - U = \beta(J_i - W_i - V - U) \qquad (19)$$

From equations (16) and (17), it is possible to obtain two expressions for $W_i\ and\ J_i$. Substituting the latter in (19) and imposing the equilibrium condition $V = 0$ yields the following wage equation:

$$w_i = rU + \beta(p - rU) \qquad (20)$$

The wage is such that workers receive the reservation wage rU and a fraction β of the surplus they obtain from the match. Equation (20) implies that the wage is the same for all workers, allowing us to rewrite conditions (19) and (20) as follows:

$$W - U = \beta(J + W - V - U) \qquad (21)$$

[6] In the ideal situation, $\beta = \frac{1}{2}$ and agents split the surplus equally

$$w = rU + \beta(p - rU) \qquad (22)$$

The unemployed permanent income rU, making use of equation (9) in order to substitute $W - U$ out of (12), is given by the following equation:

$$rU = z + \frac{\beta}{1-\beta} pc\theta \qquad (23)$$

Substituting the latter in (22), it is possible to derive the equilibrium aggregate wage:

$$w = (1-\beta)z + \beta p(1 + c\theta) \qquad (24)$$

Equation (24) is the analogous of the Walrasian labour supply and, under the assumptions of constant labour force and identical search intensity it is, geometrically, a vertical line.
However, given the existence of monopoly rents, even under these assumptions, the wage curve is upward sloping in the θ-w space.

1.6 Labour Market Equilibrium

In this section the main characteristics and the main properties of the equilibrium in the labour market are illustrated.
In this setting, equilibrium is a triple (u, θ, w) that satisfies equations (7), (11) and (24).
In order to characterise the steady-state equilibrium and to show that is unique, three equilibrium conditions must be satisfied:

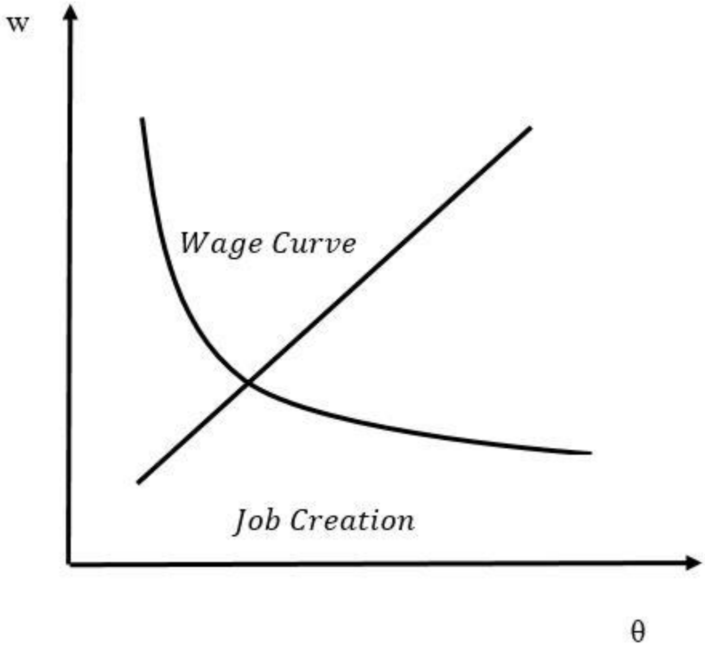
$$u = \frac{\lambda}{\lambda + \theta q(\theta)} \qquad (7)$$

$$p - w - \frac{(r+\lambda)pc}{q(\theta)} = 0 \qquad (11)$$

$$w = (1-\beta)z + \beta p(1 + c\theta) \qquad (24)$$

After having specified the equilibrium conditions, the equilibria in both the (θ, w) space and in the (u,v) space are analysed.

Figure 1. Equilibrium Wages and Market Tightness



In the (θ,w) space, the job creation condition derived by equation (11) defines a quasi-demand function, decreasing in w, hence negatively sloped.

The idea is that the higher is the wage, the lower is the incentive for firms to create new jobs. On the other hand, the wage curve derived in equation (24) is the analogous of the Walrasian supply and is increasing in the market tightness. What emerges from Figure 1 is that these two curves intercept only once, implying the uniqueness of equilibrium.

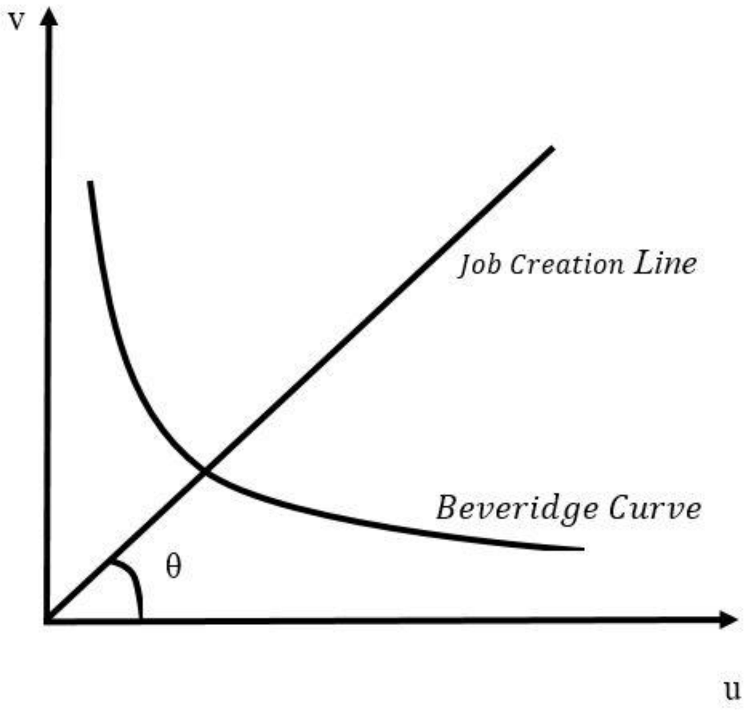
Before moving to the equilibrium in the (u,v) space, it first must be shown that the equilibrium θ does not depend on unemployment.

This can be shown by substitution of equation (24) in (11), to get:

$$(1-\beta)(p-z)-\frac{r+\lambda+\beta\theta q(\theta)}{q(\theta)}pc=0 \qquad (25)$$

This alternative job creation condition is an increasing line whose slope is θ, while the steady-state equation for unemployment is given by the Beveridge Curve derived in equation (7) and is downward-sloping.

Figure 2. Equilibrium Vacancies and Unemployment



In the vacancy-unemployment space, equilibrium is reached at the intersection between the job creation line and the Beveridge Curve and since the intercept only once, equilibrium is again unique, as shown in Figure 2.

1.7 Out-of-Steady-State Dynamics

The goal of this section is to consider whether the properties of the steady state model derived in the preceding sections hold even out of steady state. The analysis of the economy out of steady state allows us to understand whether there exist a unique and stable saddle path and whether, over the cycle, unemployment and vacancies are able to predict the counterclockwise loop observed in the Beveridge Curve. For this reason, the dynamic behaviour of vacancies, unemployment and wages must be examined.

The first assumption is that both vacancies and wages are jump variables, implying that firms are able to open and close vacancies instantaneously and that the surplus sharing rule defined by equation (19) still holds.

While vacancies and wages are jump variables, hence unstable, unemployment depends on the matching function, which does not allow for jumps, implying that unemployment is predetermined and hence stable.

To get dynamic equations for wages and market tightness, a set of Bellman equations for workers and firms has to be specified.

The value of a vacant job satisfies the following Bellman equation:

$$rV = -pc + \dot{V} + q(\theta)(J - V) \qquad (26)$$

The only difference between equations (26) and (8) is the term $\dot{V}$ that represents the expected capital gain (or loss) of the asset evaluation during the adjustment.

The capital value of a filled position is given by:

$$rJ = p - w + \dot{J} - \lambda J \qquad (27)$$

where $\dot{J}$ is again the capital value during the adjustment. Assuming, as in the steady state economy, that the free entry condition still holds, it is possible to set $V = \dot{V} = 0$ to get two conditions for J:

$$J = \frac{pc}{q(\theta)} \qquad (28)$$

$$\dot{J} = (r + \lambda)J - (p - w) \qquad (29)$$

The asset evaluations of unemployment and employment, out of steady state, are, respectively:

$$rU = z + \dot{U} + \theta q(\theta)(W - U) \qquad (30)$$

$$rW = w + \dot{W} + \lambda(U - W) \qquad (31)$$

Since the value of a filled job J and wages are monotonically increasing in the market tightness θ, equations (28) and (29) are characterised by only one rational expectations solution that holds when $\dot{J} = \dot{\theta} = 0$, with two main implications.

The first is that wages and market tightness intersect only once, as in the case of the steady state economy; the second is that, independently of the initial conditions, vacancies and wages instantaneously jump to the equilibrium.

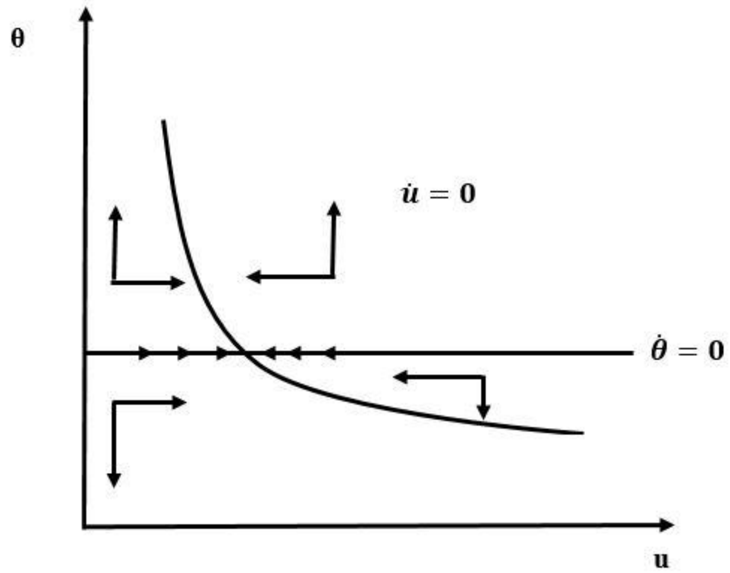
To show the dynamic behaviour of the Beveridge Curve the dynamic equations for unemployment and market tightness must be combined to get a system of two equations where u and θ are the only unknowns.

As before, the dynamics of unemployment are described by equation (5) with θ as a driving force. Substituting the wage equation (19) and the job value (28) into equation (29), an unstable condition in θ is obtained, with the latter as a unique unknown. From the first-order linear approximation of these differential equations it is possible to get:

$$\begin{pmatrix} \dot{u} \\ \dot{\theta} \end{pmatrix} = \begin{pmatrix} - & - \\ 0 & + \end{pmatrix} \begin{pmatrix} u \\ \theta \end{pmatrix} \qquad (32)$$

The necessary and sufficient conditions for a saddle point are satisfied, since the determinant is negative. The assumptions about unemployment and vacancies unable us to obtain the saddle point. In this framework, unemployment is *backward-looking* and thus stable, while vacancies are *forward-looking* and unstable. If firms expect a fall in the arrival of new employees, they want to have few vacancies in the future and, in order to achieve this goal, they have to open more vacancies. The result is an increase in vacancies and a fall in the arrival rate of new employees. The stability of the saddle point can be examined by a geometrical point of view.

Figure 3. Adjustment Path in θ-U Space

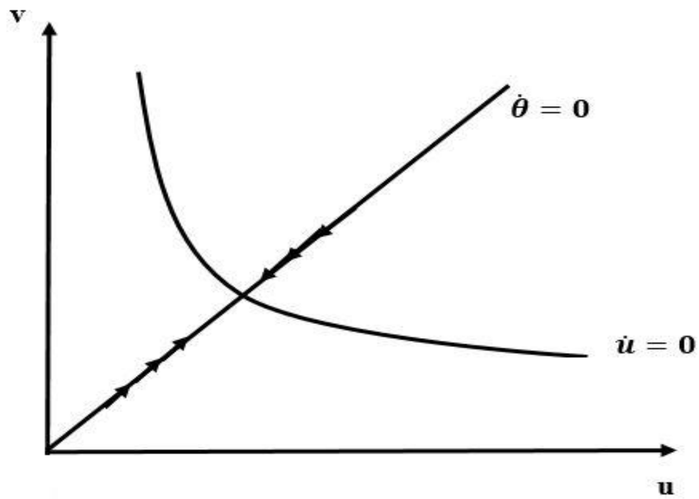


Given that θ is the only unstable variable, if it is not in equilibrium, it will diverge.

Thus, the saddle-path is θ-stationary and convergent to steady-state equilibrium at the intersection of the straight line $\dot{\theta} = 0\ and\ \dot{u} = 0$.

It is now possible to turn to the adjustment in the u-v space.

Figure 4. Adjustment Path in U-V Space

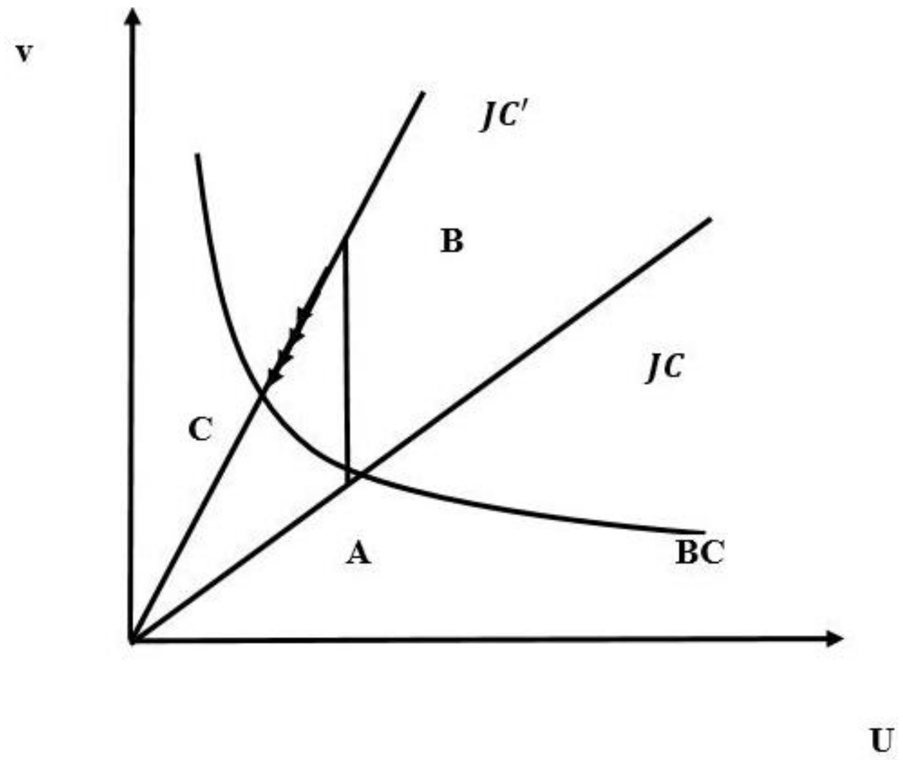


In this case, the line through the origin is θ-stationary and is equivalent to the saddle-path. Vacancies and unemployment move in the same direction during the adjustment process. This means that firms open new vacancies at the beginning of the process, while during the adjustment their number falls through the matching process.

A positive shock in productivity or demand shifts upward both the wage curve and job creation curve in Figure 3, increasing both wages and market tightness, which immediately adjust to the new equilibrium, implying that, for these variables, there is no adjustment process.

A different situation, described below, emerges with respect to the behaviour of the Beveridge Curve, where changes in productivity or demand lead to an anticlockwise rotation in the job creation line.

Figure 5. Adjustment in the U-V Space after a Productivity Shock



Assuming that the initial equilibrium is in point A, firms take advantage of the increase in productivity and have an incentive to open new vacancies, moving the economy from point A to point B.

In point B, the dynamics of unemployment are such that the economy moves down on the new job creation line and the final steady state equilibrium is given by point C in the picture and the dynamic behaviour of the economy out of steady state is able to predict the counterclockwise loop in the Beveridge Curve.

1.8 Welfare Evaluation

The discussion of the search and matching model continues by considering its properties in terms of welfare, i.e. if the private equilibrium is Pareto efficient. In the previous sections, it has been shown that the key variable in the matching framework is job creation, which follows from the firm maximisation problem. It has also been shown that, in the uncoordinated and decentralised search process, congestion externalities and other frictions arise. The goal is to determine whether the wage set through the Nash bargaining solution is able to internalise such externalities and, therefore, if it leads to the social efficient number of jobs created. In this setting, the assumption is that there exist a social planner wants to maximise the following social welfare function for an infinitely lived economy:

$$\Omega = \int_0^\infty e^{-rt}\,[p(1-u) + zu - pc\theta u]dt \qquad (33)$$

The social planner decision is constrained to the evolution of unemployment as the case of private choice:

$$\dot{u} = \lambda(1-u) - \theta q(\theta) \qquad (34)$$

Given the objective function and the constraint, the social planner solves the dynamic optimisation problem:

$$H = e^{-rt}[p(1-u) + zu - pc\theta u] + \mu[\lambda(1-u) - \theta q(\theta)] \qquad (35)$$

where θ is the control variable, u is the state variable and μ is the co-state variable.

The first order conditions for a maximum are obtained differentiating the Hamiltonian with respect to θ and u.

$$\frac{\partial H}{\partial \theta} = -e^{-rt} pcu + \mu u q(\theta)[1-\eta(\theta)] = 0 \qquad (36)$$

$$\frac{\partial H}{\partial u} = -e^{-rt}(p - z + pc\theta) + [\lambda + \theta q(\theta)]\mu - \dot{\mu} = 0 \qquad (37)$$

Substituting μ from (37) into (36), it is possible to obtain the socially efficient number of jobs:

$$[1-\eta(\theta)](p-z) - \frac{\lambda + r + \eta(\theta)\theta q(\theta)}{q(\theta)} pc = 0 \qquad (38)$$

Comparing equation (38) with the job creation condition derived in (25), it is trivial to show that the private solution and the social planner solution are identical if and only if the following equality holds:

$$\beta = \eta(\theta) \quad (39)$$

This condition, known in the literature as the Hosios condition7, simply states that the matching model is efficient if and only if the worker's share of the surplus is equal to the elasticity of the matching function with respect to unemployment.

If this condition is satisfied, then the decentralised job creation process is socially efficient and the congestion externalities are fully internalised.

However, in general, this equality does not hold since β is a constant, while η(θ) depends on the matching technology, implying that the number of new jobs created is usually lower than the minimum between vacancies and unemployment, i.e. $m(u, v) \leq \min(u, v)$.

The resulting equilibrium unemployment will be greater than the socially efficient one if $\beta > \eta(\theta)$ and lower if $\beta < \eta(\theta)$.

1.9 The Beveridge Curve

Before search and matching models were developed, a powerful and popular tool for explaining the dynamics and the cyclical behaviour of unemployment was already available in the literature: the Beveridge Curve.

[7] This condition was derived by Arthur Hosios (1990).

The discussion begins by providing, as already done in section 1.3, the derivation of the Beveridge Curve.

It has been shown that the evolution over time of unemployment is given by the following first-order differential equation.

$$\dot{u} = \lambda(1-u) - \theta q(\theta)u$$

This condition states the evolution of unemployment is driven by the difference between inflows and outflows.

In steady-state, $\dot{u} = 0$ and the steady-state unemployment rate is:

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

As in section 1.3, this equation defines a negative and convex relationship, known in the literature as the Beveridge Curve.

Initially discovered by Dow and Dicks-Mireaux (1958), the Beveridge Curve-a major stylised fact of modern macroeconomics-represents the inverse co-movement between the vacancy rate and the unemployment rate.

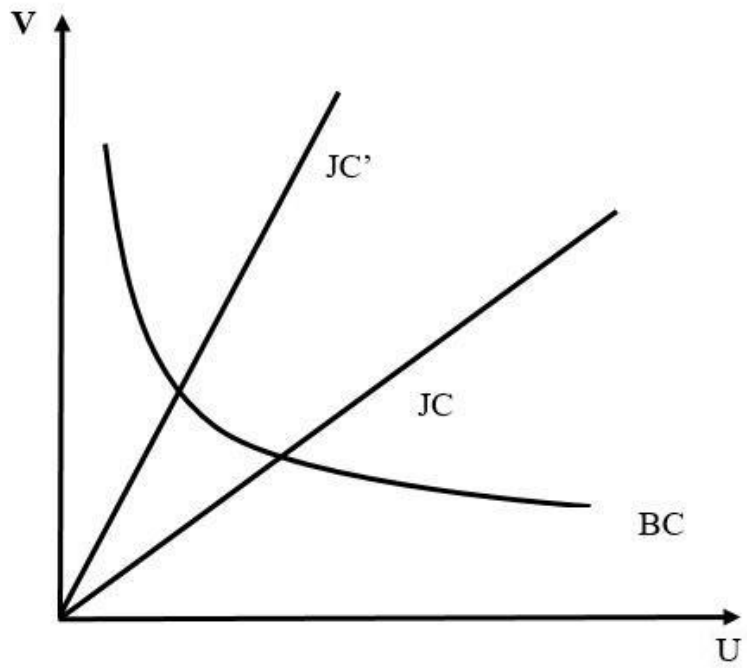
The rationale for such a negative relationship is quite intuitive: when the number of vacancies in the economy is high relative to job seekers, unemployed workers move quickly from unemployment to employment and the increased job-finding rate leads to a contraction in unemployment.

Viceversa, when the amount of vacancies is low, agents exit unemployment at a lower rate and unemployment increases.

In the first situation, the labour market is said to be tight, while in the second case is said to be slack. From the inspection of the Beveridge Curve, researchers can get useful information about the health of the labour market and about its ability in matching workers and firms. It is possible to distinguish between movements along the Beveridge Curve and shifts in the Beveridge Curve. Movements along the Beveridge Curve are driven by cyclical fluctuations in aggregate economic activity, hence by variations in the demand of labour services by firms.

Expansions in aggregate economic activity are phases characterised by a large amount of vacancies and a low level of unemployment, while recessions are periods where vacancies are low and unemployment high. It turns out that booms are periods where labour markets are tight, while crises are characterised by slack labour markets. In order to explain how the economy reacts to productivity or demand shocks, the graphical analysis is exploited.

Figure 6. Counterclockwise Loop in the Beveridge Curve

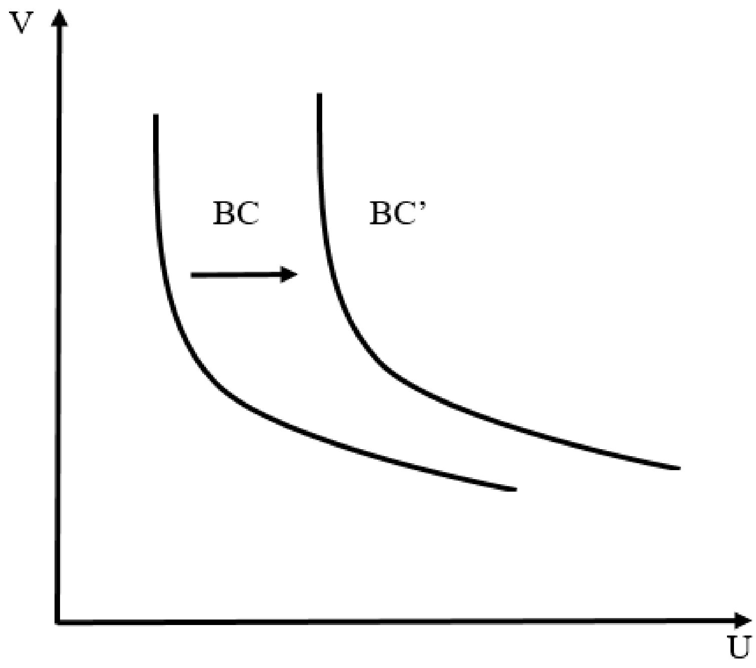


When productivity or demand shocks hit the economy, vacancies and unemployment trace counterclockwise loops around the Beveridge Curve.

