ISSN 1791-3144

DEPARTMENT OF ECONOMICS

DISCUSSION PAPER SERIES

Labour Market Dynamics in EU: a Bayesian Markov Chain Approach

George Christodoulakis and Emmanuel C. Mamatzakis

Discussion Paper No. 2009 - 07

Department of Economics
University of Macedonia
156 Egnatia str
540 06 Thessaloniki
Greece
Fax: + 30 (0) 2310 891292
http://econlab.uom.gr/econdep/

Labour Market Dynamics in EU: a Bayesian Markov Chain Approach

April 2009

George A. Christodoulakis[1] and Emmanuel C. Mamatzakis[2]

Abstract

This paper focuses on labour market dynamics in the EU 15 using Markov Chains for proportions of aggregate data for the first time in this literature. We apply a Bayesian approach, which employs a Monte Carlo Integration procedure that uncovers the entire empirical posterior distribution of transition probabilities from full employment to part employment, temporary employment and unemployment and vice a versa. Thus, statistical inferences are readily available. Our results show that there are substantial variations in the transition probabilities across countries, implying that the convergence of the EU-15 labour markets is far from completed. However, some common patterns are observed as countries with flexible labour markets exhibit similar transition probabilities between different states of the labour market.

Keywords: Employment, Unemployment, Markov Chains.

JEL Classification: C53, E24, E27, E37

[1] Manchester Business School, University of Manchester, MBS Crawford House, Booth Street West, Manchester M15 6PB, UK, Tel: +44-161-3066402, george.christodoulakis@mbs.ac.uk.

[2] Department of Economics, University of Macedonia, Egnatia Avenue 156, Thessaloniki 540 06, Greece, Tel: +30-2310-891773, tzakis@uom.gr

1. INTRODUCTION

A subject of high importance in the economic policy agenda in the EU concerns labour market issues. The European Council of March 2004 has underlined the urgency for Europe to take effective action as it recognised that Europe needs more and better jobs. The outcome of this Council took the form of the European Employment Strategy (EES). In line with the Lisbon strategy the European Employment Strategy sets three overreaching objectives: first to raise full employment, second to improve quality and productivity at work, and finally to strengthen social cohesion and inclusion. Within this strategy there exist some further specific guidelines and guidance on improving governance of employment policies in general. Based on these guidelines in recent years reforms in many Member States have taken place and based on a recent report of EU Commission (2008) these reforms have proved their worth in improving labour market performance. This assessment is mainly on the employment growth of the earlier years of 2000s and by the resilience of employment in EU in the recent economic slowdown.

However, not all developments paint a rosy picture in the EU labour market as in the past three years progress towards the Lisbon 2010 target of a 70% overall employment rate is recorded to be rather limited, while even the intermediate employment rate target for 2005 of 67% was missed by a 2% margin. This calls for urgent action now as the 2010 target will also be certainly missed. Also, labour productivity growth has continued to slow down and inclusive labour markets remain important challenges in many Member States (see, EU Commission, 2005). The question that emerges is where the action should be directed to. This paper does have ambition to provide the answer. However, as recent labour market developments show, labour market must not be seen within a static framework, but rather one that could capture the underlying dynamics. Revealing the dynamics between different states of labour market (e.g. full time employment to unemployment) could be then used to guide appropriate action.

Several studies have focused on labour market dynamics, building upon the work of Mortensen and Pissarides (1994), which examines the dynamics between unemployment and employment. Gali (1999) using a structural vector autoregression (SVAR) argues that the dynamics in employment could be explained by the shocks in technology and labour productivity. Yet, the literature on labour market dynamics is not conclusive. Christiano et al. (2004) criticise the findings of Gali (1999).

Although, this literature attempts to identify the underlying factors, such as productivity shocks and factors related to the business cycle, that influence mainly employment dynamics, an issue that has not been investigated and remains open concerns the magnitude of the transition probability between different states of labour market. In this paper, we depart from the analysis of the above studies and employ instead Markov Chains analysis for the first time in the literature to address the issue of the underlying labour market dynamics.

In detail, we adopt a Bayesian approach so as to estimate the transition probabilities between four different states, namely full time employment, part employment, temporary employment, and unemployment. Our contribution is, thus, twofold: first, we study the dynamics of four different states of labour market using a Markov process for fifteen European countries. Second, we employ a Bayesian estimation method through Monte Carlo Integration that uncovers the entire empirical posterior distribution for each probability estimate of the transition matrix.

In what follows, section 2 presents some stylized facts for the labour market in the EU-15, section 3 reports the methodological framework. Section 4 presents the empirical results, while section 5 concludes.

2. Stylised facts

Despite recent shadows, mainly due to the hikes in the prices of food and oil, over prospects of the EU economy, the economic environment in EU in recent years has been rather favourable, and in particular in the period 2004-2006. Moreover, solid growth performance has had a positive impact on the European labour markets. In 2006 employment growth picked, nearly 4 million new jobs were created and unemployment reached the lowest levels in years. The overall employment rate in active population increased to 64.3% (EU Commission, 2008). This employment expansion went hand in hand with an accelerating rate of productivity growth. However, the positive performance in recent years EU has remained still short of the 2010 employment targets (see EU Commission, 2008). The current employment rate implies that another 20 million jobs will have to be created by 2010 if the target is to be reached. The unfavourable recent world economic environment as reflected to a downward revision of growth forecasts would imply that the 2010 target would be missed and the lower target of an additional 5.5 million new jobs to be reached by 2009 is also distancing away. Thus, the overall target of a 70% employment rate in active population by 2010 appears quite ambitious at the present juncture.

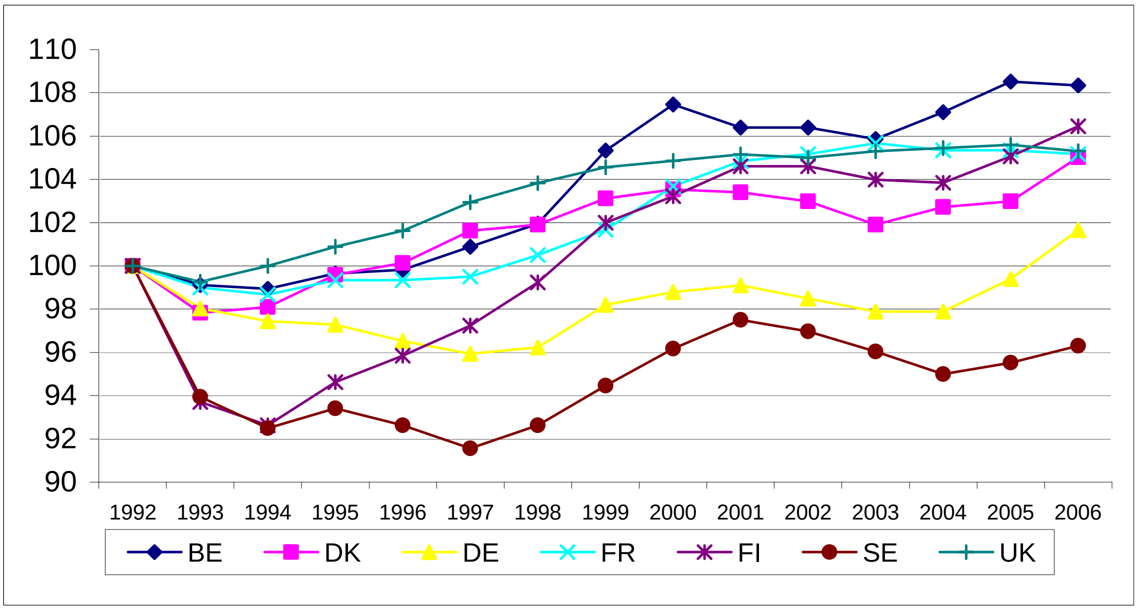
Regarding the unemployment rate, it declined from 8.9% in 2005 to 8.2% in 2006, as most EU Member States exhibit an improvement in unemployment. Both women and men benefited as the corresponding unemployment rates fell to 9% and 7.6% respectively. The strong performance of the labour market is also evident by the long-term unemployment rate that fell from 4% in 2005 to 3.6% in 2006.