The economic mechanism that drives these counterclockwise loops proceeds as follows: when the economy is hit by a positive shock, firms have incentive to open new vacancies, the job creation line shifts to the left, and the new equilibrium will be characterised by more vacancies and less unemployment. Conversely, when a negative shock hits the economy, firms have a lower incentive to open new vacancies, the job creation line shifts to the right and the equilibrium will be characterised by less vacancies and more unemployment.

If movements along the Beveridge Curve are determined by cyclical fluctuations in the economy, shifts in the Beveridge Curve signal a worsening in the labour market condition and a deterioration in the matching process.

Figure 7. Outward Shift in the Beveridge Curve



A shift in the Beveridge Curve can be thought of as a situation in which the unemployment rate is greater than it was before at the same level of vacancies, i.e. a positive co-movement between the vacancy rate and the unemployment rate.

Various factors produce shifts in the Beveridge Curve. Passive policies, like unemployment benefits, increase workers' reservation wages and reduce their search intensity, making vacancies less profitable and increasing unemployment, shifting the Beveridge Curve outward. On the contrary, active labour market policies, like the provision of incentives to the search activity, can improve the performance of the labour market, shifting the Beveridge Curve inward. The same happens when a negative shocks hits the economy. In this case, the inflow in unemployment is greater with respect to the outflow, shifting the Beveridge Curve.

Finally, the case of an exogenous increase in the rate of mismatch is considered. An increase in the rate of mismatch reduces the job- finding rate of unemployed job seekers and this, in turn, moves the Beveridge Curve far from the origin.

In view of the above, it turns out that the position of the Beveridge Curve can shed light about the degree of frictions in the labour market. If the labour market is characterised by a high degree of frictions, the Beveridge Curve is expected to position far from the origin. Conversely, if the economy has fewer frictions, it is reasonable to expect that the Beveridge Curve will position near the origin in the Cartesian plane.

It is useful to see how the role of the Beveridge Curve has changed over time. Given its importance in modern macroeconomics, the pioneering contribution of Dow and Dicks-Mireaux has stimulated a large amount of research over time. Within the literature, plenty of contributions involve the analysis of the Beveridge Curve (Holt and David, 1966; Hansen, 1970; Bowden, 1980; Abraham and Katz, 1986; Abraham 1987; Blanchard and Diamond, 1989; Hall, 2005; Shimer, 2005; Ghayad-Dickens 2012; Ghayad, 2013; Blanchard and Sahin, 2014).

Early contributions about the Beveridge Curve, in particular the afore-mentioned papers of Dow and Dicks-Mireaux, Holt and David and Hansen provided a closed relationship between the Beveridge Curve and the Phillips curve. Not surprisingly, these papers considered the contemporaneous existence of unfilled vacancies and unemployment as a phenomenon attributable to the incomplete adjustment of the labour market to the excess of demand of labour services, or, using the terminology of Dow and Dicks-Mireaux, to the so called maladjustment[8].

[8] The maladjustment is defined as the amount of unemployment that exists if there is zero excess demand.
The main causes of maladjustment are skills mismatch, labour turnover and geographical mismatch.

With the development of the search and matching theory, the role of the Beveridge Curve has deeply changed. Instead of signalling the degree of frictions in the labour market, vacancies and unemployment, in the equilibrium unemployment theory, are conceived as equilibrium phenomena rather than disequilibrium outcomes.

The Beveridge Curve is therefore an equilibrium relationship and is the locus where the equilibrium unemployment is determined, since along the Beveridge Curve flows in and out of unemployment are equivalent.

Moreover, it is possible to provide a closed relationship between the Beveridge Curve and the building block of the search and matching theory, represented by the matching function. According to Pissarides (2011), if the regularity conditions commonly imposed to matching function are satisfied, then the Beveridge Curve and the matching function are essentially the same. For a given number of matches, the matching function can be interpreted as an isoquant in the v-u space and, hence, equivalent to the Beveridge Curve.

1.10 Concluding Remarks

The goal of this chapter was to introduce the search and matching approach to labour market analysis, trying to analyse its main properties and its recent developments.

It has been shown that the search and matching models have become the most popular tool for explaining the dynamics of unemployment and the behaviour of various labour market outcomes over the business cycle.

Moreover it has been shown that in the matching approach unemployment is an equilibrium outcome, determined by the contemporaneous creation and destruction of jobs and that, given the lack of coordination, firms and workers are forced to engage in a costly search process to find the other side of the market.

This process is usually described by means of a matching function, which summarises the way unemployed workers and vacant jobs get together and how large numbers in the market, i.e. the so called congestion externalities, affect both the efficiency and the wealth of the agents in the market.

The analysis of the search and matching model has begun with the evaluation of the standard Pissarides (2000) model. Under fairly general assumptions, the model predicts the existence of a unique rate of unemployment, determined by the job-finding and the job-separation rates. The job creation decisions of firms and the behaviour of job-seekers have been introduced, deriving the equilibria of the model in the unemployment-vacancy space and in the tightness-wage space.

Great attention has been paid to the economy out of steady state, where the goal was to test the ability of the model in predicting the counterclockwise loops in the Beveridge Curve. The penultimate section was devoted to the welfare evaluation of the matching model. The condition that determines the efficiency of the matching model has been introduced and it has been shown that the matching model is efficient if and only if the Hosios condition is satisfied. If this condition holds, the private solution and the social planner solution are identical and the number of jobs created is efficient for the society as a whole. Unfortunately, the private solution is usually unlikely to be efficient and the equilibrium unemployment rate can be either below or above its socially efficient value.

In the last part of the chapter, the attention has been focused on the analysis of the Beveridge Curve, the negative relationship between vacancies and unemployment. Beyond the explanation of the main properties of the Beveridge Curve, it has been illustrated how the Beveridge Curve is able to capture the main facts regarding the cyclicality of the economy and the behaviour of the labour market over the cycle.

Four main issues have been addressed: the intuition behind the inverse co-movement between vacant jobs and unemployed workers, the observed counterclockwise loops over the cycle, the factors that shift the Beveridge and the relationship between the Beveridge Curve and the matching function.

The aim of the remainder of the thesis is to deal more closely with the Beveridge Curve in OECD economies. More precisely, in chapter 2, the dynamics of unemployment in the OECD are analysed, obtaining comparable estimates of inflow and outflow rates for twenty OECD economies. These two transition rates are then used to estimate the equilibrium unemployment rate predicted by the standard search and matching model.

Chapter 3 is dedicated to an econometric analysis of the Beveridge Curve, considering two different sets of countries, namely thirteen OECD economies and twelve European economies.

The goal of that chapter is, first, to reassess the role of institutional variables, like unemployment insurance, active labour market policies, union density and strictness of unemployment benefit system, on labour-market matching. Secondly, and more innovatively, it deals with the impact of the recent financial crisis on unemployment, with a view to understand whether the recent financial crisis has simply generated movements along the curve or shifts of the curve, eventually leading to long-lasting changes in the functioning of labour markets.

In chapter 4, the Beveridge Curve framework is extended to the analysis of youth unemployment in the OECD. In that chapter, besides considering the role of labour market institutions, demographic and educational factors are taken into account, which are assumed to be relevant in explaining youth unemployment. In order to consider the young unemployed jointly with the rest of the unemployed workers, the distance function approach is applied, assuming that youth and non-youth unemployment are jointly driven by vacancies and the other relevant variables. Although it has extensively been applied in empirical papers, especially in productivity analysis, this is the first application of the distance function approach in the macro-labour literature.

References

Abraham K.G. & Katz L.F. (1986), *Cyclical Unemployment: Sectoral Shifts or Aggregate Disturbances?* Journal of Political Economy, Vol. 94, 507-522

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

Anderson P.M. & Burgess S.M. (2000), *Empirical Matching Functions: Estimation and Interpretation Using State-Level Data,* Review of Economics and Statistics, No.1, 93-102

Andolfatto D. (1996), *Business Cycles and Lobor-Market Search,* American Economic Review, Vol. 86, 112-132

Arpaia A. & Curci N. (2012), *EU Labour Market Behaviour During the Great Recession,* Economic Papers, No. 405, pp. 1-51

Berman E. (1997), *Help Wanted, Job Needed: Estimates of a Matching Function from Employment Service Data,* Journal of Labour Economics, Vol. 15, 251-292

Beveridge W. (1944), *Full Employment in a Free Society,* London, George Allen and Unwin

Blanchard O.J. & Diamond P.A. (1989), *The Aggregate Matching Function,* NBER Working Paper, No. 3175, 1-42

Blanchard O.J. & Diamond P.A. (1989), *The Beveridge Curve,* Brookings Papers on Economic Activity, Vol. 1, 1-76

Blanchard O.J & Diamond P.A. (1990), *The Cyclical Behavior of the Gross Flows of US Workers,* Brookings Papers on Economic Activity, Vol. 2, 85-155

Bowden R.J. (1980), *On the Existence and Secular Stability of u-v Loci,* Economica, Vol. 47, 35-50

Burda M. & Wyplosz C. (1994), *Gross Worker and Job Flows in Europe,* European Economic Review, Vol. 38, 1287-1315

Coles M.G & Smith E. (1996), *Cross-Section Estimation of the Matching Function: Evidence From England and Wales,* Economica, Vol. 63, 589-597

Davis S.J. & Haltiwanger J. (1992), *Gross Job Creation, Gross Job Destruction and Employment Reallocation,* Quarterly Journal of Economics, Vol. 103, 819-863

Diamond P.A. & Maskin E. (1979), *An Equilibrium Analysis of Search and Breach of Contract, I: Steady States*, Bell Journal of Economics, Vol. 10, 282-316

Diamond P.A. (1982a), *Aggregate Demand Management in Search Equilibrium,* Journal of Political Economy, Vol. 90, 881-894

Diamond P.A. (1982b), *Wage Determination and Efficiency in Search Equilibrium*, Review of Economic Studies, Vol. 49, 217-227

Diamond P.A. & Sahin A. (2014), *Shifts in the Beveridge Curve,* Federal Reserve Bank of New York Staff Reports, No. 687, 1-15

Dow J.C.R. & Dicks-Mireaux L.A. (1958), *The Excess Demand for Labour: A Study of Conditions in Great Britain, 1946-56,* Oxford Economic Papers, Vol. 10, 1-33

Elsby M.W.L. et al. (2010), *The Labour Market in the Great Recession,* Brookings Papers on Economic Activity, Spring, 1-48

Friedman M. (1968), *The Role of Monetary Policy,* American Economic Review, Vol. 58, 1-17

Ghayad R. & Dickens W. (2012), *What Can We Learn by Disaggregating Unemployment-Vacancy Relationship?* Federal Reserve Bank of Boston, No. 12-3, 1-13

Ghayad R. (2013), *A Decomposition of Shifts of the Beveridge Curve,* Federal Reserve Bank of Boston, No. 13-1, 1-20

Gregg P. & Petrongolo B. (2005), *Stock-Flow Matching and the Performance of the Labour Market,* European Economic Review, Vol. 49, 1987-2011

Gross D.M. (1997), *Aggregate Job Matching and Returns to Scale in Germany,* Economics Letters, Vol. 56, 243-248

Hagerdon M. & Manovskii I. (2008), *The Cyclical Behaviour of Equilibrium Unemployment and Vacancies Revisited,* Working Paper Series, No. 583, 1-53

Hall R.E. (1979), *A Theory of the Natural Unemployment Rate and the Duration of Employment,* Journal of Monetary Economics, Vol. 5, 153-169

Hall R.E. (2005), *Employment Fluctuations with Equilibrium Wage Stickiness,* American Economic Review, Vol. 95, 50-65

Hansen B. (1970), *Excess Demand, Unemployment, Vacancies, and Wages,* Quarterly Journal of Economics, Vol. 84, 1-23

Hobijn B. (2012), *Potential Effects of the Great Recession on the US Labour Market,* B.E. Journal of Macroeconomics, Vol. 12, 1-9

Holt C.C. & David M.H. (1966), *The Concept of Job Vacancies in a Dynamic Theory of the Labour Market,* in the Measurement and Interpretation of Job Vacancies, Columbia University Press, New York

Hosios A.J. (1990), *On the Efficiency of Matching and Related Models of Search and Unemployment,* Review of Economic Studies, Vol. 57, 279-298

Jovanovic B. (1979), *Job Matching and the Theory of Turnover*, Journal of Political Economy, Vol. 87, 972-990

Kydland F.E. & Prescott E.C. (1982), *Time to Build and Aggregate Fluctuations,* Econometrica, Vol. 50, 1345-1370

Lagos R. (2000), *An Alternative Approach to Search Frictions,* Journal of Political Economy, Vol. 108, 851-873

Lucas R.E. & Rapping L.A. (1969), *Real Wages, Employment, and Inflation,* Journal of Political Economy, Vol. 77, 721-754

Mc Call J.J. (1970), *Economics of Information and Job Search,* Quarterly Journal of Economics, Vol. 84, 113-126

Merz M. (1995), *Search in the Labour Market and the Real Business Cycle,* Journal of Monetary Economics, Vol. 36, 269-300

Mortensen D.T. (1970), *A Theory of Wage and Employment Dynamics,* in Phelps E. et al., The Microeconomic Foundations of Employment and Inflation Theory, Norton, New York

Mortesen D.T. (1982), *The Matching Process as a Noncooperative Bargaining Game,* in the Economics of Information and Uncertainty, John McCall Ed., 233-258

Mortesen D.T. (1986), *Job Search and Labour Market Analysis,* Handbook of Labour Economics, Edited by O. Ashenfelter and D. card, Elsevier Science B.V. Vol. 2, 849-919

Mortesen D.T. (1989), *The Persistence and Indeterminacy of Unemployment in Search Equilibrium,* Scandinavian Journal of Economics, Vol. 91, 347-370

Mortesen D.T. (1992), *Search Theory and Macroeconomics,* Journal of Monetary Economics, Vol. 29, 163-167

Mortesen D.T. & Pissarides C.A. (1994), *Job Creation and Job Destruction in the Theory of Unemployment,* Review of Economic Studies, Vol. 61, 397-415

Mortesen D.T. & Pissarides C.A. (1998), *Technological Progress, Job Creation and Job Destruction,* Review of Economic Dynamics, Vol. 1, 733-753

Mortesen D.T. & Pissarides C.A. (1999a), *Job Reallocation, Employment Fluctuations and Unemployment,* Handbook of Macroeconomics, Vol. 1, Edited by J.B. Taylor and M. Woodford, Elsevier Science B.V., 1172-1228

Mortesen D.T. & Pissarides C.A. (1999b), *New Developments in Models of Search in the Labour Market,* Handbook of Labour Economics, Vol. 3, Edited by O. Ashenfelter and D. card, Elsevier Science B.V., 2568-2627

Petrongolo B. & Pissarides C.A. (2001), *Looking into the Black Box: a Survey of the Matching Function,* Journal of Economic Literature, Vol. 39, 390-431

Petrongolo B. & Pissarides C.A. (2008), *The Ins and the Outs of European Unemployment,* American Economic Review, Vol. 98, 256-262

Pissarides C.A. (1974), *Risk, Job Search, and Income Distribution,* Journal of Political Economy, Vol. 82, 1255-1267

Pissarides C.A. (1976), *Job Search and Participation,* Economica, Vol. 43, 33-49

Pissarides C.A. (1979), *Job Matchings with State Employment Agencies and Random Search,* Economic Journal, Vol. 89, 813-833

Pissarides C.A. (1984), *Search Intensity, Job Advertising, and Efficiency,* Journal of Labour Economics, Vol. 2, 128-143

Pissarides C.A. et al. (1986), *Unemployment and Vacancies in Britain,* Economic Policy, Vol. 1, 499-559

Pissarides C.A. (2000), *Equilibrium Unemployment Theory,* Second Edition. Cambridge, MA:MIT Press

Pissarides C.A. (2011), *Equilibrium in the Labour Market with Search Frictions,* American Economic Review, Vol. 101, 1092-1105

Phelps E.S. (1967), *Expectations of Inflation and Optimal Unemployment Over Time,* Economica, Vol. 34, 254-281

Phelps E.S. (1968), *Money-Wage Dynamics and Labour-Market Equilibrium,* Journal of Political Economy, Vol. 76, 678-711

Rogerson R. et al. (2005), *Search-Theoretic Models of the Labour Market: a Survey,* Journal of Economic Literature, Vol. 43, 959-988

Rogerson R & Shimer R. (2010), *Search in Macroeconomic Models of the Labour Market,* NBER Working Paper, No. 15901, 1-93

Shimer R. (2005), *The Cyclical Behavior of Equilibrium Unemployment and Vacancies, American Economic Review, Vol. 95, 25-49*

Stigler G.J. (1962), *Information in the Labour Market,* Journal of Political Economy, Vol. 70, 94-105

van Ours J. (1991), *The Efficiency of the Dutch Labour Market in Matching Unemployment and Vacancies,* De Economist, Vol. 139, 358-378

van Ours J. & Ridder G. (1992), *Vacancies and the Recruitment of New Employees,* Journal of Labour Economics, Vol. 10, 138-155

Warren R.S. (1996), *Returns to Scale in a Matching Model of the Labour Search,* Economics Letters, Vol. 50, 135-142

Yashiv E. (2000), *The Determinants of Equilibrium Unemployment,* American Economic Review, Vol. 90, 1297-1322

Yashiv E. (2004), *Macroeconomic Policy Lessons of Labour Market Frictions,* European Economic Review, Vol. 48, 259-284

Yashiv E. (2006a), *Evaluating the Performance of the Search and Matching Model,* European Economic Review, Vol. 50, 909-936

Yashiv E. (2006b), *The Beveridge Curve*, IZA Discussion Paper, No. 2479, 1-6

Yashiv E. (2007a), *Labour Search and Matching in Macroeconomics,* European Economic Review, Vol. 51, 1859-1895

Yahiv E. (2007b), *US Labour Market Dynamics Rivisited,* Scandinavian Journal of Economics, Vol. 109, 779-806

Chapter 2. Inflow and Outflow Rates across the OECD

2.1 Introduction

The Diamond-Mortensen-Pissarides search and matching model represents nowadays the main macroeconomic model for the analysis of labour markets characterised by search frictions and uncoordinated trade.

In the basic set-up a key role is played by a set of elements. Among them, one can easily recognise both inflow and outflow rates, i.e. the rates at which workers enter and exit unemployment, and the existence of a unique and stable unemployment rate, as a function of the afore-mentioned parameters.

In this chapter, building upon the contribution of Elsby et al. (2013), updated estimates of inflow and outflow rates for twenty OECD economies are provided. These two flow hazard rates are then used to calculate the steady-state equilibrium unemployment rate predicted by a standard theoretical model and to compare it with the registered series of the OECD, to test whether the theoretical model is able to replicate the dynamics of unemployment across these economies. The parameters' estimates suggest that entry and exit rates from unemployment strongly vary across countries, with Anglo-Saxon and Nordic economies being characterised by high inflow and outflow rates. On the other hand, limited entry and exit rates are observed in various European economies, like, for example, Belgium, Ireland, Spain, Germany and Italy.

Due account shall be take in these results for the empirical analysis proposed in the thesis.

The remainder of the chapter is organised as follows: section 2.2 reviews the main literature concerning inflow and outflow rates, while section 2.3 describes the data used for the derivation of the rates. In section 2.4, the basic methodology is introduced, while section discusses the estimation's results. In section 2.6 the comparison between actual and steady-state unemployment rates is provided., while section 2.7 concludes.

2.2. A Literature Review

One of the pioneering contributions for the derivation of inflow and outflow rates is the influential paper of Shimer (2005) who derives monthly estimates of inflow and outflow rates for the US throughout the period 1948-2004, using microdata from the Current Population Survey (CPS).

In the paper, he finds evidence of strong procyclical behaviour in the outflow rate and acyclicality in the inflow rate.

Fujita and Ramey (2009) provide estimates of the flow hazard rates for the US for the period 1976-2005 using gross flow data from the Current Population Survey.

In line with Shimer, they find that the outflow rate is largely procyclical but, unlike the aforementioned contribution, they show that the inflow rate is largely countercyclical.

In this paper, furthermore, the authors use the two flow hazard rates to evaluate their relative contribution to variations in the unemployment rate.

They show that a consistent part of the variation in the unemployment rate is driven by variations in the inflow rate. Elsby, Michaels and Solon (2009) obtain monthly estimates of inflows and outflows for the US for the period 1948-2004 using CPS microdata.

In line with Fujita and Ramey, they show that the outflow rate is largely procyclical, while the inflow rate is strongly countercyclical.

Moreover, unlike Shimer (2005) and Hall (2005; 2006), they show that variations in the unemployment rate are not driven solely by variations in the outflow rate and that the inflow rate explains a consistent part of the variation in the unemployment rate.

Shimer (2012), using data from on unemployment by duration from the Bureau of Labour Statistics, provides monthly estimates of job-finding and separation rates for the US for the period 1948-2010 and analyses, quantitatively, the relative contribution of these rates.

He shows, again, that while the job-finding rate is strongly procyclical, the separation rate is relatively acyclical. Moreover, in his analysis, he shows the job-finding rates accounts for three-quarters of the variation in the unemployment rate, while the separation rate accounts for the remaining one-quarter.

The first important contribution focused on European economies is the paper of Petrongolo and Pissarides (2008), who provide estimates of the flow hazard rates for three EU economies, namely France, Spain and UK, using both administrative and labour force data.

They find that, for France, most of the variation in the unemployment rate is explained by variations in the outflow rate, while for Spain both rates influence the dynamics of unemployment.

For the UK they find that labour market reforms during the 1980's had a sizeable impact on both rates.

Hobijn and Sahin (2009) provide estimates of job-finding and separation rates for twenty OECD economies, using data on unemployment by duration and data on job tenure.

Unlike other papers, they derive the two transition rates using the Generalised Method of Moments (GMM) and they find large cross-country variability, showing that the US outperform other OECD economies in terms of both job-finding and separation rates.

Arpaia and Curci (2010), relying on Eurostat Labour Force Survey data, infer quarterly estimates of inflow and outflow rates for a sample of 27 EU economies.

They show that, over the crisis, both rates increased for Nordic economies, while countries like Spain, Ireland and Baltic economies experienced a markedly increase in the inflow rate, while in countries like Germany and Italy, both rates remained quite stable during the latest recessionary episodes.

Elsby et al. (2013) generalise the procedure proposed by Shimer (2005) and obtain estimates of inflow and outflow rates-the latter computed using an optimal weighting mechanism-for a sample of fourteen OECD economies, mainly using data on unemployment by duration.

In line with Hobijn and Sahin (2009), they show that the US perform better than other OECD economies and that European economies are usually characterised by low entry and exit rates.

Arpaia et al. (2014), following Elsby et al. (2013), i.e. providing optimal weights in the computation of the outflow rate, obtain quarterly averages of the transition rates for twenty-six EU economies, and compare their behaviour before and after the financial crisis.

They show that the Great Recession has led to a general worsening in the ability of the labour market in matching workers and jobs.

Hairault et al. (2015) obtain estimates of job-finding and separation rates for France for the period 1991-2010, using both administrative data and labour force data, and they show that, over the business cycle, variations in the unemployment rate are almost driven by fluctuations in the outflow rate.

Elsby et al. (2015), in a survey paper concerning the Beveridge Curve, obtain estimates of inflow and outflow rates for the US for the period 1948-2013.

They show that the inflow rate is largely countercyclical, increasing at the beginning of the recessions and the declines.

On the other hand, the outflow rate is markedly procyclical, increasing during expansions and decreasing during recessionary periods.

2.3. The Data

In order to obtain estimates of inflow and outflow rates, the analysis mainly relies on publicly available data from the OECD.

More precisely, the main reference is represented by the stock of unemployed workers by duration of unemployment.

The OECD collects the stock of unemployed workers by duration at annual frequencies and distinguishes across five different duration bins: < one month, i.e. short-term unemployed workers, >1 and <3 months, >3 and <6 months, >6 and <12 months and > 12 months, i.e. long-term unemployed workers.

As notably argued by Elsby et al. (2013), the computation of the hazard rates using data on unemployed by duration can be noisy when applied to OECD economies.

For this reason, their approach is followed, adding additional information and using quarterly data on unemployment rate[9].

The sample, that stops in 2014 for the whole set of countries, is an unbalanced panel which includes the following twenty OECD economies: Australia, Austria, Belgium, Canada, Denmark, Finland, France Germany, Ireland, Italy, Japan, Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, UK and US.

[9] For Switzerland, data for the yearly unemployment rate are taken from both OECD and ILO, while the quarterly unemployment rate is taken from Elsby et al. (2013).

2.4. The Basic Methodology

The starting point in the contribution of Elsby et al. (2013) is represented by the law of motion of unemployment.

More precisely, the evolution of unemployment can be described by the following first-order differential equation:

$$\frac{du}{dt} = s_t(1 - u_t)\text{-}f_t u_t \qquad (1)$$

where s_t is the inflow rate and f_t is the outflow rate.

As shown in equation (1), the evolution of unemployment over time is determined by the difference between inflows and outflows. In order to relate the continuous time evolution of unemployment to the unemployment rate registered at annual frequencies, the two hazard rates are assumed to be constant within years, allowing to solve equation (1) forward one year to obtain:

$$u_t = u_{t-12}(1 - \lambda_t) + u_t^{ss}\lambda_t \qquad (2)$$

where $u_t^{ss} = \frac{s_t}{s_t+f_t}$ is the steady-state equilibrium unemployment rate and $\lambda_t = 1 - e^{-12(s_t+f_t)}$ is the annual rate of convergence to steady-state.

To infer f_t, the procedure proposed by Shimer (2005) is followed. Unlike his analysis, based only on short-term unemployed workers, those with an unemployment spell lower than one month, all the different duration bins of the OECD are considered in this setting. This enables to write the variation in unemployment as:

$$u_{t+12} - u_t = u_{t-12}^{<d}\text{-}F_t^{<d}u_t \qquad (3)$$

where $u_{t-12}^{<d}$ is the stock of unemployed workers with duration less than *d* months, F_t is the outflow probability.

It is thus possible to solve equation (3) for F_t and obtain:

$$F_t^{<d} = 1 - \frac{u_{t+1} - u_{t+1}^{<d}}{u_t} \qquad (4)$$

From the outflow probability of equation (4), the outflow rate, within d months, can be computed as follows:

$$f_t^{<d} = -\ln(1 - F_t^{<d})/d \qquad (5)$$

where *d=1,3,6,12.*

In the literature pertaining the derivation of inflow and outflow rate, a crucial point is to test whether there exists or not *duration dependence*, i.e. whether $f_t^{<1} > f_t^{<3} > f_t^{<6} > f_t^{<12}$.

As noted by Elsby et al. (2013, pag. 538) if there exists duration dependence, then $f_t^{<3}, f_t^{<6}$ *and* $f_t^{<12}$ are not consistent estimates of the outflow rate and, in this case, $f_t^{<1}$ is the preferred measure for the outflow rate. On the other hand, Arpaia and Curci (2010, pag.20) show that, if there is no duration dependence, i.e. $f_t^{<1} = f_t^{<3} = f_t^{<6} = f_t^{<12}$, then averaging over *f* produces an unbiased, albeit not efficient, estimate of the outflow rate.

Hence following both the above quoted contributions, for those countries for which there is evidence of duration dependence, $f_t^{<1}$is the proxy of the outflow rate, while for those countries for which the hypothesis of duration dependence is not accepted, the simple average of the four different outflow rates is used to estimate the probability of flowing from unemployment to employment.

At this point, it is possible to show how to compute the inflow rate. In particular, equation (2) defines a non-linear equation which depends on the flow hazard rates, f_t and s_t, and on the unemployment rates, u_t and u_{t+12}.

Hence, solving equation (2) for s_t, it is possible to obtain an estimate of the inflow rate.

2.5. The Main Evidence

Estimates of inflow and outflow rates for the set of economies considered in the chapter are reported in Table 1 of the Appendix. Evidence of large cross-country variability, with respect to both transition rates, is found among the set of countries included in the sample.

The derivation of the flow hazard rates reveals large heterogeneity. Among the countries considered, evidence of duration dependence is found for countries like Australia, Canada, Denmark, Finland, Japan, New Zealand, Norway, Sweden, UK and US, while this hypothesis is rejected for countries like Austria, Belgium, France, Germany, Ireland, Italy, Netherlands, Portugal, Spain and Switzerland.

In terms of outflow rate, the best performance among the sample is realised by the US, whose outflow rate is estimated to be 49.84%.

Behind the US, it is possible to find the Norway, with an average outflow rate of 37.57% and New Zealand, where the probability of entering the pool of employed workers averages 28.65%.

Good performances in terms of outflow rate are for countries like Sweden (27.33%), Canada (23.37%), Australia (23.18%), Denmark (20.55%), Japan (18.01%). Countries such as Austria, Finland, Switzerland and UK show an average outflow rate higher than 10%.

For Austria, the estimated outflow rate is 13.31%, while for Finland it is equal to 14.34%.

For Switzerland it is 10.98% and for the UK 13.93%. At the other flip of the coin it is possible to find the other European economies.

The estimation reveals that the outflow rate averages 5.64% for Belgium, 9.64% for France, 7.19% for Germany, 6.54% for Ireland and 4.69% for Italy, which registered the worst performance within the set of countries considered.

For Netherland, the exit rate is estimated to be 7.24%, while for Portugal it is 7.27% and 8.40% for Spain.

A similar picture emerges with respect to the inflow rate.

Also in this case there exist large differences across the sample analysed.

As before, the US have the higher inflow rate, which averages 3.23%, followed by Canada (2.35%), New Zealand (1.78%), Sweden (1.71%), Australia (1.64%), Spain (1.49%), Norway (1.47%), Finland (1.40%), Denmark (1.26%), France (1.08%) and UK (1.01%).

Other countries have an average inflow rate below 1%.

This is the case of Austria (0.66%), Belgium (0.49%), Germany (0.61%), Ireland (0.64%), Italy (0.47%), Japan (0.60%), Netherlands (0.43%), and Switzerland (0.42%).

Overall, it seems to be reasonable to state that labour markets in the OECD are characterised by different degrees of activity, with countries like US, Canada, Australia, New Zealand, Sweden, Norway and UK with large transition rates with respect to other countries included in the sample.

2.6. Comparing Unemployment Rates

The aim of this section is to calibrate the equilibrium unemployment rate predicted by the standard search and matching model and to compare it with the registered series from the OECD, making use of the flow hazard rates derived in the previous section.

This kind of exercise can be tough of as a way to shed light about the ability of the conventional model in replicating the dynamics of unemployment.

Recall that unemployment is assumed to evolve according to the following first-order differential equation:

$$\frac{du}{dt} = s_t(1 - u_t)\text{-}f_t u_t \quad (6)$$

In steady-state, since $du/dt = 0$, it is possible to obtain the equilibrium unemployment rate as a function of the two transition rates:

$$u_t^{ss} = \frac{s_t}{s_t + f_t} \qquad (7)$$

Equation (7) states that the steady-state equilibrium unemployment rate is such to equate inflows and outflows, or, in terms of job creation and job destruction, is such to equate the amount of newly created jobs with the amount of jobs that are destroyed.

In Table 2 of the Appendix, statistics of both actual and steady-state unemployment rate are reported.

The first thing that emerges with respect to the unemployment rate is that it heavily differs across countries and over time. However, the aim of this section is to compare the time series behaviour of the unemployment rate registered by the OECD and the constructed equilibrium unemployment rate series obtained using the transition rates.

Since the comparison between the averages values of actual and steady-state unemployment rates is not very informative about the ability of the model in explaining the evolution of unemployment, in Table 3 of the Appendix are reported the results of a regression-based model in which the actual unemployment rate is regressed against its steady-state counterpart.

The results obtained via this regression-based approach suggest that the matching model seems to able to replicate the dynamics of unemployment for countries like the US, Australia, Austria, Finland, Japan, Norway, Sweden, UK, Denmark, New Zealand and Japan, as shown by both the coefficients of determination and the adjusted root mean squared errors[10].

On the other hand, the model does not provide an adequate description of the unemployment patterns in countries like Germany, Portugal, Switzerland, Italy, Spain, Ireland, Belgium and Netherlands.

What drives these different performances lies outside the aim of this chapter. However, as pointed out by Elsby et al. (2013), the search and matching model tracks well the actual unemployment rate only if the underlying economy displays high entry and exit rates from unemployment and the results obtained in the chapter seem to work in this direction and seem to be in line with their previous findings. This, however, shall be taken in due account in pursuing the empirical analysis in this thesis. For this reason, in the remainder of the thesis, in order to explain the drivers and the dynamics of unemployment, the approach of the Beveridge curve is taken.

[10] The Adjusted Root Mean Squared Error is computed as the ratio between the Mean Squared Error and the mean of the actual unemployment rate.

2.7. Concluding Remarks

In this chapter, building upon the contribution of Elsby et al. (2013) and using data from the OECD, yearly estimates of inflow and outflow rates for twenty OECD economies have been provided.

These estimates have been used to calibrate the steady-state equilibrium unemployment rate predicted by the conventional matching model, in order to test the ability of the model in replicating the dynamics of unemployment. Large heterogeneity in all the different aspects considered in the analysis is found. Inflow and outflow rates, for example, show a large amount of variability with the sample.

Results suggest that the US perform better than other OECD economies in terms of outflow rate and have the highest inflow rate within the sample. In line with the contribution of Elsby et al., the US labour market is the most dynamic one, with large flows of workers between the states of unemployment and employment. Also Scandinavian and Anglo-Saxon economies show a considerable performance in terms of both entry and exit rate from unemployment. The opposite, however, holds when one looks at most European economies, where both inflow and outflow rates are in general lower with respect to other OECD economies.

Explaining the rationale of this result lies outside the aim of the chapter, although one possibility is represented by the institutional setting of these economies and by the existence of institutional rigidities, which make firms more reluctant in creating new jobs, hence reducing the probability, for unemployed workers, to flow from unemployment to employment.

It has been shown that the search and matching model provides a good description of unemployment patterns only if the economy is characterised by high rates of inflow and outflow. If this condition does not hold, the model seems to be unable to replicate the dynamics of unemployment, showing large deviations from steady-state. Hence in the rest of this thesis, labour-market matching will be analysed through the more traditional tool of the Beveridge Curve. At any rate, in the following analysis (in Chs. 3 and 4), the indicators developed in this chapter will prove useful for the econometric estimation of the unemployment-vacancies trade-off, allowing to control for the inflow rate, a shift factor which is assumed to be a relevant variable since Nickell et al. (2003) but that rarely has been explicitly included in empirical models.

References

Arpaia A. & Curci N. (2010), "*EU Labour Market Behaviour During the Great Recession",* Economic Papers, No. 405, 2-51

Arpaia et al. (2014), *Is Unemployment Structural or Cyclical? Main Features of Job Matching in the EU after the Crisis",* Economic Papers, No. 527, 1-51

Elsby M.W.L. et al. (2009), "*The Ins and the Outs of Cyclical Unemployment",* American Economic Journal: Macroeconomics, Vol. 1, No. 1, 84-110

Elsby M.W.L. et al. (2013), *"Unemployment Dynamics in the OECD",* Review of Economics and Statistics, Vol. 95, No. 2, 530-548

Fujita S. & Ramey G. (2009), *"The Cyclicality of Separation and Job Finding Rates",* International Economic Review, Vol. 50, No. 2, 415-430

Hairault J.O. et al. (2015), "*The Cyclicality of Separation and Job Finding Rates in France",* European Economic Review, Vol. 76, 60-84

Hall R.E. (2005), *"Employment Fluctuations with Equilibrium Wage Stickiness",* American Economic Review, Vol. 95, 50-65

Hall R.E. (2006), "*Job Loss, Job Finding and Unemployment in the US Economy over the Past Fifty Years: Comment",* in NBER Macroeconomics Annual 2005, Ed. Mark Gertles and Kenneth Rogoff, 101-137, MIT Press

Hobijn B & Sahin A. (2009), "*Job-Finding and Separation Rates in the OECD",* Economics Letters, Vol. 104, 107-111

Petrongolo B. & Pissarides C.A. (2008), "*The Ins and the Outs of European Unemployment*", American Economic Review, Vol. 98, 256-262

Shimer R. (2005), "*The Cyclicality of Hires, Separations, and Job-to-Job Transitions",* Federal Reserve Bank of St. Louis Reviews, Vol. 84, 493-507

Shimer R. (2012), "*Reassessing the Ins and the Outs of Unemployment",* Review of Economic Dynamics, Vol. 15, 127-148

Appendix

Derivation of the Outflow Rates

The fractions of the labour force that are unemployed are defined as follows:

1) $u_t^{<1}$ for unemployed workers with an unemployment spell lower than one month
2) $u_t^{<3}$ for unemployed workers with an unemployment spell greater than one month but lower than three months
3) $u_t^{<6}$ for unemployed workers with an unemployment spell greater than three months but lower than six months
4) $u_t^{<12}$ for unemployed workers with an unemployment spell greater than six months but lower than twelve months
5) u_t^{∞} for unemployed workers with an unemployment spell greater than one year

Adding quarterly data on the unemployment rates, the four outflow rates are computed according to the following conditions:

$$f_t^{<1} - \ln(u_t^{<3} + u_t^{<6} + u_t^{<12} + u_t^{\infty}) + \left(\frac{2}{3}\ln(u_t^{<1} + u_t^{<3} + u_t^{<6} + u_t^{<12} + u_t^{\infty}) + \frac{1}{3} ln u_{t-3}\right)$$

(1a)

$$f_t^{<3} = -(\ln(u_t^{<6} + u_t^{<12} + u_t^{\infty})\text{-}ln u_{t-3})/3 \quad (2a)$$

$$f_t^{<6} = -(\ln(u_t^{<12} + u_t^{\infty})\text{- } ln u_{t-6})/6 \quad (3a)$$

$$f_t^{<12} = -(\ln(u_t^{\infty}) - \ln(u_{t-12}))/12 \quad (4a)$$

As noted by Elsby et al (2013), this procedure enables to annualise data for the different duration bins, since it is unknown the period in which they are measured.

It turns out that the four values of the outflow rate contain the average of the lagged unemployment rates ($u_{t-3}, u_{t-6}, u_{t-12}$) for the quarters of the year for which the outflow rates are computed.

Table 1. Inflow and Outflow Rates: Summary Statistics

Sample Period	**Country**	**Outflow Rate**	**Inflow Rate**
1979-2014	Australia	23.18%	1.64%
1995-2014	Austria	13.31%	0.66%
1984-2014	Belgium	5.64%	0.49%
1977-2014	Canada	23.37%	2.35%
1984-2014	Denmark	20.55%	1.26%
1996-2014	Finland	14.34%	1.40%
1984-2014	France	9.64%	1.08%
1992-2014	Germany	7.19%	0.61
1984-2014	Ireland	6.54%	0.64%
1984-2014	Italy	4.69%	0.47%
1978-2014	Japan	18.01%	0.60%
1984-2014	Netherlands	7.24%	0.43%
1987-2014	New Zealand	28.65%	1.78%
1990-2014	Norway	37.57%	1.47%
1987-2014	Portugal	7.27%	0.60%
1988-2014	Spain	8.40%	1.49%
1984-2014	Sweden	27.33%	1.71%
1992-2014	Switzerland	10.98%	0.42%
1984-2014	UK	13.93%	1.01%
1969-2014	US	49.84%	3.23%

Source: Author's Calculations from OECD Data

Table 2. Actual and Steady-State Unemployment Rates: Summary Statistics

Sample Period	**Country**	**Actual UR**	**Steady-State UR**
1979-2014	Australia	6.99%	7.01%
1995-2014	Austria	4.78%	4.78%
1984-2014	Belgium	8.33%	8.11%
1977-2014	Canada	8.44%	8.41%
1984-2014	Denmark	6.09%	6.02%
1996-2014	Finland	9.10%	9.01%
1984-2014	France	10.02%	10.05%
1992-2014	Germany	8.10%	8.09%
1984-2014	Ireland	10.93%	10.77%
1984-2014	Italy	9.27%	9.59%
1978-2014	Japan	3.46%	3.43%
1984-2014	Netherlands	5.95%	5.83%
1987-2014	New Zealand	6.37%	6.35%
1990-2014	Norway	3.99%	3.98%
1987-2014	Portugal	8.05%	8.16%
1988-2014	Spain	16.41%	16.37%
1984-2014	Sweden	6.23%	6.22%
1992-2014	Switzerland	3.73%	3.71%
1984-2014	UK	7.43%	7.35%
1969-2014	US	6.34%	6.32%

Source: Author's Calculations from OECD Data

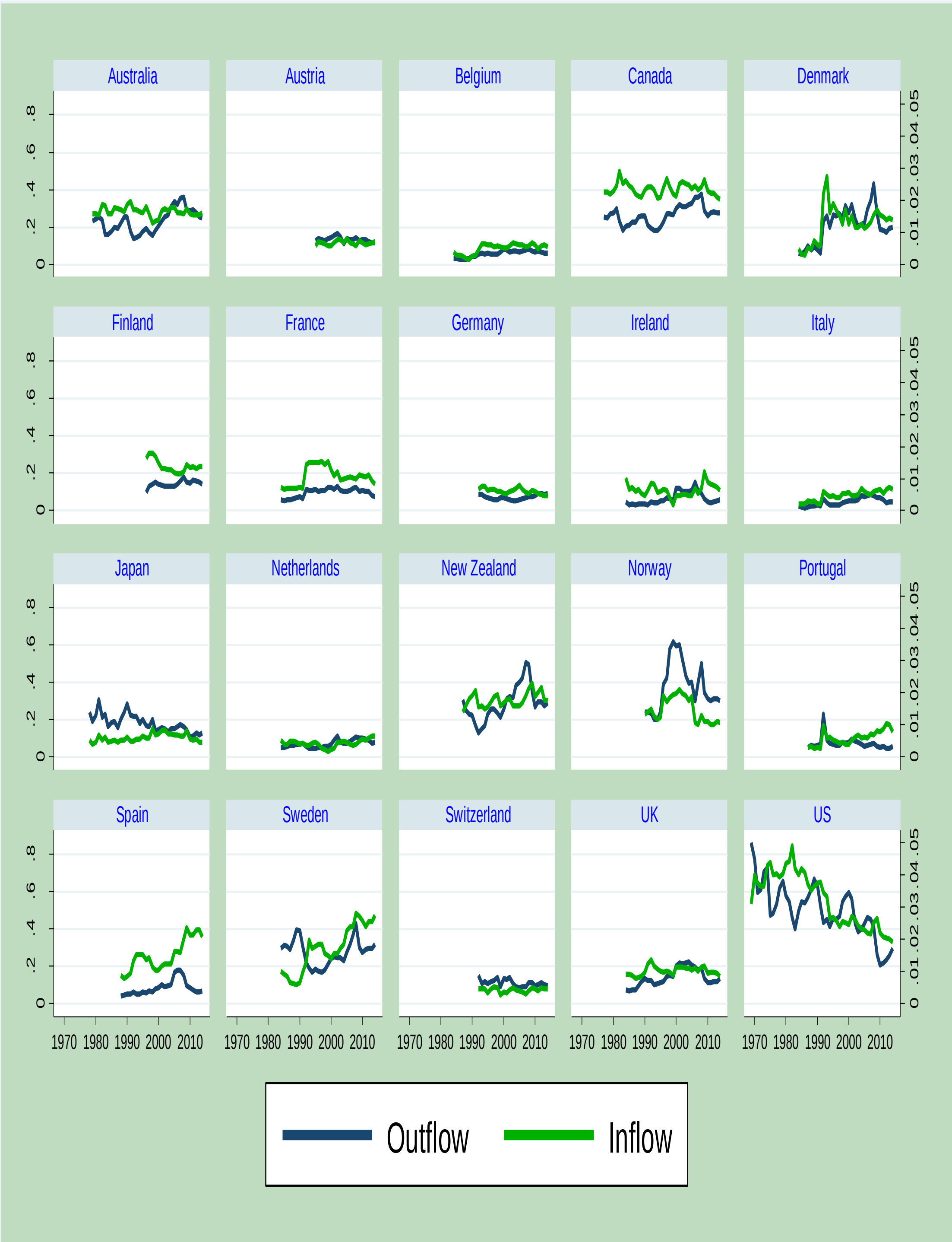
Table 3. OLS Regression of the Actual Unemployment Rate on the Steady-State Unemployment Rate

Country	R^2	**Adj-RMSE**	**N**
Australia	0.997	0.013	36
Austria	0.954	0.024	20
Belgium	0.681	0.081	31
Canada	0.999	0.007	38
Denmark	0.977	0.038	31
Finland	0.994	0.017	19
France	0.957	0.028	31
Germany	0.918	0.061	23
Ireland	0.927	0.120	31
Italy	0.761	0.087	31
Japan	0.995	0.022	37
Netherlands	0.875	0.096	31
New Zealand	0.998	0.014	28
Norway	0.999	0.006	25
Portugal	0.949	0.096	28
Spain	0.957	0.067	27
Sweden	0.999	0.013	31
Switzerland	0.929	0.044	23
UK	0.987	0.032	31
US	0.999	0.006	46

Figure 1. Unemployment Rates in the OECD

Australia
Austria
Belgium
Canada
Denmark
Finland
France
Germany
Ireland
Italy
Japan
Netherlands
New Zealand
Norway
Portugal
Spain
Sweden
Switzerland
UK
US
0
10
20
30
1980
1990
2000
2010

Figure 2. Inflow and Outflow Rates in the OECD - Inflow Rate Scaled on the Axis at the Right



Chapter 3. The Beveridge Curve Before and After the Great Recession

3.1 Introduction

The goal of this chapter is to analyse the joint behaviour of vacancies and unemployment for two different groups of countries, namely thirteen OECD economies and twelve EU countries (the choice crucially depends on the availability and the length of the series for the stock of vacant jobs) for the period 1985-2013, proposing new measures for the employment protection legislation, unemployment benefits and assessing the impact of other labour market institutions on unemployment.

The analysis developed in this chapter provides useful information concerning the existing relationships between unemployment and a set of labour market institutions, assumed to play a key role in explaining the dynamics of unemployment across countries and over time.

Moreover, the recent financial crisis has stimulated a large amount of research about the Beveridge Curve (see Bonthuis et al. (2013); Hobijn and Sahin (2013); Sell and Reinisch (2013), Arpaia et al. (2013).

However, there is yet no contribution in the literature that explicitly takes into account the effects of this large set of labour market institutions and policies on unemployment before and after the *Great Recession*, which is assumed to determine structural changes in the functioning of labour markets. Although some of these contributions have identified shifts in the Beveridge Curve for some economies, the relationship between this shift and labour market institutions is still a neglected factor and a limit that the analysis of the chapter tries to overcome.

The remainder of the chapter in organised as follows: section 3.2 provides a review of the literature about the Beveridge Curve, with great focus on the studies concerning OECD economies. In section 3.3 the econometric procedure applied for the purposes of the chapter is discussed, while section 3.4 explains the data used in the econometric exercise. In section 3.5 the results obtained via the estimated regressions are shown, while section 3.6 concludes.

3.2. Literature Review

The starting point is represented by the pioneering contribution of Nickell el al. (2003), in which they analyse the behaviour of unemployment for a set of twenty OECD economies for the period 1960-1990, considering not only the changes in the real wages but also the Beveridge Curves directly.

In their chapter, the attention is particularly focused on the impact of labour market institutions on unemployment, trying to determine whether labour market institutions produce shifts in the unemployment-vacancy trade-off.

Among the institutional factors introduced in the analysis, they consider the impact of variables like unemployment benefits replacement rate, an index of benefit duration, union density, bargaining coordination, union coverage, employment protection legislation, tax wedges and homeownership rate.

They find, as one might expect, that factors like unemployment replacement rates, benefit duration, union density and homeownership lead to an outward shift in the Beveridge Curve, hence producing a worsening in the ability of the labour market in matching workers and firms, while the opposite holds true when one looks at the impact of employment protection legislation, which improves the unemployment-vacancy trade-off, since it probably decreases flows from employment to unemployment. As already stated in the introduction, the advent of the recent financial crisis has stimulated new research about the Beveridge Curve, whose main goal is to establish whether the Great Recession will lead to long-lasting changes in the global economy.