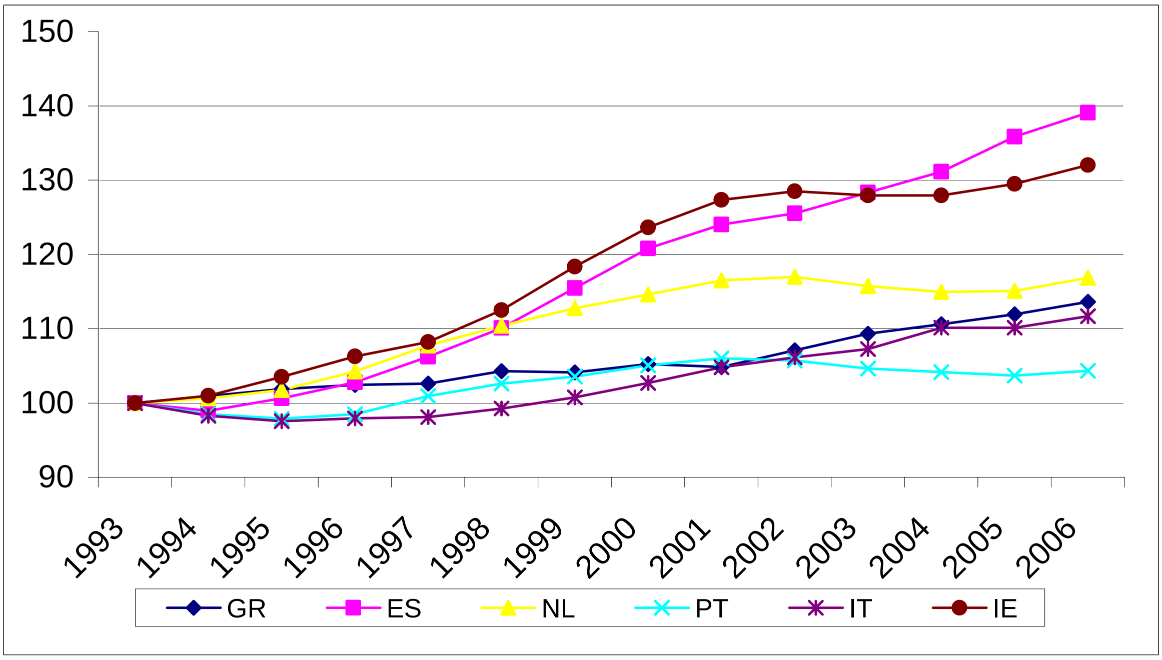
For 2007 employment growth rate recorded strong performance at 1.7% in the EU, corresponding to nearly 4 million new jobs, while the unemployment rate fell to a record low of 7.1%. However, recent forecasts and preliminary data for 2008 show that employment growth declines sharply to 0.8%, a rate well below the long-term average.

Despite the recent pessimism over the short term prospects of the labour market in the EU, the movements of the aggregate employment/ unemployment variables certainly fail to highlight the differences between national labour market dynamics within the EU-15. Similarly, it is not possible either to observe co-movements in employment, unemployment and participation. To reveal these differences or similarities one need a procedure that examines the underlying labour market dynamics on a country by country base.

Diagram 1 reports the employment rates across EU-15. Although across all EU countries differences exist some common patterns emerge. Moreover, countries like France, Finland, Denmark, Belgium, Germany, and UK appear to have been evolving in a similar way between 1992 and 2006. In the case of Ireland and Spain, and to a less extend in Greece and the Netherlands, a much higher employment rate than the rest of the countries is observed, showing a sharp rise over the years.