From the perspective of the Beveridge Curve this is essentially equivalent to test whether the curve has shifted and to identify the driving forces of the shifts.

There are several factors that can determine shifts in Beveridge Curve, like hysteresis effects, increased mismatch or variations in labour market institutions.

For example, the increased generosity of the unemployment benefit systems rises workers' reservation wage, reducing the incentive to actively look for a job, shifting the curve outwards. On the other hand, increased public spending in active labour market policies should improve matching efficiency, shifting the curve inwards.

Arpaia and Curci (2010), consider the Beveridge Curve in EU countries, finding evidence for movements along the curve rather than shifts.

Elsby et al. (2010) analyse the Beveridge Curve in the US for the period 1951-2010, showing an outward shift of the curve since 2009. They ascribe this shift to increased mismatch between demand and supply.

Diamond and Sahin (2014), mainly relying on the graphical evaluation of the curve and using quarterly data for the period 1951-2014, show that shifts in the Beveridge Curve are common after recessionary periods. Over the period considered, the Beveridge Curve shifted in seven out of eight different business cycles but in three cases unemployment went back to its pre-recessionary levels. Their analysis, therefore, seems to imply that shifts in the Beveridge Curve are temporary and do not determine structural changes in the labour market efficiency.

Hobijn and Sahin (2013) provide a cross-country analysis of the Beveridge Curve, mainly focused on the identification of shifts since the recent financial crisis.

In the first part of the paper, they focus their attention on the unemployment-vacancy trade-off for the US for the period 2000-2010, using data from the Bureau of Labour Statistics (BLS). They find evidence of an outward shift of the curve, driven by increased mismatch and higher availability of unemployment benefits. In the second part of the paper, the analysis is addressed to a set of twelve OECD economies.

They show that the Beveridge Curve has shifted outward in four countries, namely Portugal, Spain, Sweden and UK. While for Portugal, Spain and UK, the driving forces of the shift are essentially the same as US, the outward shift in Sweden seems to be determined by the labour market reforms intervened.

For all other countries included in the sample (Australia, Austria, Belgium, France, Germany, Japan, the Netherlands, Norway and Switzerland), they find no evidence of an outward shift from the onset of the recent financial crisis.

Bonthuis et al. (2013) evaluate the behaviour of vacancies and unemployment after the recession for EU countries, finding evidence of an outward shift in countries like France and Spain, while in Germany labour market reforms have increased matching efficiency, leading to an inward shift of the curve. Furthermore, in their analysis, they apply a Probit model to identify the driving forces of the shift in the Beveridge Curve. Their analysis suggests that sectoral employment losses, labour force age and skills determine an outward shift in the Beveridge Curve, while labour market institutions are almost not significant.

Arpaia et al. (2014) provide an econometric analysis of the Beveridge Curve in the EU, trying to determine whether unemployment is structural or cyclical.

Their analysis reveals a worsening in the labour market efficiency for those countries that suffered from debt crisis, while the opposite holds true for Germany. They find evidence of large cross-country variability and they show that the deterioration in matching efficiency can be explained through increased unemployment spell, skill and sectoral mismatch. In the paper, they take into account the role of labour market institutions. Their analysis reveals that while active labour market policies are effective in increasing matching efficiency, increased generosity and availability worsen labour market conditions, implying a detrimental effect on matching efficiency.

Both Bonthuis *et al*. (2013) and Arpaia *et al*. (2014) rely on a two-step approach, potentially prone to misspecification, and consider only a limited set of institutional variables (basically employment protection legislation, unemployment benefits and active labour market policies).

In the papers considered above, mismatch has often been - rightly - referred to as one of the main influences behind shifts in the Beveridge Curve, and sometimes its empirical counterparts[11] have been utilised in econometric estimation. However, these traditional mismatch measures, being based on employment indicators, make any relationship between them and the Curve liable to a charge of spuriousness. This point is dealt at length in Entorf (2003; it is perhaps not surprising that Nickell et al., 2003, being well grounded in this early tradition, do not make any use of these indicators). Here an alternative solution to this problem is provided, by taking into account some exogenous determinants of labour-market mismatch.

Few economists would deny that globalisation have been among the fundamental socio-economic phenomena of this turn of century and it may be expected to impact heavily on the matching of labour supply and demand across the world (and in fact there has been substantial attention paid to their role in shaping wage and income inequality). Yet in the literature related to the Beveridge Curve only very few contributions have considered this variable. It is reasonable to say this is an important gap. Making full allowance for globalisation, one of the

[11] They are basically measures of dispersion of age-, area-, skill- or sector-specific employment; in the past, unemployment and vacancies have also been taken beside employment.

main potential determinants of mismatch, should bring in the estimates relevant information about this phenomenon without incurring in any spuriousness charge.
The influence of increasing international interdependence and integration on labour market matching has never been embodied in formal economic models. The IMF and the OECD (see e.g. IMF, 1996, and OECD, 1997) have shared the opinion that globalisation, far from being a source of unemployment, can be used in a strategy for better growth and employment. On the other hand, many critics of globalisation (ICFTU, 1996; Thorpe, 1997) have voiced the concern that this phenomenon has been associated with rising structural unemployment among low-skilled workers, mainly in the manufacturing sectors most exposed to international competition. According to Nickell and Bell (1995) and Song and Webster (2003), there is indeed some empirical evidence that the Beveridge Curve for unskilled workers has shifted outwards in recent years, due to increasing competition from low-wage countries. A corresponding outward shift in the aggregate Beveridge Curve should have also followed.

3.3. Empirical Strategy

From the discussion developed in the recent section of the chapter, it turns out that an econometric analysis of the Beveridge Curve can be obtained only through a cross-country study, which includes a large set of labour market institutions, as common in the literature, and some structural factors, which are assumed to influence the unemployment-vacancy trade-off, like, for instance globalisation. The selection of labour market institutions closely follows the pioneering contribution of Nickell et al. (2003).
The first key factor considered is the generosity of unemployment benefit systems. The inclusion of this variable in the econometric set-up is determined by the fact that higher benefit availability should increase workers' reservation wage, hence discouraging the search activity and leading to an increase in the unemployment rate.
The literature concerning the Beveridge curve often deals with the role of the Employment Protection Legislation (EPL). The relationship between workers' protection and the Beveridge Curve is of high interest since there is no consensus in the literature. Increased employment protection, indeed, may make firms more reluctant in creating new jobs, leading to an increase

in unemployment. On the other hand, according to Daniel and Stilgoe (1978), the higher is the protection for employed workers, the lower will be the flows from employment to unemployment, suggesting that increased employment protection should reduce, rather than increase, unemployment.

Another relevant variable for the analysis proposed in this chapter is represented by active labour market policies, where it is reasonable to assume a positive relationship between the former and labour market matching, hence improving the efficiency of the labour market in matching workers and firms. The inclusion of this variable is interesting since Nickell et al. (2003) only mention it as a potential shifting factor. Arpaia et al. (2014) determine, econometrically, its impact on unemployment, but it has already been noticed that their set-up is prone to criticism.

Another important variable in the empirical analysis of the Beveridge Curve is trade union density, which is expected to worsen matching since it discourages the creation of new employment positions for firms. A further relevant variable in this set-up is represented by the tax wedge, which is here defined as the difference between labour costs to the employer and the corresponding net take-home pay of the employee for a single-earner couple with two children (OECD).

Moreover, the econometric exercise proposed enables to control for the inflow rate, i.e. the probability, for employed workers, to flow into unemployment. This variable, indeed, is relevant in the contribution of Nickell et al. (2003), who define it as the ratio between the amount of workers with an unemployment spell lower than one month and the total number of employees in the economy. In this chapter, however, a different approach, based on the method proposed by Elsby et al. (2013) and already explained in the second chapter of the thesis, is followed[12]

Table A1 of the Appendix recapitulates the expected impact of each variable on unemployment.

Moving to the econometric specification, the starting point of the empirical analysis is the following specification

[12] The indicator suggested by Nickell et al. (2003) has been tried, but the fit was invariably lower.

$$ur_{it} = f\left(vr_{it}, inf_{it}, Z_{it}, a_t, a_i, t_i, t_i^2\right) \qquad (1)$$

where $i = 1, \dots, N$ is the country and $t = 1, \dots, T$ is the time period, an year, ur_{it} is the natural log of the unemployment rate, while vr_{it} is the vacancy rate. Notice that since the analysis deals with two different groups of countries, two different measures of the vacancy rate, which will be explained in a more detailed way in the next section, have been considered. While for OECD sample, the natural log of the vacancy rates has been adopted, for the Eurostat sample a hyperbolic functional form has been chosen.

Inf_{it} is the natural log of the inflow rate, while the vector Z_{it} includes all the factors that are assumed to be relevant in explaining the dynamics of unemployment, a_t and a_i are time and country-specific effects, while t_i and t_i^2 are linear and quadratic time-specific effects.

In order to analyse the impact of the recent financial crisis, an augmented version of equation (1) is proposed, which is specified as follows:

$$ur_{it} = f\left(vr_{it}, inf_{it}, Z_{it}, f(crisis), a_t, a_i, t_i, t_i^2\right) \qquad (2)$$

There are several ways in which the impact of the recent financial crisis on unemployment can be tested.

The simplest and most immediate one consists in creating a dummy variable, which takes the value of zero for the period before up to 2007 and one for the subsequent period. In this case, equation (2) can be written as follows:

$$ur_{it} = f\left(vr_{it}, inf_{it}, Z_{it}, crisis, a_t, a_i, t_i, t_i^2\right) \qquad (2a)$$

This specification, however, implies that the impact of the Great Recession is the same across the whole set of countries considered in the two different simple.

For this reason, an alternative version of equation (2a) is proposed, which allows for country-specific period dummies.

The main implication is that, in this case, the impact of the recent financial crisis is not identical but differs across countries. Therefore, it is possible to propose the following specification:

$$ur_{it} = f\left(vr_{it}, inf_{it}, Z_{it}, crisis_i, a_t, a_i, t_i, t_i^2\right) \qquad (2b)$$

In the econometric set-up, no restriction on the dynamic specification of the regressors is provided and, following the approach proposed by Pissarides and Vallanti (2007), the unemployment rate is assumed to follow a second-order autoregressive process, i.e. *AR(2),* while other variables enter with a current and a lagged value. Hence, in order to estimate the specified set of equations, the starting point is represented by a fixed-effects Autoregressive-Distributed Lag (2,1) model. Furthermore, different functional forms have been experimented. In the end, it was found that a Cobb-Douglas specification was chosen on grounds of parsimony and satisfactory performance.

Two different sets of countries have been considered, respectively composed by thirteen OECD economies and twelve EU countries. The choice of these two different samples is determined by the quality of existing statistics for vacancies.

The thirteen OECD sample includes Australia, Austria, Belgium, Finland, Germany, Japan, Norway, Portugal, Spain, Sweden, Switzerland and UK and US while the EU sample includes the following countries: Austria, Belgium, Denmark, Finland, France, Germany, Italy, Netherlands, Portugal, Spain, Sweden and UK.

More precisely, the OECD provides consistent time-series data for vacancies only for the afore-mentioned set of countries. On the other hand, the European Commission provides new and updated data for the twelve above-quoted economies, but not for extra-European countries.

The econometric analysis also deals with the potential problem of endogeneity, a factor often neglected in the literature concerning the Beveridge Curve. Indeed, it is reasonable to assume that the current values of the key variables included in the estimates, like the vacancy rate, the inflow rate and the main labour market institutions are determined jointly with the unemployment rate, hence endogenous. Eqs. 1-2b are estimated applying the Two Stages Least Squares (2SLS) method, in order to deal with this issue.

The current values of the vacancy rate, the inflow rate, and the main labour market institutions are treated as endogenous and instrumented with their own lagged values and lagged values of other labour market institutions (tax wedges, the KOF indices of globalisation and the wage coordination index proposed by Visser, 2013).

3.4. Data Description

The aim of this section is to describe data and sources used for the econometric exercise developed in the chapter.

For the purposes, two different sets of countries have been considered. For both sets considered, the sample period includes annual data from 1985 to 2013. Since the dataset contains some missing values for some countries and some years, the dataset is an unbalanced panel.

The first set, namely the Eurostat sample, contains the following countries: Austria, Belgium, Denmark, Finland, France, Germany, Italy, Netherlands, Portugal, Spain, Sweden and UK On the other hand, the OECD sample includes the following economies: Australia, Austria, Belgium, Finland, Germany, Japan, Norway, Portugal, Spain, Sweden, Switzerland UK and US

Looking at the main variables included in the econometric set-up, the preferred measure of unemployment is the standardised unemployment rate taken from the OECD Short-Term Labour Market Statistics.

For the vacancy rate, two different measures have been provided, depending on the sample considered. The vacancy rate for the OECD sample is computed, according to Nickell et al. (2003), as the ratio of vacancies to employment. Statistics for annual vacancies come from the OECD Registered Unemployed and Job Vacancies Dataset. Only for the US the vacancy rate has been computed extrapolating these data through the composite Help Wanted Index (HWI) proposed by Barnichon (2010).

On the other hand, for the Eurostat sample, a different measure of vacancy rate is adopted, represented by the proportion of firms reporting labour as one of the factors that limit production. Statistics for this variable are taken from the European Commission Business and Consumer Survey. Data concerning the factors limiting production are recorded quarterly. In order to obtain a yearly indicator for the vacancy rate, the original series has been averaged over the year.

The application of these data does not represent something new in the literature, since they have been used in the contributions of Bonthuis et al. (2013). The rationale for their application is determined by the fact that these data series are much lengthier when compared to Eurostat statistics for vacancies. For some countries, the series in the 1980s has been extrapolated using vacancy data from Nickell et al. (2003).

Turning now to the labour market institutions considered in the econometric analysis, ensuring their consistent measurement has involved a careful sifting of the available indicators and, for some variables, a sizeable work of data reconstruction.

The computation of the inflow rate has been carried out applying the procedure proposed by Elsby et al. (2013), which was already described in detail in Chapter 2. For the estimation of this variable, the analysis has relied on the yearly and quarterly harmonised unemployment rates from the OECD Short-Term Labour Market Statistics Dataset, and, for the stock of unemployed workers by duration, on the OECD Unemployment by Duration Dataset. Furthermore, in order to obtain lengthier series for the inflow rate, the resulting series have sometimes been extrapolated with the rates obtainable from Elsby et al. (2013) and Nickell et al. (2003).

Moving to the derivation of the employment protection legislation, two different sources have been utilised: the OECD Strictness of Employment Protection Dataset, which provides data from 1985 onwards, and the data obtainable from Allard (2005). In deriving this indicator, the three main aspects of the employment protection legislation have been considered, namely regular contracts, temporary contracts and collective dismissals. The final index is therefore a weighted average, where the weights are assigned according to the mechanism proposed by Allard (2005). While regular contracts and temporary contracts receive a weight of five twelfths, collective dismissals receive a weight of two twelfths. Moreover, since OECD data are available only from 1985 onwards, data from Allard (2005) have been used in order to construct a series that cover the period 1980-2013.

The multidimensional nature of unemployment benefits has made it necessary a particularly careful work of reconstruction. Two different measures have been considerd. The first one, based on OECD statistics, constructs an index of the net reservation wage, where the latter is computed as the net replacement rate multiplied by the duration of benefits and divided by the strictness of unemployment benefits. Statistics on the net replacement rate are taken from the OECD Tax and Benefits Dataset until 2000 and then extrapolated using data from the Unemployment Replacement Rates Dataset of Van Vliet-Caminada (2012) in order to obtain a series from 1980 onwards.

Duration and strictness are both numbers bounded between zero and one. Duration measures the duration of unemployment benefits over a five-year period and is computed using data provided by the OECD and is the ratio between the months in which unemployed workers receive benefits minus the waiting periods, over 60 months. The indicator for strictness, which measures the severity of the rules and administrative procedures that govern the distribution of unemployment benefits, has required the lengthiest work of all indicators. Although this is arguably the most innovative indicator, it builds upon some previous contributions: Ministry of Finance Denmark (1998), Hasselpflug (2005), Venn (2012) and Lagenbucher (2015).

The final indicator is the weighted average of three different sub-indicators, namely availability requirements, job-search requirements and sanctions. Each of the sub-indicator receives equal weight - one third - in the computation of the final indicator and the weighting scheme applied is the one proposed by Lagenbucher (2015).

Furthermore, each sub-indicator depends on a set of variables. More precisely, availability requirements depend on the availability during active labour market policies (ALMP) participation, demands on occupational mobility, demands on geographical mobility and other valid reasons for refusing job offers (each with a weight of 0.08).

Job-search requirements and monitoring depend on the frequency of job-search monitoring and the documentation of job-search activity (with a weight of 0.17).

Finally, there are sanctions, which include five different variables, namely sanctions for voluntary unemployment (with a weight 0.11), sanctions for refusing job offers (with a weight of 0.06), sanctions for repeated refusals of job offers (with a weight of 0.06), sanctions for refusing public employment service activities or ALMP placements (with a weight of 0.06) and sanctions for repeated refusals of public employment service activities or ALMP placements (with a weight of 0.06).

An alternative set of measures, constructed by Scruggs et al. (2014), have been used in the proposed specifications. They first include the unemployment generosity index taken from the Comparative Welfare Entitlements Dataset (CWED2):

$$
\begin{aligned}
&Unemployment\ Generosity_{nt} \\
&\qquad = \big[2 * z(Benefit\ Replacement\ Rate_{nt}) \\
&\qquad + z(\ln(Benefit\ Duration\ weeks_{nt})\big) \\
&\qquad + z(\ln(Benefit\ Qualification\ weeks_{nt})) + z(Waiting\ Days_{nt}) + 12.5] \\
&\qquad * Insurance\ Coverage_{nt}
\end{aligned}
$$

Where benefit replacement rate is the average replacement rate for a single person and one-earner married couple with two children; duration is the maximum amount, in weeks, of benefit entitlement; qualification is the amount of time, measured in weeks, necessary to qualify for benefits; waiting days is the number of days needed before benefits start; insurance coverage is the quota of the labour force insured. The constant term 12.5 is used to guarantee that the sum in brackets reaches its minimum at 0. The z's, for a generic variable k, are computed as:

$$\frac{Value_{knt} - MeanValue_{1980}}{St.Dev_{1980}}$$

The choice of the base year 1980 is arbitrary.

The second measure taken from Scruggs et al. (2014) relates to benefit duration. This indicator measures, in terms of weeks, the duration of unemployment benefits (excluding means-tested assistance). It is not bounded between zero and one.

Moving to active labour market policies, statistics on this variable come from the OECD Public Expenditure and Participant Stocks on ALMP Dataset and are expressed as proportion of gross domestic product (GDP).

With respect to unions, the trade union density, which, according to the OECD, is the ratio of wage and salary earners who are trade union members divided by the total number of wage and salary earners, has been considered. Statistics for this variable come from the OECD Trade Union Density Dataset.

Finally, statistics for the tax wedge come from the OECD Tax and Benefits Dataset.

Two distinct proxies for the globalisation have been used, namely the KOF index of actual economic flows (allowing for external trade, capital flows and outsourcing) and the KOF overall index of globalisation, both developed by Dreher (2006) and taken from the Swiss Federal Institute of Technology Zurich (ETH)[13].

In Figures 1 and 2 of the Appendix, as usual in the Beveridge Curve evaluation, the scatter plots of the vacancy and the unemployment rates for the sets of countries examined have been provided.

As the figure shows, there exists large cross-country heterogeneity, but nothing can be inferred the driving forces of the shifts in the Beveridge Curve.

Table 2 of the Appendix also provides the descriptive statistics for the main variables used in the econometric analysis, showing a sizeable degree of heterogeneity.

3.5. Estimation Results

All the estimated models are reported into tables A.3 - A.8 of the Appendix at the end of the chapter. All models have been estimated using the two different indices of globalisation and the measures of all institutional variables, including alternative combinations of indicators for unemployment benefits. The net reservation wage, as well as with the decomposition of this variable into its three main components, namely net replacement rate, benefit duration and strictness, has been experimented. Furthermore both the generosity and the duration indices of Scruggs et al. (2014) have been included in the estimates. Also, to repeat, the starting point is the Autoregressive-Distributed Lag (2,1) model and then performed a general-to-specific search. Yet only the results for the preferred specifications are reported.

In columns (1) and (2) of Tables A.3-A.4 the preferred estimates for Eq. (1) are reported over, respectively, 1985-2007 and 1985-2013. In this way, it is immediately possible to assess whether the occurrence of the Great Recession has a relevant impact on the structural stability of the Curve parameters. In columns (3) and (4) the preferred estimates for Eqs. (2a) and (2b) are given.

The discussion begins by considering the results obtained applying the LSDV estimator to Eqs. 1-2b. For both sets of economies analysed, the inflow rate, as expected, is positive and significant. As expected evidence of an outward shift in the Beveridge Curve determined

[13] In the final version, these variables have been retained as instruments

(although only transiently) by trade union density is found, and of an inward shift determined by unemployment benefit strictness (only significant in the OECD sample). More surprisingly, the estimates reveal an inverse relationship between the unemployment benefit generosity indicator of Scruggs et al. (2014) and unemployment. The unemployment benefit duration indicator of Scruggs et al. (2014) has the expected positive sign (only in the Eurostat sample). The OECD net replacement rate is never significant.

Active labour market policies have a transient *detrimental* effect, while employment protection legislation and tax wedge are found to determine no significant shift in the Beveridge Curve (neither of the latter two variables is reported in the preferred estimates). No globalisation index is significant either.

Further comments about these results shall be provided, when dealing with the more reliable 2SLS evidence. At any rate, it is comforting to see a broad convergence in results across the OECD and Eurostat samples. All the above results are also pretty stable for 1985-2007 and 1985-2013. Looking now more precisely at the role of the crisis, Eq. 2a, shows a significantly negative crisis dummy for the Eurostat sample and a negative, albeit not significant, dummy for the OECD sample.

With respect to the estimate of country-specific dummies, in the Eurostat sample evidence of a worsening in labour market conditions is found only for Spain, while in other economies results indicate a generalised improvement in the matching efficiency. Similar results are obtained in the case of the OECD sample, where a worsening of the trade-off after the recession is found for Norway and the US

Since one of the limitations of the previous contributions involving the Beveridge Curve is the issue of endogeneity, the main gist of the analysis must come from the model estimates carried out via 2SLS and reported in tables A.5.-A.6. Once again, in columns (1) and (2) of Tables A.5-A.6 provide the preferred estimates for Eq. (1) over, respectively, 1985-2007 and 1985-2013, and in columns (3) and (4) the preferred estimates for Eqs. (2a) and (2b) are given. In all the estimated equations, some of the variables which were statistically significant when using LSDV, are no longer significant (this is the case, throughout the Eurostat and OECD samples, of trade union density and active labour market policies). For robustness sake the preferred 2SLS estimates with and without these variables are reported.

Once more, for both sets of economies analysed, the regression results indicate that the inflow rate is positive and significant. As expected, the higher are the flows into unemployment, the further off from the origin is the Beveridge trade-off.

As previously with LSDV, a robust evidence of an inward shift determined by unemployment benefit strictness is found. Stricter rules governing the provision of unemployment benefits can play a key role in improving the unemployment-vacancies trade-off, since they probably induce unemployed workers to actively search for a job, hence avoiding moral hazard behaviour. However, the 2SLS models reiterate the existence a favourable role of the unemployment benefit generosity indicator of Scruggs et al. (2014) upon the Beveridge trade-off. This result can at any rate be rationalised in terms of the efficient insurance model proposed by Acemoglu and Shimer (1999).

On the other hand, the a priori expected positive impact of the unemployment benefit duration indicator of Scruggs et al. (2014), in the Eurostat sample, and the transient effects of active labour market policies and trade union density are not substantiated by 2SLS estimates. Among these three outcomes, the one that can be most easily ascribed to a correct treatment of reverse causality relates to active labour market policies. In any case, as said above, results are compared with and without changes in active labour market policies and trade union density.

Convergence in results across the OECD and Eurostat samples is now even stronger than with LSDV. Again all results are reasonably stable throughout the 1985-2007 and 1985-2013 samples.

As already stated in the previous sections, one of the goals of the empirical analysis is to deal with the impact of the recent financial crisis. In Table A.5, the preferred models for the Eurostat sample include both the crisis dummy and the country-specific dummies. The estimated coefficients for the crisis dummy are equal to -0.05 and are statistically significant, implying an improvement in labour market matching after 2007.

Looking at the impact of the Great Recession on labour market outcomes in each single economy, evidence of a statistically significant improvement in labour market matching is found in Austria, Belgium, Denmark, France, Germany, Netherlands and Portugal, while no evidence of significant variation in Finland, Italy, Spain, Sweden and UK is found.

Moving to the effects of the crisis in the OECD sample (Table A.6), the overall impact of the recession is found to be not significant. As far as the estimates for the country-specific dummies[14] are concerned, evidence of improvement in the labour markets of Austria, Finland, Germany and, to a lesser extent, of Switzerland is found.

It could be finally asked whether the evidence about the impact of the Great Recession on the Beveridge Curve does not unduly depend on (slight) parameter changes occurring with the financial crisis. It is difficult to formally test for parameter constancy in 2SLS panel estimates, but it is possible to conclude the evaluation of the Great Recession by considering the following robustness check, whose results are reported into Tables A.7.-A.8. In this econometric exercise, both the crisis dummy and the country-specific crisis dummies have been estimated through Constrained Ordinary Least Squares (COLS). The estimates have been constrained to take the coefficients of the 1985-2007 preferred specifications, and estimate the crisis-related parameters over 1985-2013. If neither the crisis dummy nor the country-specific crisis dummies appreciably differ from their estimated values (from Tables A5-A6), this suggests that the impact of the Great Recession on the Beveridge Curve does not depend on parameter changes.

With respect to the Eurostat sample, reported in Table A.7, the coefficient of the crisis dummy is negative but not significant, suggesting that the significant improvement of matching efficiency in Table A.5 may depend on parameter changes for the 1985-2013 estimates slightly detrimental to the pre-crisis overall situation of the countries under scrutiny.

When turning to the country-specific effects of the crisis, evidence of an improvement in labour matching is found for Austria, Belgium, Denmark, Germany and Portugal and a worsening in the labour market efficiency for Spain and UK. The latter worsening is the main difference vis-à-vis Table A.5. It is likely to depend on parameter changes for the 1985-2013 that have been detrimental to the pre-crisis overall situation of the countries under scrutiny.

At any rate, the changes between Tables A.5 and A.7 can be concluded to be quite limited, which is comforting. All the same, they point to the need for further research, not only to shed light on the different results for Spain and U. K., but also to inquire about the sources of improved matching efficiency for Austria, Belgium, Denmark, Germany and Portugal.

[14] Country-specific results are not reported for Belgium and Spain since their samples stop in 2003.

In the OECD sample, reported in Table A.8, the coefficient of the crisis dummy is found to be negative and significant, suggesting that the insignificant coefficient in Table A.6 may depend on parameter changes for the 1985-2013 estimates slightly favourable to the pre-crisis overall situation of the countries under scrutiny.

As far as the country-specific effects of the crisis are concerned, the results show a significant improvement for Austria, Finland, Germany, Portugal, Switzerland and UK, while there is only weak evidence of worsening for Australia and US. There are no sizeable differences vis-à-vis Table A.6. One cannot help noticing, however, that the main changes in evidence according to the specification and the sample used, relate to the UK. They cannot simply depend on parameter changes, but are also likely to be related to the different measures of the vacancy rate used in the Eurostat and OECD sample. A look at Figure 1 shows indeed that the UK is perhaps the country for which the Beveridge diagrams differ most across the two samples.

Summing up, one of the main objectives of the econometric analysis developed in this chapter is to evaluate the impact of the Great Recession on the Beveridge Curve. Since the gist of the aggregate effects, and most of the country-specific effects, are unaffected by parameter changes across the recession, it is possible to conclude that the recent financial crisis has implied either movements along the curve or favourable shifts of the curve. This seems to be true with respect to both the Eurostat and the OECD samples, and suggests the need for further research about the structures of the labour markets that have consistently shown signs of improvement (perhaps most of all, Austria, Germany and Portugal). Useful policy advice can derive if one ascertains long-lasting changes in the functioning of these labour markets.

3.6. Concluding Remarks

In this chapter the joint behaviour of vacancies and unemployment for a sample of thirteen OECD economies and a set of twelve EU economies has been considered, during the 1985-2013 period, taking into account various measures of labour market institutions.

The econometric analysis developed in this chapter suggests that employment protection legislation and tax wedge have no statistically significant impact on unemployment. The same is true (although only with 2SLS) for trade union density and active labour market policies.
On the other hand, the higher is the probability of flowing into unemployment, the higher will be the unemployment rate. Unemployment benefits also matter, but in a rather articulated way. The unemployment-vacancies trade-off is improved by *higher* generosity and more strictness in the benefit provision protocol, both these effects being rationalisable in terms of higher search efficiency. At least with 2SLS, benefit duration does not seem on the other hand to have no statistically significant for the unemployment-vacancy trade-off.
Furthermore, the analysis tries to shed light on the impact of the Great Recession on the Beveridge Curve. The results suggest that the recent financial crisis has, as a whole, either left unchanged or improved the Beveridge trade-off. Further research is advisable for those countries that have consistently shown signs of improvement (mainly, Austria, Germany and Portugal).

References

Acemoglu D. & Shimer R. (1999), *"Efficient Unemployment Insurance",* Journal of Political Economy, Vol. 107, 893-928

Allard G. (2005), "*Measuring The Changing Generosity Of Unemployment Benefits: Beyond Existing Indicators"*, Instituto de Empresa Working Paper, Working Paper 05-18.

Arpaia A. & Curci N. (2010), "*EU labour market behaviour during the Great Recession"*, EU Economic *Papers*, No. 405.

Arpaia A. et al. (2014), "*Is Unemployment Structural or Cyclical? Main Features of Job Matching in the EU after the Crisis"*, IZA Policy Paper No. 91.

Balakrishnan R. & Michelacci C. (1999), *"Unemployment Dynamics Across OECD Countries",* European Economic Review, Vol. 45, 135-15

Barnichon R. (2010), *"Building a Composite Help-Wanted Index",* Economics Letters, Vol. 105, 175-178

Bean C.R. et al. (1986), *"The Rise in Unemployment: A Multi-Country Study",* Economica, Vol. 53, S1-S22

Belot et al. (2007), *"Welfare-Improving Employment Protection",* Economica, Vol. 74, 381-396

Blanchard O. & Wolfers J. (2000), *"The Role of Shocks and Institutions in the Rise of European Unemployment: The Aggregate Evidence",* Economic Journal, Vol. 110, C1-C33

Bentolila S. & Saint-Paul G. (2003), *"Explaining Movements in the Labour Share"*, B.E. Journal of Macroeconomics. Vol. 3, 1-33.

Bonthuis B. et al. (2013), "*What's going on behind the euro area Beveridge Curve(s)?"*, ECB Working Paper No. 1586.

Booth A. et al. (2000) "*What do Unions do in Europe?", A Report*, Fondazione Rodolfo DeBenedetti, Milan.

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

Calmfors L. et al. (1988), *"Bargaining Structure, Corporatism and Macroeconomic Performance",* Economic Policy, Vol. 3, 13-61

Daniel W. W. & Stilgoe E. (1978), "*The Impact of Employment Protection Laws*", London, Policy Studies Institute.

Destefanis S.& Mastromatteo G. (2015), "*The OECD Beveridge Curve: technological progress, globalisation and institutional factors*", Eurasian Business Review, Vol. 5, 151-172.

Diamond P.A. & Şahin A. (2014), "*Shifts in the Beveridge Curve*", Federal Reserve Bank of New York Staff Reports, No. 687.

Dreher A. (2006), "*Does Globalization Affect Growth? Evidence from a New Index of Globalization*" Applied Economics, Vol. 38, 1091-1110.

Elsby M.W.L. et al. (2010), "*The Labour Market in the Great Recession*", National Bureau of Economic Research Working Paper, No. 15979.

Elsby M.W.L. et al. (2013), "*Unemployment Dynamics in the OECD*", Review of Economics and Statistics, Vol. 95, 530-548

Elsby M.W.L. et al. (2014), *"The Beveridge Curve: A Survey"*, Journal of Economic Literature, Vol. 53, 571-630

Entorf H. (2003), "*Do Aggregate Measures of Mismatch Measure Mismatch? A Time Series Analysis of Existing Concepts*", Labour and Demography, EconWPA.

Hobijn B. & Şahin A. (2013), "*Beveridge Curve shifts across countries since the Great Recession*", IMF Economic Review, Vol. 61, 566-600.

Hasselpflug S. (2005), *"Availability Criteria in 25 Countries"*, Ministry of Finance Denmark, Working Paper No. 12, Copenhagen

Holmlund B. (2014), *"What Do Labour Market Institutions Do?"*, Labour Economics, Vol. 30, 62-69

ICFTU (1996), "*The Global Market: Trade Unionism's Great Challenge*," ICFTU 16th World Congress, Brussels.

IMF (1996), "*The Impact of Globalisation on Workers and Their Trade Unions*".

Koeniger W. et al. (2007), *"Labour Market Institutions and Wage Inequality"*, Industrial and Labour Relations Review, Vol. 60, 340-356.

Lagenbucher K. (2015), *"How Demanding Are Eligibility Criteria for Unemployment Benefits, Quantitative Indicators for OECD and EU Countries"*, OECD Social, Employment and Migration Working Paper, No. 166, Paris, OECD Publishing

Layard R. et al. (1991), "*Unemployment: Macroeconomic Performance and the Labour Market"*, Oxford University Press.
Ministry of Finance Denmark (1998), "*Availability Criteria in Selected OECD-Countries",* Working Paper, No. 6
Lazear E.P. (1990), "*Job Security Provisions and Employment",* Quarterly Journal of Economics, Vol. 105, 699-726
Ljungqvist L. & Sargent T.J. (1998), *"The European Unemployment Dilemma",* Journal of Political Economy, Vol. 106, 514-550
Nickell S. & Bell B. (1995), "*The Collapse in Demand for the Unskilled and Unemployment across the OECD",* Oxford Review of Economic Policy, Vol. 11, 40-62.
Nickell S. & Layard R. (1999), "*Labour Market Institutions and Economic Performance"* in Ashenfelter O. and Card C. (eds), Handbook of Labour Economics, Vol. 3 (Amsterdam: North Holland).
Nickell S., Nunziata L., Ochel W., Quintini G. (2003), The Beveridge Curve, Unemployment and Wages in the OECD from the 1960s to the 1990s, in Aghion P., Frydman R., Stiglitz J. and Woodford M. (eds.), *Knowledge, 'Information and Expectations' in Modern Macroeconomics: in honour of Edmund S. Phelps*, Princeton University Press, New Jersey, pp. 394-431.
Nickell W. (2006), *"The CEP-OECD Institutions Data Set (1960-2004)"*, Discussion Paper No.759, Centre for Economic Performance, London School of Economics, November.
OECD (1997), "*Implementing the OECD Jobs Strategy: Member Countries' Experience".*
Pissarides C.A. (1990), "*Equilibrium Unemployment Theory"*, Cambridge, MA: MIT Press.
Pissarides C.A. & Vallanti G. (2007), *"The Impact of TFP Growth on Steady-State Unemployment",* International Economic Review, Vol. 48, 607-640
Roodman D. (2009b), *"A Note on the Theme of Too Many Instruments",* Oxford Bulletin of Economics and Statistics, Vol. 71, 135-158.
Scruggs L., Detlef J. & K. Kuitto (2014), "Comparative Welfare Entitlements Dataset 2. Version 2014-03." University of Connecticut and University of Greifswald.
Sell F.L. & Reinisch D.C. (2013), *"How do the Eurozone's Beveridge and Phillips curves perform in the face of global economic crisis?",* International Labour Review, Vol. 152, 191-204.

Song L.L. & Webster E. (2003), "*How Segmented Are Skilled and Unskilled Labour Markets? The Case of Beveridge Curves"*, Australian Economic Papers, Vol. 42, 332-345.

Thorpe V. (1997), "*Globalisation and Social Policy"*, Draft ICEM Position Paper.

Van Vliet O & Caminada K. (2012), *"Unemployment Replacement Rates Dataset Among 34 Welfare States, 1971-2009, An Update, Extension and Modification of the Scruggs' Welfare State Entitlements Data Set",* Neujobs Special Report, No. 2, 1-75.

Venn D. (2012), *"Eligibility Criteria for Unemployment Benefits: Quantitative Indicators for OECD and EU Countries",* OECD Social, Employment and Migration Working Paper, No. 131, Paris, OECD Publishing

Appendix

Table A.1. Expected shifts of the Beveridge Curve: institutional and structural variables

	Expected Main Impact
Unemployment benefits (net reservation wage), as decomposed in:	
(Net) retention ratio	Outward shift: Nickell *et al.* (2003)
Duration	Outward shift: Nickell *et al.* (2003)
Strictness	Inward Shift: Venn (2012), Lagenbucher (2015)
Inflow Rate	Outward shift: Nickell *et al.* (2003)
Employment protection legislation	Outward **or** inward shift: Nickell *et al.* (2003)
Tax wedge	Outward shift: Nickell *et al.* (2003)
Active Labour Market Policies	Inward shift: Nickell *et al.* (2003), Arpaia et al. (2014)
Bargaining coordination	Inward shift: Nickell *et al.* (2003)
Union density	Outward shift: Nickell *et al.* (2003)
Globalisation	Outward shift (ICFTU, 1996; Thorpe, 1997) **or** Inward shift (IMF, 1996; OECD, 1997)

Table A.2. The main variables – labels and some descriptive statistics

Variable	**Label**	**N**	**Mean**	**Min**	**Max**
Unemployment Rate	Ur	680	7.31	0.6	26.11
Vacancy Rate-OECD	Vr	423	0.86	0.08	3.34
Vacancy Rate-Eurostat	Vr	403	0.74	0.44	1.91
Inflow Rate	Inf	622	0.01	0.0015	0.04
Employment protection legislation	Epl	680	2.04	0.08	4.89
Unemployment benefits (net reservation wage)	Nrw	680	0.32	0.02	0.65
(Net) retention ratio	Nrr	680	0.60	0.07	0.94
Duration	Dur	680	0.60	0.04	1
Strictness	Strict	680	0.69	0.44	1
Generosity (Scruggs, 2014)	Generosity	680	9.89	2.6	14.5
Duration (Scruggs, 2014)	Duration	680	216.72	21	999
Union Density	Ud	680	0.37	0.07	0.83
Wage bargaining coordination	Coord	680	3.05	1	5
Almp (Expenditures Over GDP)	ALMP	561	0.007	0.0008	0.02
Tax Wedge	Tw	665	0.37	0.15	0.57
Overall Index of Globalisation	Kof	680	0.77	0.41	0.93
Globalisation index for actual economic flows	Kfa	680	0.72	0.28	0.97

Legend of tables

The dependent variable is always the natural log of the unemployment rate.

The vacancy rate for the EU sample is measured as 1/(percentage of firms reporting labour among the factors limiting production)^2, while for OECD countries it is computed as the ratio between vacancies and total employment.

An initial *l* stands for a variable taken in natural logarithms.

Year-specific effects and linear and quadratic country-specific time trends have been included, not shown in the interest of parsimony, in all specifications.

N is the number of observations, while the R2–adj. is the coefficient of determination adjusted for degrees of freedom

Coefficient significances are denoted by stars: * means a p-value < .1; ** a p-value < .05; *** a p-value < .01.

The *p-value* of the Hansen J-Statistic of overidentifying restrictions is reported for all the models estimated via 2SLS.

Table A.3. The EU Sample: Preferred Specifications-LSDV

Regressors	**(1)**	**(2)**	**(3)**	**(4)**
	1985-2007	**1985-2013**	**1985-2013**	**1985-2013**
D1.lur	0.43***	0.43***	0.41***	0.38***
L1.lur	-0.40***	-0.34***	-0.34***	-0.35***
Vr	0.18***	0.17***	0.18***	0.19***
Linf	0.16***	0.17***	0.18***	0.18***
Lgener	-0.26	-0.34**	-0.35**	-0.35**
Ldurat	0.06**	0.07***	0.06***	0.06***
L.strict	-0.24	-0.10	-0.09	-0.27
D1.Ud	1.68***	1.37**	1.40**	1.39**
D1.Almp	6.75*	6.61	7.32	9.95**
Crisis			-0.06*	
Austria				-0.24***
Belgium				-0.23***
Denmark				-0.34***
Finland				-0.13***
France				-0.17***
Germany				-0.23***
Italy				-0.11***
Netherlands				-0.16***
Portugal				-0.20***
Spain				0.09***
Sweden				-0.13***
UK				-0.10***
N	243	313	313	313
R2–adj.	0.72	0.66	0.68	0.70

Table A.4. The OECD Sample: Preferred Specifications-LSDV

Regressors	**(1)**	**(2)**	**(3)**	**(4)**
	1985-2007	**1985-2013**	**1985-2013**	**1985-2013**
D1.lur	0.33***	0.34***	0.34***	0.32***
L1.lur	-0.34***	-0.33***	-0.33***	-0.33***
D1.lvr	-0.27***	-0.26***	-0.26***	-0.26***
L1.lvr	-0.14***	-0.12***	-0.12***	-0.14***
Linf	0.16***	0.16***	0.16***	0.17***
L1.lgener	-0.49**	-0.31*	-0.29*	-0.34*
L1.Strict	-0.91***	-0.78**	-0.81**	-0.80**
D1.Ud	1.11*	1.15**	-0.81**	1.09*
D1.Almp	10.46**	10.17**	10.18*	10.72**
Crisis			-0.03	
Australia				-0.01
Austria				-0.17***
Finland				-0.13***
Germany				-0.14***
Japan				-0.04**
Norway				0.12***
Portugal				-0.06*
Sweden				-0.10**
Switzerland				-0.08***
UK				-0.11***
US				0.05***
N	254	318	318	318
R2–adj.	0.74	0.72	0.72	0.73

Table A.5. The EU Sample: Preferred Specifications-2SLS

Regressors	**(1a)**	**(1b)**	**(2a)**	**(2b)**	**(3a)**	**(3b)**	**(4a)**	**(4b)**
	1985-2007	**1985-2007**	**1985-2013**	**1985-2013**	**1985-2013**	**1985-2013**	**1985-2013**	**1985-2013**
D1.lur	0.51***	0.52***	0.51***	0.50***	0.49***	0.48***	0.46***	0.47***
L1.lur	-0.47***	-0.48***	-0.38***	-0.38***	-0.38***	-0.38***	-0.40***	-0.40***
Vr	0.15**	0.15**	0.19**	0.17**	0.18**	0.17**	0.15**	0.14*
Linf	0.17**	0.17***	0.17***	0.15**	0.19***	0.17***	0.18**	0.17**
Lgener	-0.31	-0.31	-0.32	-0.37**	-0.34*	-0.40**	-0.34	-0.38*
L1.Strict	-0.60*	-0.60*	-0.65**	-0.53*	-0.60*	-0.49*	-0.72**	-0.66**
Ldurat	0.09	0.09	0.03	0.04	0.03	0.04	0.02	0.03
D1.Ud	-0.01		-1.82		-1.77		-0.90	
D1.Almp	0.76		4.76		4.95		7.25	
Austria							-0.20***	-0.20***
Belgium							-0.22***	-0.21***
Denmark							-0.30**	-0.27**
Finland							-0.09	-0.07
France							-0.17***	-0.16***
Germany							-0.23***	-0.22**
Italy							-0.09	-0.08
Netherlands							-0.12*	-0.12*
Portugal							-0.16***	-0.15**
Spain							0.11	0.11
Sweden							-0.06	-0.07
UK							-0.11	-0.08
Crisis					-0.05**	-0.05**		
N	228	229	298	300	298	300	298	300
R2–adj.	0.71	0.71	0.61	0.64	0.62	0.65	0.66	0.67
Hansen	0.21	0.33	0.58	0.32	0.51	0.25	0.12	0.10

Table A.6. The OECD Sample: Preferred Specifications-2SLS

Regressors	**(1a)**	**(1b)**	**(2a)**	**(2b)**	**(3a)**	**(3b)**	**(4a)**	**(4b)**
	1985-2007	**1985-2007**	**1985-2013**	**1985-2013**	**1985-2013**	**1985-2013**	**1985-2013**	**1985-2013**
D1.lur	0.39***	0.43***	0.38***	0.39***	0.38***	0.39***	0.35***	0.38***
L1.lur	-0.37***	-0.39***	-0.35***	-0.35***	-0.35***	-0.35***	-0.35***	0.36***
D1.lvr	-0.24***	-0.23***	-0.29***	-0.29***	-0.29***	-0.29***	-0.25***	-0.25***
L1.lvr	-0.12***	-0.13***	-0.15***	-0.15***	-0.15***	-0.15***	-0.14***	-0.13***
Linf	0.17***	0.14**	0.16***	0.16***	0.16***	0.16***	0.22***	0.20***
L1.lgener	-0.28*	-0.28*	-0.21**	-0.20*	-0.21*	-0.19*	-0.24*	-0.22*
L1.Strict	-0.98***	-0.93***	-1.05***	-0.95***	-1.06***	-0.96***	-1.02***	-0.92***
D1.Ud	-0.15		-0.19		-0.13		-0.32	
D1.Almp	6.26		4.20		3.11		6.44	
Crisis					-0.02	-0.02		
Australia							0.02	0.01
Austria							-0.14**	-0.15**
Finland							-0.14***	-0.13***
Germany							-0.14***	-0.14***
Japan							-0.04	-0.05
Norway							0.10	0.09
Portugal							-0.04	-0.04
Sweden							-0.05	-0.04
Switzerland							-0.09*	-0.09
UK							-0.10	-0.08
US							0.05	0.05
N	237	238	301	303	301	303	301	303
R2–adj.	0.78	0.77	0.76	0.75	0.75	0.75	0.76	0.75
Hansen	0.55	0.63	0.09	0.13	0.79	0.14	0.83	0.09