Diagram 1: Employment rates in EU.
(100 in the starting year of the sample)



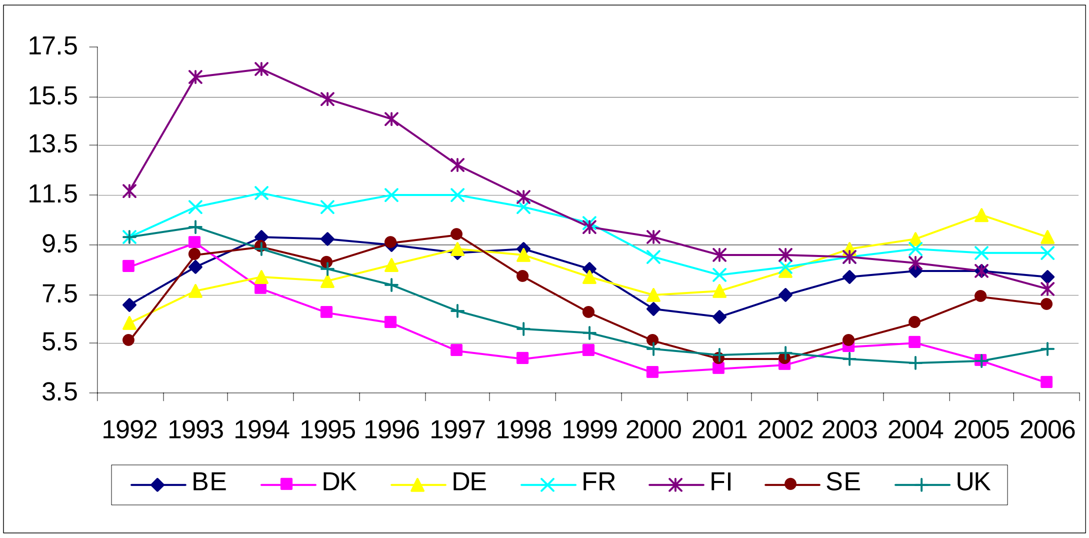


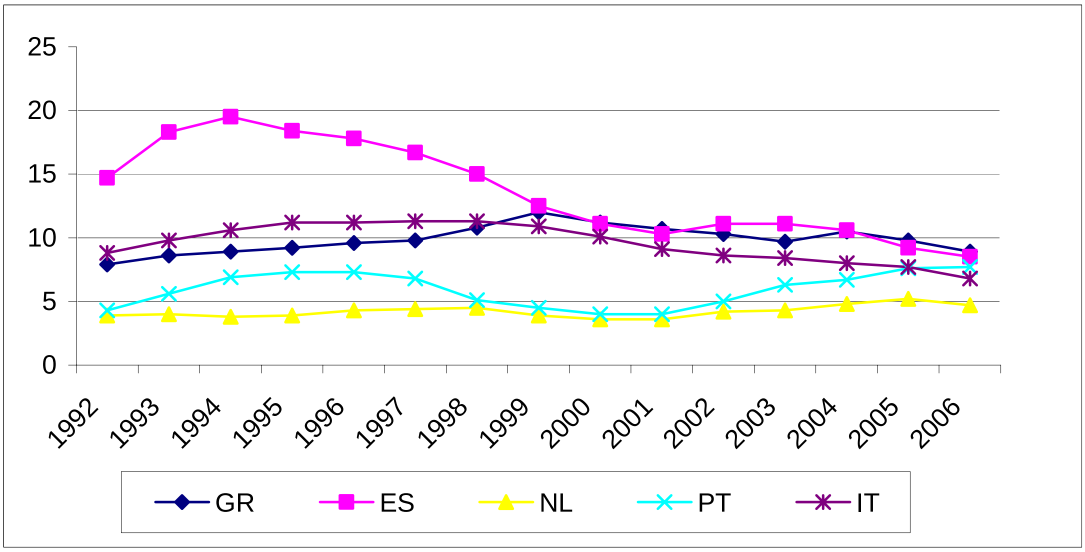
where BE=Belgium, DK= Denmark, DE=Germany, ES=Spain, FR=France, GR=Greece, NL=Netherlands, PT=Portugal, IT=Italy, SE=Sweden, and UK=United Kingdom, IE=Ireland.
Source: Eurostat.