Table A.7. The EU Sample: Estimates of Crisis and Country-Specific Dummies-COLS

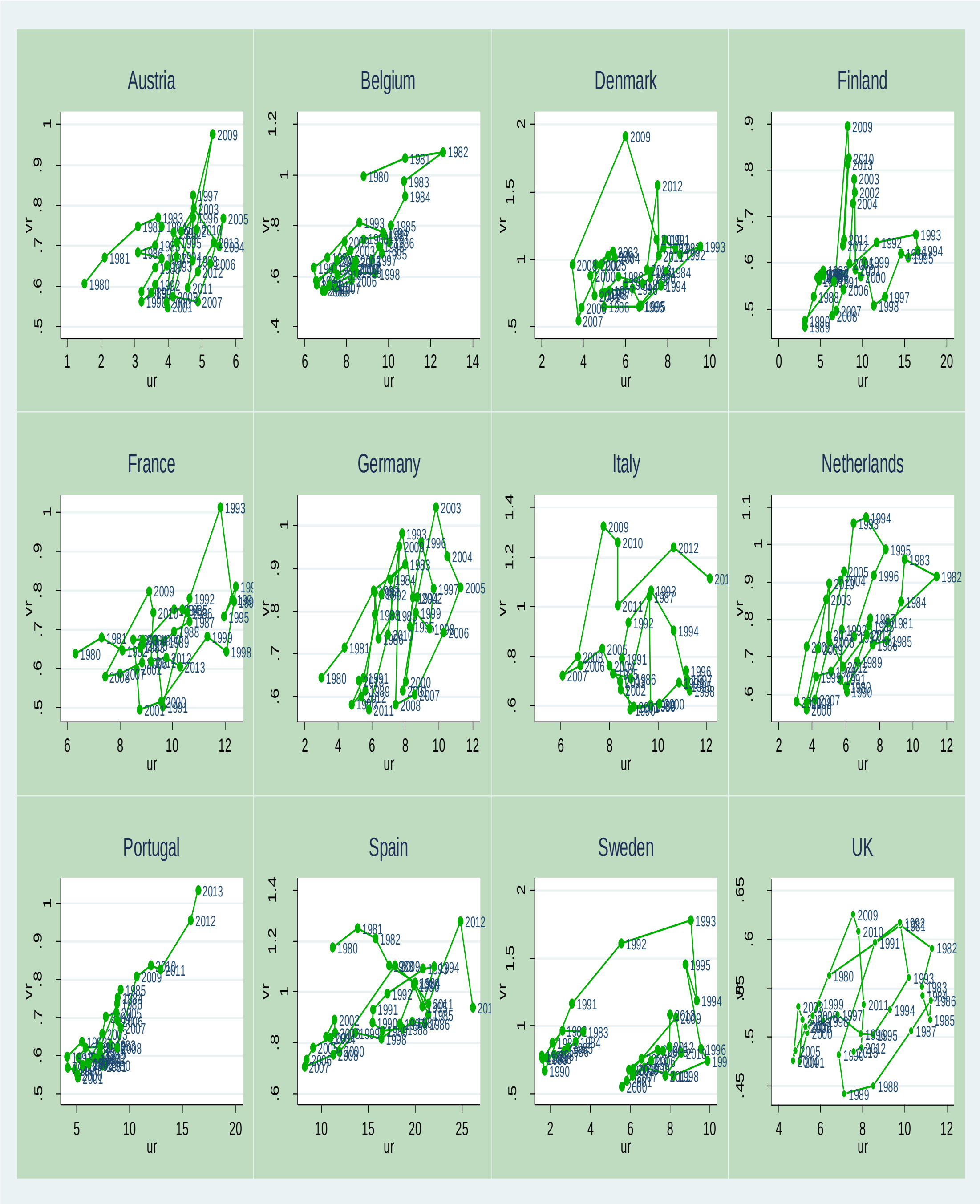
Regressors	**(3a)**	**(4a)**	**(3b)**	**(4b)**
	1985-2013	**1985-2013**	**1985-2013**	**1985-2013**
Austria		-0.29***		-0.29***
Belgium		-0.29***		-0.28***
Denmark		-0.25***		-0.25***
Finland		0.06		0.06
France		-0.06*		-0.06*
Germany		-0.35***		-0.35***
Italy		0.10		0.10
Netherlands		-0.03		-0.04
Portugal		-0.23***		-0.23***
Spain		0.23***		0.22***
Sweden		0.06		0.05
UK		0.44***		0.42***
Crisis	-0.03		-0.03	
N	298	298	300	300

Table A.8. The OECD Sample: Estimates of Crisis and Country-Specific Dummies-COLS

Regressors	**(3a)**	**(4a)**	**(3b)**	**(4b)**
	1985-2013	**1985-2013**	**1985-2013**	**1985-2013**
Australia		0.05*		0.02
Austria		-0.28***		-0.31***
Finland		-0.05**		-0.04
Germany		-0.16***		-0.20***
Japan		0.02		-0.01
Norway		0.05**		0.03
Portugal		-0.06**		-0.09**
Sweden		0.03		0.02
Switzerland		-0.15***		-0.15***
UK		-0.11***		-0.16***
US		-0.03		0.07**
Crisis	-0.03***		-0.03***	
N	301	301	303	303

Figure 1a. The Beveridge Curve in the OECD

Figure 1b. The Beveridge Curve in the EU



Chapter 4. An Extension of the Beveridge Curve to the Youth Labour Market

4.1 Introduction

In this chapter, the goal is to extend the Beveridge Curve framework to youth unemployment in order to shed light upon the determinants of unemployment for this particular segment of the labour market. In order to do so, a distance function is applied and estimated to evaluate the efficiency of the matching process for this group of workers jointly considered with the other unemployed workers. Beyond considering the impact of the main labour market institutions, the effects of the recession and the impact of some demographic factors, the impact of various variables which are assumed to play a key role in explaining youth unemployment is investigated, like, for example, vocational and educational training, education attainment and education gap.

In order to evaluate jointly the efficiency of the matching process for youth and non-youth unemployed workers, a distance function approach is developed in the chapter, where youth and non-youth unemployment are jointly driven by vacancies and the other relevant variables. Although it has extensively been applied in empirical papers, especially in productivity analysis, this is the first application of the distance function approach in the macro-labour literature.

According to the theoretical approach proposed Jimeno and Rodriguez-Palenzuela (2002), youth and non-youth are assumed to be inputs of the same production function, characterised by imperfect substitution.

Furthermore, in their empirical analysis the endogenous variable is represented by the difference between youth and non-youth unemployment rates.

Other studies, like the contribution of Bassanini and Duval (2006) take the non-youth unemployment rate as given.

Although youth and non-youth labour market outcomes are differently influenced by fluctuations in the aggregate demand of labour services, they are assumed to be inputs of the same technology, therefore providing a consistent justification for the application of the distance function, where it is further assumed that the dynamics of youth unemployment depend on variations in the non-youth unemployment rate.

For this reason, in the preferred specifications proposed in this chapter, the non-youth unemployment rate is one of the chosen regressors, appearing in the right-hand side of the proposed specifications.

Youth unemployment in both advanced and developing countries still remains an open issue, which has attracted the attention of both international institutions and governments. This problem seems to be very persistent, although actually the youth are largely more educated and skilled than before. Moreover, the 2007 financial crisis has further exacerbated this problem, leading to an almost generalised increase in the youth unemployment rates. Also after the Great Recession, i.e. during the recovery, the unemployment rate for people in the age range 15-24 continued to rise, with the implication that the crisis has been truly severe for youth. Recent statistics provided by the ILO (2016) show that youth unemployment dramatically increased during and after the Great Recession, with countries like Italy, Portugal and Spain displaying a youth unemployment rate larger than 40%.

Besides, youth represent one of the most vulnerable socio-demographic groups within our societies. Experiencing large and consistent unemployment spells during youth has several adverse consequences for the individual life-cycle, since it increases the risk of lifetime poverty, raises the probability of experiencing further unemployment in the future, negatively affects future incomes, reduces the probability of obtaining good job matches in the regular labour market and raises the probability of committing criminal activities (Fougère et al., 2009)

The drivers of youth unemployment have always stimulated the attention of both international institutions and economists. Factors like skills mismatch, the structure and the functioning of the different labour markets, labour market institutions, structural reforms and business cycle fluctuations are some of the possible causes able to explain what is behind youth unemployment.

The aim of this chapter is to extend the framework developed in chapter 3 to the analysis of youth unemployment, applying, in this case, the distance function approach, to evaluate the efficiency of the matching process for this particular segment of the labour market jointly with that for the other unemployed workers. The remainder of the chapter is organised as follows: section 4.2 reviews the main literature concerning youth unemployment, while in section 4.3 specifies the econometric set-up of the distance function. Section 4.4 provides a description of the data used for the econometric exercise performed. Section 4.5 discusses the results obtained through the econometric estimates, while section 4.6 concludes.

4.2. Literature Review

Clark (1982), using gross change data from the Bureau of Labour Statistics (BLS) analyses the distribution of unemployment and the patterns of mobility across youth. According to his contribution, youth unemployment is mostly determined by the availability of new jobs, with youth remaining unemployed for a large amount of time. He also deals with the relationship between the economic cycle and youth unemployment, showing that the latter is highly sensitive to economic fluctuations and to aggregate demand.

Gregg (2001) uses data from the National Child Development Survey (NCDS) to analyse the impact of youth unemployment on future labour market outcomes. His analysis reveals structural dependence determined by early unemployment, especially for men. More precisely, experiencing prolonged unemployment spells during youth raises the probability of being unemployment when adult. He also shows that factors like low educational attainment, family background and the characteristics of local labour markets are key factors in explaining youth unemployment.

Shimer (2001), using data for the State unemployment rates in the United States for the period 1978-1996, focuses his attention on the relationship between young workers and aggregate labour markets. Consistently with a frictional unemployment model with search on the job, he shows that increases in the proportion of youth workers in one state or region, respect to the rest of the United States, causes a consistent contraction in the unemployment rate and a small increase in the participation rate.

Jimeno and Rodriguez-Palenzuela (2002) using a panel of nineteen OECD economies study the relationship between the size of the youth population, labour market institutions and macroeconomic shocks on youth unemployment rates. They find that variations in size, decline in fertility rates and labour market institutions have an adverse impact on youth unemployment rates.

Neumark and Wascher (2004) consider the empirical nexus between youth employment and labour market institutions for a set of seventeen OECD economies for the period 1975-2000. They find evidence of an inverse relationship between minimum wages and employment, although this relationship appears to be strong for countries with largely deregulated labour markets and partially mitigated when if the underlying country provides the youth with sub-minimum wages. In their analysis, they also show that labour market institutions affect youth employment. While union coverage is negatively correlated with employment, employment protection legislation and active labour market policies are effective in improving the employment prospects of youth workers.

Gregg and Tominey (2005) use data from the NCDS to study the relationship between youth unemployment and future earnings. After controlling for factors like education, family background and other individual characteristics, they find that experiencing unemployment during youth leads to a consistent wage penalty in the future. This penalty lies in the range of 13-23% if the individual has had repeated unemployment spells during youth, while the effect is mitigated, lying in the range 9-11%, if the individual did not experience repeated unemployment spells.

Hordoy (2005) studies the impact of a set of labour market programmes on labour market outcomes in Norway during the early ’90. The paper shows that employment programmes increase the likelihood of obtaining a full-time job for females, while the opposite holds true for males and for people over 20. The analysis also shows that training programmes have no positive effects across all sub-groups, while vocational programmes are counterproductive for teenagers.

Fougère et al. (2006) analyse the nexus between unemployment and crime for France for the period 1990-2000 using regional-level data. They find evidence of a positive relationship between youth unemployment and crime.

Bassanini and Duval (2009) consider both the impact of labour market institutions and their interactions on unemployment for a set of OECD economies. They show that there exists a positive relationship between unemployment and some labour market institutions, like unemployment benefits, tax wedge and stringent anti-competitive policies. On the other hand, factors like wage coordination seem to be helpful in reducing unemployment. In their analysis, Bassanini and Duval (2009) focus the attention on the possibility of reforms complementarity, showing that the effects of a given reform depend on the overall institutional structure of the labour market and suggesting that the more employment-friendly is the institutional structure, the higher will be the effects, in terms of employment, of that reform.

Verick (2009) considers the impact of the 2007 financial crisis on youth unemployment in the OECD, showing that the recession has led to an almost generalised increase in the youth unemployment rate. The paper also shows that the recession has been truly severe for young workers and that youth unemployment rate shows an increasing pattern also during the recovery.

Perugini and Signorelli (2010) provide a comparison of European regions, distinguishing between Western and Eastern regions for the period 1999-2006. They show that youth unemployment rates display a high degree of stability at high levels. Their paper also reveals that structural and institutional factors are relevant variables in explaining the dynamics of youth unemployment, although this result crucially depends on the gender and the geographical sample considered.

Choudry el al. (2012) consider the impact of the 2007 financial crisis on youth unemployment, allowing for different types of crisis, namely systematic crisis, bank crisis, non-systematic crisis, currency crisis and debt crisis. They find evidence of long-lasting effects of the financial crisis on youth unemployment. More precisely, they show that the effects of the crisis last for 5 years and that the more adverse effects of the recession take place during the second and the third year after the onset of the crisis. They also consider the role of institutions, showing that active labour market policies and efficient school-to-work institutions are effective in reducing the risk of prolonged and repeated unemployment spells for youth.

O' Higgins (2012), using both cross-section and time-series rolling regressions, respectively from the period 2007-2011 and 1988-2011, analyses the impact of the Great Recession on youth labour market outcomes, with great emphasis on the interactions that exist between the latter and the main labour market institutions.

According to this contribution, the adverse consequences of the crisis on the employment situation of the youth can be ameliorated through the implementation of policies based on stricter employment protection legislation.

Cahuc et al. (2013) consider the time-series behaviour of youth unemployment in France and Germany. While France shows a markedly increase in youth unemployment, the same does not hold for Germany, where youth unemployment shows a decrease, during and after the recent financial crisis. These different performances can be ascribed to structural differences in both the policies implemented and the educational systems. According to their contribution, the problem of youth unemployment can be partially solved through the implementation of structural reforms.

Choudry et al. (2013), using a fixed-effects model for a set of 26 high-income OECD economies, analyse both youth and total unemployment rates. They find that economic growth, economic freedom, labour market reforms, active labour market policies and part-time employment opportunities reduce both total and youth unemployment rates.

Cockx and Pisicchio (2013) study the impact of youth unemployment on labour market outcomes using a multivariate duration model. They show that experiencing unemployment during youth negatively affects both the probability of finding a job in the future and the quality of subsequent matches. Moreover, if the unemployment spell during is prolonged, this raises the issue of negative duration dependence in the job-finding rate, determined by the fact the long-term unemployed workers send a negative signal to the labour market, making them less attractive, hence reducing the probability of a good job match.

Caporale and Gil-Alana (2014), using data for a set of 15 EU countries and applying both VAR and fractional integration models, consider both the persistence of youth unemployment and the nexus between the latter and its macroeconomic determinants. They find evidence of a strong degree of persistence in youth unemployment and provide favorable evidence of a long-run equilibrium relationship between youth unemployment and some of the main macroeconomic variables, like GDP and inflation.

Eichhorst and Rinne (2016), based on the empirical evidence of the literature, provide a review of the policies that can be drawn in order to improve youth employment, distinguishing between institutional measures and active and passive labour market policies. With respect to the institutional framework, relevant policies are vocational education and training, minimum wages and employment protection legislation, while the main active and labour market policies mainly involve unemployment benefits, activation and active labour market spending. Vocational education and training is assumed to be a relevant policy since it should facilitate the school-to-work transitions and should provide youth with the necessary skills to avoid educational mismatch.

Although the impact of vocational education and training on youth employment is still an open issue, both cross-country (Quintini and Manfredi, 2009) and country-specific studies (Winkelmann, 1996; Plug and Groot, 1998; Bonnal et al., 2002 and Parey, 2009) show that countries characterised by the dual apprenticeship system facilitate the school-to-work transitions of young people.

The second important policy measure is represented by minimum wages, which are assumed to be a relevant factor, since they affect the firms' cost function, reducing their willingness in opening new vacant positions, hence depressing their job creation abilities. The effects of minimum wages on youth employment are, however, largely debated in the literature. Some studies, like Abowd et al. (2000); Kramarz and Philippon (2001); Neumark and Wascher (2008) find a negative impact of minimum wages on youth employment-especially if the former is too high. Other contributions, like the papers of Portugal and Cardoso (2006) and Hyslop and Sillman (2007) find a positive relationship between minimum wages and youth employment. More precisely, while Portugal and Cardoso show that increases in minimum wages lead to a decrease in the amount of separations for young people, Hyslop and Sillman show that an increase in minimum wages is associated to an increase in youth working hours, wages and earnings.

The third institutional policy considered is represented by employment protection legislation. According to some studies (Cahuc and Postel-Vinay, 2002; Blanchard and Landier; 2002), the emergence of deregulated fixed-term contracts has had an adverse impact on youth, decreasing the probability of obtaining a permanent job and exacerbating the problem of youth unemployment. This seems to be particularly true in countries like France, Italy, Spain and Portugal. Moreover, according to Eichhorst (2014), the growth of fixed-term contracts may give rise to the emergence of dual labour markets, with youth entrapped in a flexible labour market, which drastically reduces the probability of obtaining a permanent job.

Moving to the role of active labour market policies, the contributions of Card et al. (2010); Card et al. (2015) and Kluve et al. (2016) provide evidence that active measures designed for youth unemployed are less effective than programmes directed to unemployment in general. These papers also show that, during recessionary periods, when the participation in active labour market programmes is often made compulsory, policies specifically designed for youth may be more effective in reducing youth unemployment.

Caliendo et al. (2011b) consider the impact of the participation in active labour market programmes on employment in both the short and the long-term for German youth under the age of 26, in order to evaluate the differences between participants and non-participants. They show that the impact of programmes aimed at creating jobs in the public sector are negatively correlated with future employment prospects in the short-run, while in the long-run these types of programmes seem to be largely ineffective. On the other hand, both the short and the long-run effects seem to be largely positive for people who took part in wage subsidy programmes. Moreover, their analysis reveals that active labour market programmes tend to benefit more both medium and high-skilled youth workers with respect to low-skilled youth.

Similar results are obtained in the paper of Larsson (2003), who analyses the impact of two different programmes, namely subsidised work programme in both the public and the private sector and training programme, on future employment prospect for Sweden youth during the early 1990's. The paper shows that both programmes have no effect in the short-run, while in the long-run the impact of these programmes is zero or, at most, mildly positive.

Canteno et al. (2009) consider the effects of two different job search assistance programmes in Portugal during the 1990's. One of these two programmes was implemented for youth unemployed in the initial phase of unemployment. The paper shows that the programme had adverse impact on youth unemployment, in the sense that people who took part in the programme experienced longer unemployment spells with respect to people who did not take part in the programme. According to the authors, this negative result can be motivated by the fact the programme did not allow for wage subsidies.

Hohmeyer and Wolff (2012) analyse the effects of the participation in the German programme *One-Euro-Jobs*, a programme aimed at activating people who received welfare assistance. They show that the programme had an adverse impact for those participants aged below 25 and for people who lost their job in the year preceding the beginning of the programme. On the other hand, this programme seems to be successful for both long-term unemployed and for older people who took part in the programme.

De Giorgi (2005) considers the impact of a specifically designed programme in the UK, namely *New Deal for Young People*, which consisted in a mix of various measures, like job search assistance, training, wage subsidies and job experience. The paper shows that the probability of becoming employed by an amount that can be quantified in about 5%.

Caliendo and Kunn (2011a) analyse the relationship existing between two different start-up programmes and unemployment in Germany. They show that start-up subsidies seem to be beneficial for both general and youth unemployment.

This survey makes clear that evidence in this field is by no means conclusive, especially when some important policy measures are considered. Secondly, while there is relatively abundant evidence related to cycle, demographics and (to a lesser extent) overall labour-market institutions, there is not much work on the joint relationships between all these factors and various features of the educational system. A final point is that there is virtually no attempt to consider youth unemployment jointly with the rest of the unemployed pool. This may produce a considerable loss in estimation efficiency since both pools of unemployed may be jointly affected by observable and non-observable factors. In the next section, some econometric evidence is provided, which attempts shedding new light on youth unemployment issue, by dealing with the above highlighted issues.

4.3. The Empirical Framework and the Distance Function Approach

4.3.1 The General Set-up

The above discussion point suggests that both labour market institutions and demographic or educational factors can sizeably affect youth unemployment and, for this reason, the econometric framework ties to include all these factors.

The same labour market institutions (plus inflow rate and globalisation proxies) that have already been considered in chapter 3, are used within the chapter. Additionally to labour-market institutions, some demographic and educational variables are considered: relative youth cohort, general educational attainment, relative youth education, VET participation rates, and various measures of the expenditures in public education.

The relative youth cohort, youth population over total working age population, may stand for positive or negative externalities brought about by a sizeable young population. General educational attainment is supposed to help labour-market matching, while relative youth education, the difference between the number of education years of total population aged 15 and over and the number of education years of total population aged 25, may stand for some differential mismatch effects, the most likely one being of overqualification of the young. The VET participation, that is the ratio of technical/vocational (ISCED 2 and 3) over total secondary enrolment, is supposed to have favourable effects, especially in country where VET is accompanied by dual apprenticeship schemes. Finally the percentage of expenditure in public education:[15] in this case it is reasonable to expect that investment in education should facilitate the matching process of young workers.

4.3.2 The Distance Function Approach

It would appear that the above considerations could animate the specification and estimation of a Beveridge Curve including youth unemployment, vacancies, and the set of variables indicated in the above sub-section. However, this kind of simple specification would neglect the obvious fact that vacancies, and many institutional variables, affect not only the young, but also the rest of unemployed workers. Besides, there are phenomena of substitution and complementarity between these two pools of workers. For example, Jimeno and Rodriguez-Palenzuela (2002), propose a theoretical model in which youth and non-youth are inputs of an aggregate production function and assumed to be substitutes, according to the following CES technology:

$$Y = [N_1^{\rho} + \delta N_2^{\rho}]^{\alpha/\rho} \quad 1 \geq \alpha > 0 \qquad (1)$$

where N_1 is the total amount of young workers and N_2 is the amount of adult workers, δ is the adult relative productivity and α is the degree of returns to labour. Since these inputs are driven together by the factors affecting output fluctuations, it seems reasonable to take advantage of this commonality by adopting an estimation technique that fully allows for their correlation. Now, at least to some extent, the correlation between youth and non-youth employment must be reflected by a correlation between youth and non-youth unemployment. In the ambit of the Beveridge Curve, this can be done by adopting a distance function approach where youth and non-youth

[15] Both the percentage of expenditure in public education over GDP, and the percentage of expenditure in public education over final government consumption expenditure have been experimented. The latter gave slightly better results, which is comforting, because it is in principle a better measure of the focus of a given government on education.

unemployment rates are considered as variables jointly determined by the vacancy rate and other factors (the other variables included in the Beveridge Curve).

Indeed, just regressing the youth unemployment rate on the vacancy rate and the other variables would assume away both the impact of these variables on the rest of the unemployed and the impact of the other unemployed on young unemployed. Equally, just including the unemployment rate for the rest of the workers as regressor along with the vacancy rate and the other variables would not be a satisfactory way of modelling this nexus. In this case, it is possible to implicitly assume away the impact of the vacancy rate and the other variables on the unemployment rate for the rest of the workers. It thus follows that a better solution to the modelling of youth unemployment and non-youth unemployment in a Beveridge Curve set-up ought to draw upon the literature on multi-output multi-input transformation functions (see Coelli and Perelman, 1999; Kumbhakar 2012, 2013; for further details on this kind of specification).

The Beveridge curve is then modelled as:

$$yur_{it} = -\alpha(nyur_{it} - yur_{it}) + \beta vr_{it} + \gamma Z_{it} + \mu_{i1}t + \mu_{i2}t^2 + \lambda_i + \lambda_t + \varepsilon_{it} \quad (4.1)$$

where yur_{it} is the (natural log of the) youth unemployment rate, $nyur_{it}$ is the (natural log of the) non-youth unemployment rate, vr_{it} is (a function of) the vacancy rate, Z_{it} is the vector of the variables referred to above, t and t^2 are, respectively, linear and quadratic trends, while λ_i and λ_t are country-specific effects and country-specific time effects. This framework could very easily incorporate a dynamic specification along the following lines:

$$\begin{aligned} yur_{it} = {} & -\alpha(nyur_{it} - yur_{it}) + \rho yur_{it-1} + \varphi(nyur_{it-1} - yur_{it-1}) + \beta vr_{it} + \gamma Z_{it} \\ & + \mu_{i1}t + \mu_{i2}t^2 + \lambda_i + \lambda_t + \varepsilon_{it} \qquad (4.2) \end{aligned}$$

Obviously, Eq. (4.2) could straightforwardly incorporate dynamic terms for vr_{it} as well as for the $Z\text{'s}_{it}$.

It is perhaps worth noting that since the contribution of Debreu (1951), who specified a distance function in order to evaluate the efficiency of the economy, the distance function has been largely applied in economic analysis, especially in production and consumption theory. Deaton (1979) proposed to apply the distance function to the analysis of the consumers' behaviour, while Caves et al. (1982) used the distance function to the analysis of productivity indices.