The case of Spain and Ireland is of particular interest as in these countries, since the beginning of the 1990s, there has been a joint increase in relative working-age population, labour force and employment, mainly due to strong economic growth and a net migration flows. In the Netherlands, employment and labour force have increased much more over the past seven years than the working-age population. This reflects a strong increase in labour participation in the Netherlands since the beginning of the 1990s. In contrast, in Finland and in Sweden, after the intense downturn at the beginning of the 1990s, the dramatic decline in employment went hand in hand with a substantive increase in the unemployment rate, whereas labour force and working-age dynamics were much smoother.

Overall, unemployment in the EU-15 picked in the years 1993 and 1994 and since then appears to progressively follow a downward path, reaching its lowest value in our sample in 2001 at 6.2%. Despite similarities in the evolution of unemployment rates across countries marked differences also exist as the unemployment rate ranges from 3.9% in Denmark to 9.2% in France in 2006.

Diagram 2: Unemployment rates in EU.





where BE=Belgium, DK= Denmark, DE=Germany, ES=Spain, FR=France, GR=Greece, NL=Netherlands, PT=Portugal, IT=Italy, SE=Sweden, and UK=United Kingdom.
Source: Eurostat.

Both Diagrams above show that movements of employment and unemployment rates have been strongly linked over the period. However, one could also observe differences that could be the outcome of country specific market dynamics. Also if one considers that the relatively favourable labour market outlook is now behind, a number of serious concerns arise, regarding the exact nature of the individual market's underlying dynamics. This paper bridges a gap in the literature by providing evidence of country specific dynamics by identifying the exact transition patterns between different states of labour market. This identification would assist attempts to improve policy by prioritising actions to those particular states of labour market that exhibit stronger persistence, aiming at increasing employment rates and at decreasing unemployment. For example, by observing the transition probabilities from employment to unemployment and vice a versa for each EU-15 country we would be able to identify labour market policies that would, in turn, shorten the time between unemployment and employment.

3. Bayesian Estimation for Markovian Transition Probabilities

Policy makers often work with aggregate data to monitor the evolution of central tendencies of key policy variables. In this context we shall assume that the researcher observes only the aggregate proportions relating to the decomposition of the full work force into four classes at every time t: Full-Time employment (FT), Part-Time employment (PT), Temporary employment (TEMP) and Unemployment (UN). We denote the probability of the joint event that a worker x_t falls in two different employment states, s_i and s_j, in two sequential periods, t-1 and t, as

$$\Pr\left(x_t = s_j, x_{t-1} = s_i\right) = \Pr\left(x_{t-1} = s_i\right)\Pr\left(x_t = s_j \mid x_{t-1} = s_i\right) \quad (1)$$

which upon recursive substitution can be expressed as

$$\Pr\left(x_t = s_j\right) = \sum_i \Pr\left(x_{t-1} = s_i\right)\Pr\left(x_t = s_j \mid x_{t-1} = s_i\right) \quad (2)$$

The state, s_i takes the form of four mutually exclusive employment states as describes above. In our analysis, the researcher observes the unconditional probabilities of equation (2) in the form of aggregate proportions in each employment state and is interested in estimating the conditional transition probabilities between employment states, forming the time homogeneous transition probability matrix *P*.

$$P = \begin{bmatrix} p_{FT,FT} & p_{FT,PR} & p_{FT,TEMP} & p_{FT,UN} \\ p_{PT,FT} & p_{PT,PT} & p_{PT,TEMP} & p_{PT,UN} \\ p_{TEMP,FT} & p_{TEMP,PT} & p_{TEMP,TEMP} & p_{TEMP,UN} \\ p_{UN,FT} & p_{UN,PT} & p_{UN,TEMP} & p_{UN,UN} \end{bmatrix}$$

This is a Stochastic Matrix, P, and can be representative of a stochastic process only if it is associated to a converging generator matrix G. The latter property is ensured if and only if P is diagonal dominant, in that every element of the main diagonal exceeds 0.5. Thus, the empirical implementation of the transition matrix P is subject to the above constraint, as well as that each row sums to unit and all matrix elements are non-negative.