Coelli and Perelman (1999, 2000), using data for seventeen railways companies for the period 1988-1993, specified a distance function to evaluate the efficiency of European railways, providing a comparison between parametric and non-parametric distance function. This application gave to distance functions, as it were, a new lease of life in the field of the estimation of multi-output multi-input transformation functions. Another important contribution was that of Coelli (2000), who considered the possibility of endogeneity bias in the econometric estimation of the distance function, showing that, under the hypothesis of cost minimisation or profit maximisation, conventional estimates based on OLS are not consistently affected by the issue of endogeneity. Other important applications in production economics include Färhe and Primont, 1995; Briec, 1997; Chambers et al., 1998; Kumbhakar and Lovell, 2000; Färhe et al.,2002. Yet this approach has never been applied in the macro-labour literature. Its application could thus provide a worthwhile innovation that can shed light on the efficiency of the matching process for young, as well as non-young, workers, and on its determinants. The lack of previous applications for this technique in the macro-labour, and particularly in the Beveridge Curve, literature, has no obvious explanation. It can perhaps be ascribed to the relative novelty of this procedure, and to the concern that (notwithstanding the results in Coelli, 2000), by considering two jointly determined dependent variables, it may increase the potential for endogeneity in the estimates. There are however relatively straightforward estimation procedures that can obviate the latter concern, and will be used in the present application.

4.3.3 The Empirical Set-up

In order to estimate the Beveridge Curves for youth and non-youth unemployment, the following dynamic Cobb-Douglas distance function is specified:

$$yur_{it} = -\alpha(nyur_{it} - yur_{it}) + \rho yur_{it-1} + \varphi(nyur_{it-1} - yur_{it-1}) + \beta vr_{it} + \gamma Z_{it} + \mu_{i1}t + \mu_{i2}t^2 + \lambda_i + \lambda_t + \varepsilon_{it} \qquad (1b)$$

In Eq. 1b, $i = 1, \dots\dots, N$ stands for the country and $t = 1, \dots\dots, T$ stands for time. In this case, yur_{it} is the unemployment rate for people aged between 15 and 24, taken in natural logarithms, while $nyur_{it}$ is the unemployment rate for people aged between 25 and 64.

For the purposes of the chapter, two different measures of the vacancy rate have been applied, which depend on the sample considered. As in chapter 3, for the Eurostat sample a hyperbolic function to the proportion of firms reporting labour as one of the factors that limit production is considered, while for the OECD sample the natural logarithms of the ratio of vacancies to unemployment is taken.

Z_{it} is the set of labour market institutions and policies which are assumed to be relevant for determining the youth unemployment rate, λ_i and λ_t are country-specific effects and country-specific time effects, while t and t^2 are linear and quadratic trends.

As in chapter 3, in order to measure the impact of the Great Recession, a dummy variable which takes the value of 0 up to 2007 and 1 from 2008 onwards is used, proposing the following augmented version of Eq. 1b:

$$yur_{it} = -\alpha(nyur_{it} - yur_{it}) + \rho yur_{it-1} + \varphi(nyur_{it-1} - yur_{it-1}) + \beta vr_{it} + \gamma Z_{it} + \mu_{i1}t + \mu_{i2}t^2 + \lambda_i + \lambda_t + \eta Crisis + \varepsilon_{it} \qquad (2a)$$

Eq. 2a implies that the impact of the financial crisis does not differ from country to country. In order to do so, it is possible to allow for country-specific dummies, proposing the following specification, dubbed as Eq. 2b:

$$yur_{it} = -\alpha(nyur_{it} - yur_{it}) + \rho yur_{it-1} + \varphi(nyur_{it-1} - yur_{it-1}) + \beta vr_{it} + \gamma Z_{it} + \mu_{i1}t + \mu_{i2}t^2 + \lambda_i + \lambda_t + \eta_i Crisis_i + \varepsilon_{it} \qquad (2b)$$

Both yur_{it} and $nyur_{it}$ are assumed to follow an *AR(1)* process (indeed, this was the specification suggested by some preliminary estimates). The starting point is then an AutoRegressive Distributed Lag Model (1,1), estimated through a fixed effects Least Squares Dummy Variable. Notwithstanding the results from Coelli (2000), it is reasonable to assume that some of the regressors (at least the vacancy and inflow rates) are determined jointly with unemployment, hence endogenous (see on this Kumbhakar, 2013). For this reason, the set of equations 1-2a has been estimated by applying 2SLS, considering both the vacancy rate and the inflow rate as endogenous and instrumenting these variables using their own lagged values and the lagged values of other variables, like union density, tax wedge, wage coordination, relative youth cohort, vocational education and training, educational attainment and government expenditures over final government consumption expenditure.

4.4 Data Description

In this section, the main variables used in econometric analysis performed in this chapter are described. Following the protocol adopted in chapter 3, it is possible to distinguish between two different samples, namely the Eurostat sample and the OECD sample. To repeat, the Eurostat sample is composed by Austria, Belgium, Denmark, Finland, France, Germany, Italy, Netherlands, Portugal, Spain, Sweden and UK, while the OECD sample includes Australia, Austria, Belgium, Finland, Germany, Japan, Norway, Portugal, Spain, Sweden, Switzerland, UK and US. For both the sets considered, the sample period includes annual data ranging between 1985 and 2013. Considered that the dataset contains some missing values for some countries and some years, the analysis is based on an unbalanced panel.

Data sources for the vacancy rate, the inflow rate and most labour-market institutions have already been described in chapter 3. Data for youth and non-youth unemployment rate have been taken from the OECD Labour Force Survey Dataset. Recall that the youth unemployment rate is defined as the OECD rate of unemployment for workers aged between 15 and 24, and non-youth unemployment rate is the OECD rate of unemployment for workers aged between 25 and 64. From the OECD statistics portal also the relative youth cohort has been taken, that is youth population over total working age population; and the percentage of expenditure in public education (both the percentage of expenditure in public education over GDP, and the percentage of expenditure in public education over final government consumption expenditure).

These data have been integrated with other (mainly education-related) variables. The VET participation, that is the ratio of technical/vocational (ISCED 2 and 3) over total secondary enrolment, comes from the UNESCO UIS statistics portal. Educational attainment and relative youth education, that is the difference between the number of education years of total population aged 15 and over and the number of education years of total population aged 25 and over come from the Barro-Lee Website (these data are given only over five-year intervals, which meant that values for the missing years have been interpolated; in this exercise also the 2015 predicted data has been used).

4.5. Estimation Results

All the estimated equations are reported in Tables A.2-A.19 of the Appendix. Given the innovative nature of the present exercise, three different specifications have been experimented: the first one with no Z variables at all, the second one with Z including only labour market institutions, and the third one with Z also including educational and demographic variables. Naturally, these three specifications intersect with the protocol already established in chapter 3: the preferred estimates for Eq. (1) have been provided over, respectively, 1985-2007 and 1985-2013. Then, always for 1985-2013, the preferred estimates for Eqs. (2a) and (2b) are given.

The discussion begins by considering the results obtained through LSDV (they are reported for the Eurostat sample in Tables A.2-A.5, and for the OECD sample in tables A.6-A.9). Results across the two samples are reasonably similar, although by no means identical. They show that a trade-off indeed exists between youth and non-youth unemployment, and that both these variables are jointly driven by vacancy and inflow rates. Another main feature is that, in both samples, educational and demographic variables are never significant. Among labour-market institutions, the unemployment benefit duration indicator and the unemployment generosity index from Scruggs et al. (2014) are not significant, while the strictness measure is (with the a priori expected negative sign).

All throughout the estimates, similar results are obtained when the comparison between the 1985-2007 and the 1985-2013 specifications is carried-out.

It is now possible to move to the discussion of the results obtained by applying 2SLS, which are reported into tables A.10-A.17. There is still convincing evidence of a trade-off between youth and non-youth unemployment driven by vacancy and inflow rates. The unemployment benefit duration indicator from Scruggs et al. (2014) is never significant again, while in the Eurostat sample there is weak evidence of an inward shift determined by the unemployment benefit generosity indicator. The strictness measure is now significant with the expected sign across both samples, and the relative youth cohort is significant and positive in the OECD sample. This could signal some matching problems brought about by excess supply and congestion in the youth labour market; see Bassanini and Duval, 2006 (the OECD sample also shows some detrimental effect of VET participation which is much less easy to rationalise).

Some misspecification problems throughout these estimates are noticed, signalled by the occasional significance of the Hansen J-Statistic of overidentifying restrictions.

Moving to the impact of the recent economic downturn, results reported in Table A.12 suggest that the financial crisis as a whole had a significant impact in the Eurostat sample rate, since the coefficient of the crisis dummy is negative and significant across the whole set of specifications. Turning in Table A.13 to the impact of the recent recession in each of the countries considered of the Eurostat sample, decisive evidence of an improvement in labour matching is found for Austria, Belgium, Denmark, Finland, France, Germany Netherlands and less strong evidence of a favourable shift in the Beveridge Curve for Portugal and Sweden. On the other hand, decreased matching efficiency after 2007 is found for Spain.

It is now possible to turn to the evaluation of Table A.17, in which the effects of the financial crisis for the OECD sample are taken into account. The estimates of the country-specific dummies suggest an improvement in labour matching, after 2007, for Austria, Finland, Germany, Japan, UK and, less so, for Sweden. A different picture emerges when one considers the impact of the crisis on Norway (and, much less so, for the US) for which the estimated coefficients suggest a worsening in the efficiency of their labour markets.

The evaluation of the estimated regression functions of this chapter concluded by considering Tables A.18-A.19, in which estimates of the crisis dummy and country-specific dummies are provided, through the application of the Constrained Ordinary Least Squares (COLS). As in chapter 3, the estimates are constrained to take the coefficients of the 1985-2007 preferred specifications, and estimate the crisis-related parameters over 1985-2013. This of course means estimating the main variables of interest (the crisis dummy and country-specific dummies) assuming that the other equation parameters are unchanged across the Great

Recession. Once more, this exploratory exercise has been reiterated for three specifications: the first one with no Z variables at all, the second one with Z including only labour market institutions, and the third one with Z also including educational and demographic variables.

For the Eurostat sample, In Table A.18, the crisis dummy of crisis is very close to the values in Table A.12, and largely significant, validating the impression that, after the Great Recession, there has been a sizeable improvement in matching efficiency for this sample. When looking at the impact of the crisis on each single economy, the analysis reveals a statistically significant improvement in Austria, Belgium, Denmark, Finland, France, Germany, Italy, and the Netherlands. To a varying extent also Portugal, Sweden and UK show improving labour-market efficiency, while Spain is the only country for which this exercise shows signs of worsening in matching efficiency.

Relating the OECD sample, results are reported in Table A.19. The overall crisis dummy is not significant, while the estimates of the country-specific dummies show a pretty heterogeneous picture. More precisely, the COLS estimates decisively suggest an improvement in the matching efficiency for Austria and Sweden and, to a less extent, for Australia, Finland and Switzerland, while there is evidence of a worsening in labour market functioning for Germany, Norway and the UK. It should be pointed out that, for this sample, the COLS estimates with Z variables are out of sync with rest of the evidence. The analysis proposed in this chapter is not able to ascertain the cause of this phenomenon, which requires devoting further attention.

All in all, the results suggest that the Great Recession has had no particular detrimental effects on the joint Beveridge Curve for youth and non-youth unemployment rates. This seems to be true in both the Eurostat and OECD samples. There is on the other hand, some sign of improving performance, especially in Austria, Germany, Sweden and Switzerland, which calls for further research focusing on the labour markets of these countries.

A final comment is that not many institutional or structural variables, especially those related to the youth labour market, turned out to be significant in the estimates. At least to some extent, and particularly in relationship with the Vocational Education and Training variable, this can be ascribed to problems of measurement. It is certainly an issue to be taken up again in future work.

4.6. Concluding Remarks

In this chapter the joint determinants and dynamics of youth and non-youth unemployment have been studied, using two different sets of economies, namely the Eurostat sample and the OECD sample, taking into account the effects of the recent financial crisis on youth matching efficiency. This analysis is carried out through a multi-output multi-input transformation function, which represents the main methodological innovation that introduced in this chapter. Although this kind of distance function has been largely applied in empirical contributions, especially in productivity analysis, this the first time that it is applied in the macro-labour literature.

Results obtained using this econometric procedure indicate that in the Eurostat sample the inflow rate, the strictness of unemployment benefits and the unemployment generosity are relevant shifting factors, the first having a detrimental impact on labour market matching, and all the others having a positive impact on unemployment. The duration of the unemployment benefit, educational expenditures, demographic factors and vocational education and training do no lead to any significant shift in the Beveridge Curve.

Looking at the impact of the crisis, the analysis reveals that, in this sample, significant shift in the Beveridge Curve appears as a whole after 2007, since the estimated dummy is always significant in the Eurostat sample. In the Eurostat sample, estimates for the country-specific dummies suggest an improvement in labour matching, after 2007, for Austria, Belgium, Denmark, Finland, France, Germany, the Netherlands and Portugal and a worsening for Spain. In the OECD sample the evidence suggests an improvement in labour matching, after 2007, for Austria, Finland, Germany, Japan and the UK and a worsening for Norway and, to a less extent, for the US.

Although in this chapter the application of the distance function has provided a promising framework for the evaluation of the efficiency of the matching processes, the proposed analysis is not immune to limitations. The most important is, of course, represented by the misspecification problems signalled by the significance of some Hansen J-statistics. It turns out, therefore, that future research must take into account this limitation and must exert its effort in order to find valid instruments in order to improve the quality of the estimates and, hence, the quality of the inferences that can be drawn in the analysis of youth unemployment.

The dubious results with some COLS estimates for the OECD sample must also be carefully appraised in future research.

At any rate, there is pervasive evidence of improving performance, especially in Austria, Germany and Switzerland, which calls for further research focusing on the labour markets of these countries, if useful policy advice must be delivered in this ambit.

References

Aaronson A. et al. (2006), *"The Decline in Teen Labour Force Participation",* Economic Perspectives, Federal Bank of Chicago, 2-18

Abowd et al. (2000), *"Minimum Wages and Youth Employment in France and in the United States",* in David G. Benchflower and Richard B. Freeman (eds.): Youth Employment and Joblessness in Advanced Countries, University of Chicago Press

Allegretto S.A. el al. (2011), *"Do Minimum Wages Really Reduce Teen Employment? Accounting for Heterogeneity and Selectivity in State Panel Data",* Industrial Relations, Vol. 50, 205-240

Atkinson S.E. & Primont D. (2002), "*Stochastic Estimation of Firm Technology, Inefficiency, and Productivity Growth Using Shadow Cost and Distance Functions",* Journal of Econometrics, Vol. 108, 203-225

Atkinson S.E. & Dorfman J.H. (2009), *"Feasible Estimation of Firm-Specific Allocative Inefficiency Through Bayesian Numerical Methods",* Journal of Applied Econometrics, Vol. 24, 675-697

Banerji A. et al. (2014), *"Youth Unemployment in Advanced Economies in Europe: Searching for Solutions",* IMF Staff Discussion Note, 1-32

Bassanini A. & Duval R. (2006), "*The Determinants of Unemployment Across OECD Countries: Reassessing the Role of Policies and Institutions",* OECD Economic Studies, Vol. 42, 7-89

Bassanini A. & Duval R. (2009), "*Unemployment, Institutions and Reform Complementarities: Re-Assessing the Aggregate Evidence for the OECD",* Oxford Review of Economic Policy, Vol. 25, 40-59

Battese G.E. & Coelli T.J. (1992), "*Frontier Production Functions, Technical Efficiency and Panel Data: With Application to Paddy Farmers in India",* Journal of Productivity Analysis, Vol. 3, 153-169

Bell D.N.F. & Blanchflower D.G. (2010), *"Youth Unemployment: Déjà Vu?",* IZA Discussion Paper, No. 4705, 1-56

Betcherman G. et al. (2007), "*Global Inventory of Interventions to Support Young Workers Synthesis Report",* World Bank, 1-64

Blanchard O. & Landier A. (2002), *"The Perverse Effects of Partial Labour Market Reform: Fixed-Term Contracts in France",* Economic Journal, Vol. 112, 212-244

Bonnal et al. (2002), *"School-to-Work Transition: Apprenticeship Versus Vocational Education in France",* International Journal of Manpower, Vol. 23, 426-442

Briec W. (1997), *A Graph-Type Extension of Farrell Technical Efficiency Measure",* Journal of Productivity Analysis, Vol. 8, 95-110

Cahuc P. and Postel-Vinay F. (2002), *"Temporary Jobs, Employment Protection and Labour Market Performance",* Labour Economics, Vol. 9, 63-91

Cahuc P. et al. (2013), *"Youth Unemployment in Old Europe: the Polar Case of France and Germany",* IZA Journal of European Labour Studies, Vol. 2, 1-23

Caliendo M. & Kunn S. (2011a), *"Start-Up Subsidies for the Unemployed: Long-Term Evidence and Effect Heterogeneity",* Journal of Public Economics, Vol. 95, 311-331

Caliendo M. et al. (2011b), *"Fighting Youth Unemployment: The Effects of Active Labour Market Policies",* IZA Discussion Paper, No. 6222, 1-51

Caliendo M. & Schmidl R. (2016), *"Youth Unemployment and Active Labour Market Policies in Europe",* IZA Journal of Labour Policy, Vol. 5, 1-30

Canteno L. et al. (2009), *"Evaluating Job Search Programs for Old and Young Individuals: Heterogeneous Impact on Unemployment Duration",* Labour Economics, Vol. 16, 12-25

Caporale G.M & Gil-Alana L. (2014), *"Youth Unemployment in Europe: Persistence and Macroeconomic Determinants",* Comparative Economic Studies, Vol. 56, 581-591

Card D. et al. (2010), *"Active Labour Market Policy Evaluations: A Meta-Analysis",* Economic Journal, Vol. 120, F452-F477

Card D. et al. (2015), *"What Works? A Meta Analysis of Recent Active Labour Market Program Evaluations",* IZA Discussion Paper, No. 9236, 1-29

Caroleo F.E. & Pastore F. (2007), *"The Youth Experience Gap: Explaining Differences Across EU Countries",* Quaderni del Dipartimento di Economia, Finanza e Statistica, Università di Perugia, No. 41, 1-16

Caves D.W. et al. (1982), *"The Economic Theory of Index Numbers and the Measurement of Input, Output, and Productivity",* Econometrica, Vol. 50, 1393-1414

Chambers R.G. el al. (1998), *"Profit, Directional Distance Functions, and Nerlovian Efficiency",* Journal of Optimization Theory and Applications, Vol. 98, 351-364

Choudhry M.T. et al. (2012), *"Youth Unemployment Rate and Impact of Financial Crises",* International Journal of Manpower, Vol. 33, 76-95

Choudhry M.T. et al. (2013), *"Youth and Total Unemployment Rate: the Impact of Policies and Institutions",* Rivista Internaztionale di Scienze Sociali, Vol. 121, 63-86

Chung Y.H. et al. (1997), "*Productivity and Undesirable Outputs: A Directional Distance Function Approach",* Journal of Environmental Management, Vol. 51, 229-240

Clark K.B. & Summers L.H. (1982), "*The Dynamics of Youth Unemployment",* in The Youth Labour Market Problem: Its Nature, Causes, and Consequences, Richard B. Freeman and David A. Wise eds., University of Chicago Press

Cockx B. & Picchio M. (2013), *"Scarring Effects of Remaining Unemployed for Long-Term Unemployed School-Leavers",* Journal of the Royal Statistical Society, Vol. 176, 951-980

Coelli T.J. & Perelman S. (1999), "*A Comparison of Parametric and Non-Parametric Distance Functions: With Applications to European Railways",* European Journal of Operational Research, Vol. 117, 236-339

Coelli T.J. & Perelman S. (2000), *"Technical Efficiency of European Railways: A Distance Function Approach",* Applied Economics, Vol. 32, 1967-1976

Coelli T.J. (2000), *"On the Econometric Estimation of the Distance Function Representation of Production Technology",* CORE Discussion Papers, Universitè Catholique de Louvain, 1-24

Cuesta R.A. & Orea L. (2002), *"Mergers and Technical Efficiency in Spanish Savings Banks: a Stochastic Distance Function Approach",* Journal of Banking and Finance, Vol. 26, 2231-2247

Deaton A. (1979), *"The Distance Function in Consumer Behaviour with Applications to Index Numbers and Optimal Taxation",* Review of Economic Studies, Vol. 46, 391-405

Debreau G. (1951), "*The Coefficient of Resource Utilization",* Econometrics, Vol. 19, 273-292

De Giorgi G. (2005), *"The New Deal for Young People Five Years On",* Fiscal Studies, Vol. 26, 371-383

Demidova O. e al. (2013), *"Spatial Effects on the Youth Unemployment Rate",* Eastern European Economies, Vol. 51, 94-124

Eicchorst W. et al. (2009), "*Institutional Arrangements, Employment Performance and the Quality of Work",* IZA Discussion Paper, No. 4595, 1-31

Eichhorst W. (2014), *"Fixed-Term Contracts",* IZA World of Labour, No. 45

Eichhorst W. & Rinne U. (2016), *"Promoting Youth Employment in Europe: Evidence-Based Policy Lessons",* IZA Policy Paper, No. 119, 1-20

Färhe R. & Primont D. (1995), *"Multi-Output Production and Duality: Theory and Applications",* Kluver Academic Publishers, Boston, MA

Färhe R. el al. (2002), *"Hyperbolic Efficiency and Return to the Dollar",* European Journal of Operational Research, Vol. 136, 671-679

Fougère D. et al. (2009), *"Youth Unemployment and Crime in France",* Journal of the European Economic Association, Vol. 7, 909-938

Gregg P. (2001), "*The Impact of Youth Unemployment on Adult Unemployment in the NCDS",* Economic Journal, Vol. 111, 626-653

Gregg P. & Tominey E. (2005), "*The Wage Scar from Male Youth Unemployment",* Labour Economics, Vol. 12, 487-509

Hardoy I. (2005), *"The Impact of Multiple Labour Market Programmes On Multiple Outcomes:The Case of Norwegian Youth Programmes",* Labour, Vol. 19, 425-467

Hohmeyer K. & Wolff J. (2012), *"A Fistful of Euros: Is the German One-Euro Job Workfare Scheme Effective for Participants?",* International Journal of Social Welfare, Vol. 21, 174-185

Hyslop D. & Stillman S. (2007), *"Youth Minimum Wage Reform and the Labour Market in New Zealand",* Labour Economics, Vol. 14, 201-230

ILO (2015), *"Global Employment Trends for Youth 2015: Scaling Up Investments in Decent Jobs for Youth",* International Labour Office, Geneva, 1-92

ILO (2016), *"World Employment Social Outlook-Trends for Youth 2016",* International Labour Office, Geneva, 1-48

Jimeno J.F & Rodriguez-Palenzuela D. (2002), "*Youth Unemployment in the OECD: Demographic Shifts, Labour Market Institutions, and Macroeconomic Shocks",* ECB Working Paper, No. 155, 4-61

Kluve J. et al. (2016), *"Do Youth Employment Programs Improve Labour Market Outcomes? A Systematic Review",* IZA Discussion Paper, No. 10263, 1-65

Kolev A. & Saget C. (2005), "*Understanding Youth Labour Market Disadvantage: Evidence from South-East Europe",* International Labour Review, Vol. 144, 161-187

Kramarz F. & Philippon F. (2001), *"The Impact of Differential Payroll Tax Subsidies on Minimum Wage Employment",* Journal of Public Economics, Vol. 82, 115-146

Kumbhakar S.C. and Lovell C.A.K. (2000), *"Stochastic Frontier Analysis",* Cambridge University Press, New York

Kumbhakar S.C. (2012), *"Specification and Estimation of Primal Production Models",* European Journal of Operational Research, Vol. 217, 509-518

Kumbhakar S.C. (2013), *"Specification and Estimation of Multiple Output Technologies: A Primal Approach",* European Journal of Operational Research, Vol. 231, 465-473

Larsson L. (2003), *"Evaluation of Swedish Youth Labour Market Programs",* Journal of Human Resources, Vol. 38, 891-927

Neumark D. & Wascher W. (2004), "*Minimum Wages, Labour Market Institutions, and Youth Unemployment: A Cross-National Analysis",* Industrial and Labour Relations Review, Vol. 57, 223-248

Neumark D. & Wascher W. (2008), *"Minimum Wages",* MIT Press

O' Donnell C.J. & Coelli T.J. (2005), *"A Bayesian Approach to Imposing Curvature on Distance Functions",* Journal of Econometrics, Vol. 126, 493-523