We now convert model (2) into an empirical equation by substituting the unconditional probabilities with observed aggregate proportions y_j and adding a random error term u_j. Following, the conditional transition probabilities are left as unknown parameters β_{ij} and the model can be represented as:

$$y_{j,t} = \sum_i y_{i,t-1}\beta_{ij} + u_{j,t} \tag{3}$$

where $y_{j,t}$ is the proportion of the aggregate employment class j at time t over total work force. Assuming a finite sample of T observations, our properly constrained model can be written in matrix notation as:

$$\begin{aligned} &\boldsymbol{y}_j = X_j\boldsymbol{\beta}_j + \boldsymbol{u}_j \\ &\text{s.t.} \\ &\mathbf{1}'\boldsymbol{\beta}_j = 1, \quad \boldsymbol{\beta}_j \geq 0, \quad \beta_{ji} > 0.5 \text{ for } j = i \end{aligned} \tag{4}$$

where $\boldsymbol{y}$ is a vector of T observations of portfolio returns, X a matrix of T observations for K employment states, β a vector of K conditional transition probabilities, $\mathbf{1}$ is a vector of units and $\boldsymbol{u} \sim N(0, \sigma^2 I)$. Although the application of least-squares to model

(4) is possible, the distribution of the resulting estimator is unknown because of the presence of inequality constraints. Thus, our approach overcomes this difficulty by pursuing the estimation of the unknown transition probabilities using Bayesian arguments and the calculation of the posterior density through Monte Carlo Integration.

We impose the equality constraint by restating model (4) in deviation form from the k-th employment state proportion, where the t-th elements of the new variables are now denoted as $y_t^* = y_t - x_{k,t}$ and $x_{i,t}^* = x_{i,t-1} - x_{k,t-1}$, where i = 1,…,K-1 is the i-th column of X. Now our transition probability vector β^* has K-1 elements whilst the K-th beta can be obtained from the "sum to unity" constraint $1 - \mathbf{1'}\beta^*$. As a standard assumption, all elements of X^* are independent of each other and of u, β^* and σ^2. Applying Bayes law, the joint posterior density of β^* and σ^2 is given as:

$$\text{Posterior}\left(\boldsymbol{\beta}^*, \sigma^2 \middle| \boldsymbol{y}^*, X^*\right) = \text{Likelihood}\left(\boldsymbol{\beta}^*, \sigma^2 \middle| \boldsymbol{y}^*, X^*\right) \times \text{Prior}\left(\boldsymbol{\beta}^*, \sigma^2\right) \qquad (6)$$

where we have dropped the subscript j for employment state. To define our prior density, we follow van Dijk and Kloek (1980), so the prior is composed of an uninformative component for σ^2 and an informative one for β^*. By independence:

$$\text{Prior}\left(\boldsymbol{\beta}^*, \sigma^2\right) = \sigma^{-1}\, q\left(\boldsymbol{\beta}^*\right) \qquad (7)$$

where

$$q\left(\boldsymbol{\beta}^*\right) = \begin{cases} 1 & \text{if } \mathbf{1'}\boldsymbol{\beta}^* \leq 1 \text{ and } \boldsymbol{\beta}^* \geq 0 \\ 0 & \text{otherwise} \end{cases}$$

Under multivariate normality for u and integrating out σ using standard analysis the marginal posterior probability density for $\boldsymbol{\beta}^*$ is:

$$\text{Posterior}\left(\boldsymbol{\beta}^* \middle| \boldsymbol{y}^*, X^*\right) = c\left[\lambda + \frac{(\boldsymbol{\beta}^* - \boldsymbol{b})' X'^* X^* (\boldsymbol{\beta}^* - \boldsymbol{b})}{\hat{\sigma}^2}\right]^{-\frac{1}{2}(\lambda+K-1)} \times q\left(\boldsymbol{\beta}^*\right)$$

where (9)

$$c = \frac{\lambda^{\frac{\lambda}{2}} \Gamma\left[\frac{1}{2}(\lambda + K - 1)\right]}{\pi^{\frac{K-1}{2}} \Gamma\left[\frac{\lambda}{2}\right] \det\left(\hat{\sigma}^2 (X'^* X^*)^{-1}\right)^{\frac{1}{2}}}$$

and $\Gamma(\,.\,)$ is the gamma function. This is a multivariate t density with mean zero, variance $\frac{\lambda}{(\lambda-2)\hat{\sigma}^2} X'^* X^*$ and $\lambda = v$ degrees of freedom.

The empirical implementation of (9) requires the simulation in finite samples. We follow the methodology proposed by Kloek and van Dijk (1978) and further studied by van Dijk and Kloek (1980), who show that for any function $g(\,.\,)$, the point estimator of $g(\boldsymbol{\beta}^*)$ is given by:

$$E\left(g\left(\boldsymbol{\beta}^*\right) \middle| \boldsymbol{y}^* X^*\right) = \frac{\int g\left(\boldsymbol{\beta}^*\right) \text{Posterior}\left(\boldsymbol{\beta}^* \middle| \boldsymbol{y}^* X^*\right) d\boldsymbol{\beta}^*}{\int \text{Posterior}\left(\boldsymbol{\beta}^* \middle| \boldsymbol{y}^* X^*\right) d\boldsymbol{\beta}^*} \quad (10)$$

For the numerical implementation of (1) using Monte Carlo procedures, we use an importance function $I\left(\boldsymbol{\beta}^*\right)$, as a proxy to (9), from which random draws of $\boldsymbol{\beta}^*$ will be taken. Let $\boldsymbol{\beta}_1^*, \boldsymbol{\beta}_2^*, \ldots, \boldsymbol{\beta}_N^*$ be a set of N random draws from $I\left(\boldsymbol{\beta}^*\right)$, then it can be shown that:

$$\lim_{N\to\infty}\frac{1}{N}\sum_{i=1}^{N}\frac{g\left(\boldsymbol{\beta}_i^*\right)\text{Posterior}\left(\boldsymbol{\beta}_i^*\middle|\boldsymbol{y}^* X^*\right)}{I\left(\boldsymbol{\beta}_i^*\right)} = E\left(g\left(\boldsymbol{\beta}^*\right)\middle|\boldsymbol{y}^* X^*\right) \tag{11}$$

The normalizing constant can be calculated separately. Since $I\left(\beta^*\right)$ is supposed to be a proxy to the posterior distribution, equation (9) suggests that we should choose the multivariate *t* density. Then our MCI estimator will be reduced to:

$$\frac{1}{N}\sum_{i=1}^{N} g\left(\boldsymbol{\beta}_i^*\right) q\left(\boldsymbol{\beta}_i^*\right) \tag{12}$$

We shall generate multivariate *t* vectors of $\boldsymbol{\beta}_i^*$ as follows. First, we calculate the OLS estimatec of $\boldsymbol{\beta}_i^*$, b, and then the Cholesky decomposition of the covariance matrix such that:

$$AA' = \hat{\sigma}^2 (X'^* X^*)^{-1}$$

Then, we generate a *K*-1 vector $\boldsymbol{z}_i$ of independent standard normal random variables, which leads to the *i*-th replication of $\boldsymbol{\beta}_i^*$ as $\boldsymbol{\beta}_i^* = b + A\,\boldsymbol{z_i}$, which is thus drawn from a (*K*-1)-variate normal distribution. We can now convert to a *t*-distributed draw, by generating a λ vector $\boldsymbol{w}_i$ of independent standard normal variables and calculating $\boldsymbol{\beta}_i^*$ as:

$$\boldsymbol{\beta}_i^* = \boldsymbol{b} + A\,\boldsymbol{z_i}\left(\frac{\lambda}{w_i' w_i}\right)^{\frac{1}{2}} \tag{13}$$

Thus our parameter estimates can now be obtained using (12) and $g\left(\boldsymbol{\beta}_i^*\right) = \boldsymbol{\beta}_i^*$. Similarly we can obtain estimates of higher moments of β^* or any other functions of interest.