O' Higgins N. (1997), *"The Challenge of Youth Unemployment",* ILO Employment and Training Papers, No. 7, 1-71

O'Higgins N. (2010), *"The Impact of the Economic and Financial Crisis on Youth Unemployment: Measures for Labour Market Recovery in the European Union, Canada and the United States",* ILO Employment Working Paper, No. 70, 1-69

O' Higgins N. (2012), "*This Time is Different? Youth Labour Markets During the 'Great Recession'",* Comparative Economic Studies, Vol. 54, 395-412

O'Higgins N. (2015), *"Youth Unemployment",* IZA Policy Paper, No. 103, 1-21

Parey M. (2009), *"Vocational Schooling Versus Apprenticeship Training-Evidence From Vacancy Data",* mimeo

Perugini C. & Signorelli M. (2010), *"Youth Labour Market Performance in European Regions",* Economic Change and Restructuring, Vol. 43, 151-185

Plugg E. & Groot W. (1998), *"Apprenticeship Versus Vocational Education: Exemplified by the Dutch Situation",* mimeo

Portugal P. & Cardoso A.R. (2006), *"Disentangling the Minimum Wage Puzzle: An Analysis of Worker Accessions and Separations",* Journal of the European Economic Associations, Vol. 4, 988-1013

Quintini G & Martin S. (2006), "*Starting Well or Losing Their Way? The Position of Youth in the Labour Market in OECD Economies",* OECD Social, Employment and Migration Working Paper, No. 39, 1-69

Quintini G. & Manfredi T. (2009), "*Going Separate Ways? School-to-Work Transitions in the United States and Europe",* OECD Social, Employment and Migration Working Paper, No. 90

Ryan P. (2001), "*The School-to-Work Transition: A Cross-National Perspective",* Journal of Economic Literature, Vol. 39, 34-92

Scarpetta, S., A. Sonnet and T. Manfredi (2010), *"Rising Youth Unemployment During the Crisis: How to Prevent Negative Long-term Consequences on a Generation?"*, OECD Social, Employment and Migration Working Papers, No. 106, OECD Publishing, Paris, 1-34

Shimer R. (2001), "*The Impact of Young Workers on the Aggregate Labour Market",* Quarterly Journal of Economics, Vol. 116, 969-1007

Sickles R.C. et al. (2002), "*Specification of Distance Functions Using Semi- and Nonparametric Methods with an Application to the Dynamic Performance of Eastern and Western European Air Carriers",* Journal of Productivity Analysis, Vol. 17, 133-155

Verick S. (2009), *"Who is Hit Hardest During a Financial Crisis? The Vulnerability of Young Men and Women to Unemployment in an Economic Downturn",* IZA Discussion Paper, No. 4359, 1-35

Winkelmann R. (1996), *"Employment Prospects and Skill Acquisition of Apprenticeship-Trained Workers in Germany",* Industrial and Labour Relations Review, Vol.49, 658-672

Appendix

Table 1. The Main Variables

Variable	**Label**	**N**	**Mean**	**Min**	**Max**
Youth Unemployment Rate	Yur	635	15.47	3.19	55.47
Non-Youth Unemployment Rate	Nyur	635	6.25	0.99	23.87
Vacancy Rate-OECD	Vr	423	0.86	0.08	3.34
Vacancy Rate-Eurostat	Vr	403	0.74	0.44	1.91
Inflow Rate	Inf	622	0.01	0.0015	0.04
Employment protection legislation	Epl	680	2.04	0.08	4.89
Unemployment benefits (net reservation wage)	Nrw	680	0.32	0.02	0.65
(Net) retention ratio	Nrr	680	0.60	0.07	0.94
Duration	Dur	680	0.60	0.04	1
Strictness	Strict	680	0.69	0.44	1
Generosity (Scruggs, 2014)	Generosity	680	9.89	2.6	14.5
Duration (Scruggs, 2014)	Duration	680	216.72	21	999
Relative Youth Cohort	Relcohort	635	0.20	0.13	0.29
Vocational Education and Training	Vet	673	0.24	0	0.53
Educational Gap	Edu_Gap	680	0.05	-0.6	1.07
Educational Attainment	Educ	680	0.26	0.00	0.48
Educational Expenditures (Expenditures over Final Consumption)	Gov_Exp	680	0.26	0	0.48
Union Density	Ud	680	0.37	0.07	0.83
Wage bargaining coordination	Coord	680	3.05	1	5
Almp (Expenditures Over GDP)	ALMP	561	0.007	0.0008	0.02
Tax Wedge	Tw	665	0.37	0.15	0.57
Overall Index of Globalisation	Kof	680	0.77	0.41	0.93
Globalisation index for actual economic flows	Kfa	680	0.72	0.28	0.97

Legend of Tables

The dependent variable is always the natural log of the youth unemployment rate.

The vacancy rate for the EU sample is measured as 1/(percentage of firms reporting labour among the factors limiting production)^2, while for OECD countries it is computed as the ratio between vacancies and total employment.

An initial *l* stands for a variable taken in natural logarithms.

Year-specific effects and linear and quadratic country-specific time trends have been included, not shown in the interest of parsimony, in all specifications.

D is the difference operator, L is the lagged value, while N is the number of observations.

The R2–adj. is the coefficient of determination adjusted for degrees of freedom.

Coefficient significances are denoted by stars: * means a p-value < .1; ** a p-value < .05; *** a p-value < .01.

The *p-value* of the Hansen J-Statistic of overidentifying restrictions is reported for all the models estimated via 2SLS.

Table A.2. The Eurostat Sample: Eq. 1b, Preferred Specifications-LSDV

Regressors	**1985-2007**	**1985-2007**	**1985-2007**
L.yur	-0.77***	-0.74***	-0.74***
nyur_yur	-0.47**	-0.46**	-0.47**
L.nyur_yur	0.26	0.24	0.24
Vr	0.34***	0.34***	0.36***
Linf	0.20***	0.20***	0.20***
Lgener		-0.20	-0.23
Ldurat		0.02	0.03
L.strict		-1.04**	-1.11**
D.relcohort			1.20
L.relcohort			-3.55
D.vet			0.40
L.vet			-0.00
lEduc			0.86
edu_gap			-0.04
D.Gov_EXP			-0.22
L.Gov_EXP			-0.09
N	284	284	284
R2–adj.	0.90	0.90	0.90

Table A.3. The Eurostat Sample: Eq. 1b, Preferred Specifications-LSDV

Regressors	**1985-2013**	**1985-2013**	**1985-2013**
L.yur	-0.80***	-0.78***	-0.78***
nyur_yur	-0.45**	-0.44**	-0.44**
L.nyur_yur	0.26*	0.24	0.26
Vr	0.27***	0.26***	0.27***
Linf	0.20***	0.21***	0.20***
lgener		-0.23	-0.27
ldurat		0.02	0.02
L.strict		-0.38	-0.45
D.relcohort			2.35
L.relcohort			-0.97
D.vet			0.20
L.vet_c			-0.07
lEduc			-0.26
edu_gap			0.03
D.Gov_EXP			-0.08
L.Gov_EXP			-0.08
N	356	356	355
R2–adj.	0.90	0.90	0.90

Table A.4. The Eurostat Sample: Eq. 2a, Preferred Specifications-LSDV

Regressors	**1985-2013**	**1985-2013**	**1985-2013**
L.yur	-0.79***	-0.78***	-0.78***
nyur_yur	-0.46**	-0.45**	-0.44**
L.nyur_yur	0.26*	0.25*	0.26
Vr	0.29***	0.27***	0.28***
Linf	0.21***	0.21***	0.21***
Lgener		-0.23	-0.27
Ldurat		0.02	0.01
L.strict		-0.40	-0.50
D.relcohort			2.47
L.relcohort			-0.98
D.vet			0.20
L.vet			0.02
lEduc			-0.35
Edu_gap			0.10
D.Gov_EXP			-0.08
L.Gov_EXP			-0.08
Crisis	-0.07*	-0.08*	-0.08**
N	356	356	355
R2–adj.	0.90	0.90	0.90

Table A.5. The Eurostat Sample: Eq. 2b, Preferred Specifications-LSDV

Regressors	**1985-2013**	**1985-2013**	**1985-2013**
L.yur	-0.77***	-0.75***	-0.76***
nyur_yur	-0.46**	-0.45**	-0.47**
L.nyur_yur	0.26	0.23	0.24
Vr	0.28***	0.28***	0.28***
linf	0.20***	0.21***	0.21***
lgener		-0.30	-0.28
ldurat		0.02	0.02
L.strict		-0.69**	-0.78*
D.relcohort			1.47
L.relcohort			-1.46
D.vet			0.20
L.ve			-0.01
LEduc			0.39
edu_gap			0.01
D.Gov_EXP			-0.10
L.Gov_EXP			-0.12
Austria	-0.31***	-0.31***	-0.31***
Belgium	-0.22***	-0.22***	-0.23***
Denmark	-0.23***	-0.30***	-0.29***
Finland	-0.24***	-0.22***	-0.24***
France	-0.23***	-0.21***	-0.23***
Germany	-0.31***	-0.29***	-0.29***
Italy	-0.16***	-0.17***	-0.15***
Netherlands	-0.27***	-0.26***	-0.26***
Portugal	-0.22***	-0.19***	-0.20***
Spain	0.13***	0.17***	0.20***
Sweden	-0.22***	-0.29***	-0.22***
UK	-0.09***	-0.14***	-0.14***
N	356	356	355
R2–adj.	0.90	0,90	0.90

Table A.6. The OECD Sample: Eq. 1b, Preferred Specifications-LSDV

Regressors	**1985-2007**	**1985-2007**	**1985-2007**
L.yur	-0.81***	-0.80***	-0.81***
nyur_yur	-0.48***	-0.48***	-0.50***
L.nyur_yur	0.13	0.16	0.15
Lvr	-0.35***	-0.35***	-0.35***
L.lvr	0.13***	0.13***	0.15***
D.linf	0.14***	0.15***	0.16***
L.linf	0.18***	0.18***	0.19***
L.lgener		0.09	0.04
L.strict		-0.96*	-1.06*
D.relcohort			-2.38
L.relcohort			0.95
D.vet			0.14
L.vet			0.23
lEduc			0.55
edu_gap			-0.11
D.Gov_EXP			-0.00
L.Gov_EXP			-0.25
N	303	303	303
R2–adj.	0.92	0.92	0.92

Table A.7. The OECD Sample: Eq. 1b, Preferred Specifications-LSDV

Regressors	**1985-2013**	**1985-2013**	**1985-2013**
L.yur	-0.81***	-0.81***	-0.81***
nyur_yur	-0.41***	-0.41***	-0.43***
L.nyur_yur	0.14	0.15	0.15
Lvr	-0.33***	-0.33***	-0.33***
L.lvr	0.16***	0.16***	0.16***
D.linf	0.14***	0.14***	0.16***
L.linf	0.15**	0.15**	0.17**
L.lgener		0.05	0.07
L.strict		-0.50	-0.62
D.relcohort			-2.49
L.relcohort			1.00
D.vet			0.02
L.vet_c			0.07
lEduc			0.51
edu_gap			-0.05
D.Gov_EXP			-0.06
L.Gov_EXP			-0.25
N	369	369	369
R2–adj.	0.92	0.92	0.92

Table A.8. The OECD Sample: Eq. 2a, Preferred Specifications-LSDV

Regressors	**1985-2013**	**1985-2013**	**1985-2013**
L.yur	-0.80***	-0.80***	-0.79***
nyur_yur	-0.41***	-0.40***	-0.42***
L.nyur_yur	0.14	0.14	0.14
Lvr	-0.33***	-0.33***	-0.33***
L.lvr	0.15***	0.16***	0.16***
D.linf	0.14***	0.14***	0.16***
L.linf	0.16**	0.15**	0.17***
L.lgener		0.08	0.10
L.strict		-0.57	-0.72
D.relcohort			-2.54
L.relcohort			1.20
D.vet_c			0.02
L.vet_c			0.05
lEduc			0.56
edu_gap			-0.04
D.Gov_EXP			-0.04
L.Gov_EXP			-0.21
Crisis	-0.04	-0.05	-0.05
N	369	369	369
R2–adj.	0.92	0.92	0.92

Table A.9. The OECD Sample: Eq. 2b, Preferred Specifications-LSDV

Regressors	**1985-2013**	**1985-2013**	**1985-2013**
L.yur	-0.79***	-0.79***	-0.78***
nyur_yur	-0.41***	-0.41***	-0.43***
L.nyur_yur	0.13	0.14	0.14
Lvr	-0.34***	-0.34***	-0.34***
L.lvr	0.15***	0.15***	-0.16***
D.linf	0.14***	0.14***	0.15***
L.linf	0.17***	0.17***	0.18***
L.lgener		0.04	0.00
L.strict		-0.59	-0.74
D.relcohort			-2.80
L.relcohort			0.62
D.vet			-0.07
L.vet			0.15
Leduc			0.44
edu_gap			-0.01
D.Gov_EXP			-0.09
L.Gov_EXP_F			-0.30
Australia	-0.00	-0.04	-0.04
Austria	-0.23***	-0.24***	-0.24***
Finland	-0.26***	-0.28***	-0.26***
Germany	-0.17***	-0.17***	-0.18***
Japan	-0.18***	-0.17***	-0.12***
Norway	0.11***	0.11***	0.09*
Portugal	-0.05	-0.04	-0.05
Sweden	-0.13***	-0.16***	-0.23***
Switzerland	-0.14***	-0.15***	-0.16***
UK	-0.15***	-0.18***	-0.19***
US	-0.01	-0.04	-0.01
N	369	369	369
R2–adj.	0.92	0.92	0.93

Table A.10. The Eurostat Sample: Eq. 1b, Preferred Specifications-2SLS

Regressors	**1985-2007**	**1985-2007**	**1985-2007**
L.yur	-0.71***	-0.69***	-0.69***
nyur_yur	-0.45***	-0.44***	-0.44***
L.nyur_yur	0.21**	0.21**	0.23**
Vr	0.25**	0.25**	0.31**
Linf	0.32***	0.32***	0.33***
Lgener		-0.10	-0.13
Ldurat		-0.01	0.01
L.strict		-1.12***	-1.01***
D.relcohort			3.80
L.relcohort			-3.39
D.vet			0.26
L.vet			-0.02
lEduc			0.82
edu_gap			-0.36
D.Gov_EXP			-0.25
L.Gov_EXP			-0.33
N	266	266	266
R2–adj.	0.89	0.90	0.90
Hansen	0.11	0.08	0.02

Table A.11. The Eurostat Sample: Eq. 1b, Preferred Specifications-2SLS

Regressors	**1985-2013**	**1985-2013**	**1985-2013**
L.yur	-0.74***	-0.73***	-0.71***
nyur_yur	-0.41***	-0.41***	-0.39***
L.nyur_yur	0.21**	0.20**	0.22**
Vr	0.27**	0.24**	0.26**
Linf	0.28***	0.28***	0.26***
lgener		-0.20*	-0.21
ldurat		0.01	-0.00
L.strict		-0.38	-0.40
D.relcohort			3.85
L.relcohort			0.26
D.vet			0.10
L.vet			-0.12
lEduc			0.68
edu_gap			0.04
D.Gov_EXP			-0.06
L.Gov_EXP			-0.15
N	338	338	337
R2–adj.	0.90	0.90	0.90
Hansen	0.12	0.20	0.01

Table A.12. The Eurostat Sample: Eq. 2a, Preferred Specifications-2SLS

Regressors	**1985-2013**	**1985-2013**	**1985-2013**
L.yur	-0.73***	-0.72***	-0.70***
Nyuryur	-0.42***	-0.41***	-0.40***
L.nyur_yur	0.23**	0.21**	0.23**
Vr	0.30***	0.28**	0.30**
Linf	0.29***	0.29***	0.28***
Lgener		-0.20*	-0.22*
Ldurat		0.01	-0.00
L.strict		-0.38	-0.42
D.relcohort			3.94
L.relcohort			0.10
D.vet			0.10
L.vet			-0.08
lEduc			0.72
edu_gap			0.09
D.Gov_EXP			-0.03
L.Gov_EXP			-0.13
Crisis	-0.07***	-0.07***	-0.07***
N	338	338	337
R2–adj.	0.90	0.90	0.90
Hansen	0.16	0.30	0.08

Table A.13. The Eurostat Sample: Eq. 2b, Preferred Specifications-2SLS

Regressors	**1985-2013**	**1985-2013**	**1985-2013**
L.yur	-0.71***	-0.69***	-0.69***
nyur_yur	-0.44***	-0.43***	-0.42**
L.nyur_yur	0.22**	0.21**	-0.23**
vr	0.27**	0.29**	0.35**
linf	0.30***	0.30***	0.31***
lgener		-0.24*	-0.21
ldurat		0.01	0.00
L.strict		-0.66*	-0.62*
D.relcohort			3.54
L.relcohort			-0.76
D.vet			0.04
L.vet			-0.17
lnEduc			0.02
edu_gap			-0.10
D.Gov_EXP			-0.03
L.Gov_EXP			-0.18
Austria	-0.28***	-0.28***	-0.28***
Belgium	-0.22***	-0.23***	-0.22***
Denmark	-0.32***	-0.39***	-0.43***
Finland	-0.27***	-0.24***	-0.26***
France	-0.23***	-0.22***	-0.24***
Germany	-0.29***	-0.28***	-0.26***
Italy	-0.15	-0.17	-0.15
Netherlands	-0.24***	-0.23***	-0.21***
Portugal	-0.18***	-0.15**	-0.14*
Spain	0.15*	0.17**	0.18*
Sweden	-0.12	-0.18**	-0.11
UK	-0.07	-0.12	-0.13
N	338	338	337
R2–adj.	0.90	0.91	0.90
Hansen	0.05	0.30	0.10

Table A.14. The OECD Sample: Eq. 1b, Preferred Specifications-2SLS

Regressors	**1985-2007**	**1985-2007**	**1985-2007**
L.yur	-0.74***	-0.73***	-0.72***
nyur_yur	-0.54***	-0.53***	-0.50***
L.nyur_yur	0.24**	0.29**	0.50***
Lvr	-0.58***	-0.57***	-0.53***
L.lvr	0.23***	0.23***	0.28***
D.linf	0.10	0.16	0.55***
L.linf	0.19***	0.22***	0.49***
L.lgener		0.02	-0.09
L.strict		-1.03**	-1.79**
D.relcohort			0.58
L.relcohort			7.59**
D.vet			0.31
L.vet			1.05**
lEduc			-0.71
edu_gap			-0.11
D.Gov_EXP			0.11
L.Gov_EXP			-0.08
N	285	285	285
R2–adj.	0.91	0.91	0.88
Hansen	0.00	0.00	0.02

Table A.15. The OECD Sample: Eq. 1b, Preferred Specifications-2SLS

Regressors	**1985-2013**	**1985-2013**	**1985-2013**
L.myur	-0.74***	-0.74***	-0.71***
nyur_yur	-0.46***	-0.45***	-0.40***
L.nyur_yur	0.19*	0.19*	0.36***
lvr	-0.54***	-0.53***	-0.46***
L.lvr	0.26***	0.25***	0.26***
D.linf	0.00	0.02	0.39***
L.linf	0.12**	0.12*	0.34***
L.lgener		0.08	0.03
L.strict		0.38	-1.12***
D.relcohort			-0.03
L.relcohort			4.14***
D.vet			0.23
L.vet			0.58*
lEduc			-0.19
edu_gap_			-0.03
D.Gov_EXP			0.05
L.Gov_EXP			-0.08
N	351	351	351
R2–adj.	0.91	0.91	0.91
Hansen	0.13	0.07	0.66

Table A.16. The OECD Sample: Eq. 2a, Preferred Specifications-2SLS

Regressors	**1985-2013**	**1985-2013**	**1985-2013**
L.yur	-0.73***	-0.73***	-0.70***
nyur_yur	-0.46***	-0.45***	-0.40***
L.nyur_yur	0.18*	0.18*	0.33***
Lvr	-0.55***	-0.53***	-0.48***
L.lvr	0.26***	0.25***	0.25***
D.linf	-0.02	0.02	0.32***
L.linf	0.11**	0.10	0.31***
L.lgener		0.12	0.07
L.strict		0.40	-1.08***
D.relcohort			-0.06
L.relcohort			3.80***
D.vet			0.22
L.vet			0.52
lEduc			-0.13
edu_gap			-0.00
D.Gov_EXP			0.03
L.Gov_EXP			-0.09
Crisis	-0.03	-0.04*	-0.03
N	351	351	351
R2–adj.	0.91	0.91	0.92
Hansen	0.13	0.08	0.67

Table A.17. The OECD Sample: Eq. 2b, Preferred Specifications-2SLS

Regressors	**1985-2013**	**1985-2013**	**1985-2013**
L.yur	-0.71***	-0.71***	-0.68***
nyur_yur	-0.45***	-0.44***	-0.41***
L.nyur_yur	0.18*	0.19*	0.35***
lvr	-0.51***	-0.50***	-0.44***
L.lvr	0.21***	0.21***	0.23***
D.linf	0.04	0.06	0.40***
L.linf	0.16***	0.17***	0.38***
L.lgener		0.04	-0.07
L.strict		-0.53	-1.24***
D.relcohort			-0.01
L.relcohort			4.11***
D.vet			0.16
L.vet			0.71**
lEduc			-0.33
edu_gap			0.00
D.Gov_EXP			0.04
L.Gov_EXP			-0.16
Australia	-0.02	-0.05	0.03
Austria	-0.22***	-0.22***	-0.17***
Finland	-0.23***	-0.25***	-0.27***
Germany	-0.15*	-0.15*	-0.07
Japan	-0.22***	-0.20***	-0.09
Norway	0.24***	0.23***	0.19***
Portugal	0.01	0.01	-0.02
Sweden	-0.11	-0.12	-0.25***
Switzerland	-0.06	-0.07	-0.12
UK	-0.19***	-0.22***	-0.14*
US	0.03	0.00	0.11*
N	351	351	351
R2–adj.	0.92	0.92	0.92
Hansen	0.03	0.01	0.66

Table A.18. The Eurostat Sample: Crisis and Country-Specific Dummies-COLS

Regressors	**No Z's**	**No Z'x**	**Only labour-market inst.'s**	**Only labour-market inst.'s**	**All Z's**	**All Z's**
	1985-2013	**1985-2013**	**1985-2013**	**1985-2013**	**1985-2013**	**1985-2013**
Crisis	-0.07***		-0.09***		-0.07**	
Austria		-0.28***		-0.41***		-0.38***
Belgium		-0.24***		-0.27***		-0.31***
Denmark		-0.41***		-0.53***		-0.48***
Finland		-0.34***		-0.36***		-0.39***
France		-0.27***		-0.25***		-0.27***
Germany		-0.31***		-0.32***		-0.34***
Italy		-0.10**		-0.11**		-0.05
Netherlands		-0.20***		-0.16***		-0.22***
Portugal		-0.23***		-0.18***		-0.07
Spain		0.16***		0.21***		0.41***
Sweden		-0.10***		-0.18***		0.11**
UK		0.08***		-0.07**		-0.10**
N	338	338	338	338	337	337

Table A.19. The OECD Sample: Crisis and Country-Specific Dummies-COLS

Regressors	**No Z's**	**No Z'x**	**Only labour-market inst.'s**	**Only labour-market inst.'s**	**All Z's**	**All Z's**
	1985-2013	**1985-2013**	**1985-2013**	**1985-2013**	**1985-2013**	**1985-2013**
Crisis	-0.04		-0.04		-0.04	
Australia		-0.06*		-0.11		0.03
Austria		-0.22***		-0.07		-0.22***
Finland		-0.36***		1.54***		-0.36***
Germany		-0.01		-0.09		0.37***
Japan		-0.23***		0.69***		0.03
Norway		0.26***		-0.53***		0.20***
Portugal		0.01		-0.13		0.01
Sweden		-0.07*		-0.18**		-0.28***
Switzerland		-0.16***		0.73***		-0.26***
UK		-0.32***		0.23**		0.14***
US		0.32***		-0.06		-0.34***
N	351	351	351	351	351	351