4. THE DATA AND THE EMPIRICAL RESULTS

The data for the empirical analysis come from Eurostat and concern the EU-15, namely: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, Spain, Sweden and UK. Our labour data includes full-time employment, part employment, temporary employment and unemployment from 1992 to 2006.

In the present analysis the variables of our interest, that is full time employment, part employment, temporary employment and unemployment, are taken as proportions of total labour force. These proportions are then represented in changes so as to be able to estimate the underlying distribution dynamics from one state of labour market to another, referring to an evolving cross-sectional distribution over time and its persistence and transition characteristics.

Table 1 shows the transition probability matrix for the four states of labour market. In detail, the elements in the main diagonal of Table 1 provide information about persistence, as they represent estimates of non-transition probabilities, the likelihood of staying in the same state next period. According to the results, there is above 70 percent probability that an employee remains active in the labour market next year in all countries but Ireland, Netherlands and UK. There is also high persistence, but somewhat lower around 60 percent, in the case of part time employment for all countries, with Germany reaching 70 percent. In comparison, lower persistence is observed in the case of temporary employment that takes values of around 60 percent or lower for most countries, while for Ireland, Italy and Portugal persistent is higher, reaching 65 percent. In the case of unemployment for most countries the probability of persistence that a person remains unemployed, being already in the state of unemployment, is above 65 percent with the notable exception of Austria, Greece, Netherlands, Portugal and Spain for which persistence is 60 percent or below. The reported high persistent in unemployment provides evidence of the existence of unemployment trap in the EU. For the relevant transition probability from part employment to full time employment, seven countries (Austria, Denmark, France, Ireland, Netherlands, Sweden and UK) have above or close to 20 percent probability, the remaining countries have below 20%, implying that the state of part time employment carries lower persistence compared to unemployment.

Table1, The One-Step Transition Probability Matrix

Austria	FT	PT	TEMP	UN
FT	**0.781**	0.138	0.051	0.029
PT	0.226	**0.622**	0.101	0.051
TEMP	0.121	0.091	**0.605**	0.183
UN	0.105	0.194	0.101	**0.600**
Belgium	FT	PT	TEMP	UN
FT	0.753	0.106	0.102	0.039
PT	0.120	0.654	0.123	0.103
TEMP	0.107	0.168	0.589	0.136
UN	0.142	0.125	0.076	0.657
Denmark	FT	PT	TEMP	UN
FT	0.716	0.186	0.072	0.026
PT	0.195	0.607	0.143	0.055
TEMP	0.070	0.062	0.561	0.307
UN	0.149	0.136	0.065	0.651
Finland	FT	PT	TEMP	UN
FT	0.772	0.085	0.120	0.023
PT	0.133	0.625	0.164	0.078
TEMP	0.088	0.095	0.580	0.237
UN	0.164	0.090	0.054	0.691
France	FT	PT	TEMP	UN
FT	0.744	0.093	0.126	0.037
PT	0.229	0.613	0.069	0.089
TEMP	0.064	0.074	0.577	0.285
UN	0.137	0.125	0.086	0.652
Germany	FT	PT	TEMP	UN
FT	0.704	0.082	0.172	0.042
PT	0.071	0.710	0.171	0.048
TEMP	0.145	0.147	0.592	0.116
UN	0.114	0.128	0.089	0.668

Greece	FT	PT	TEMP	UN
FT	0.738	0.076	0.096	0.090
PT	0.159	0.641	0.118	0.082
TEMP	0.109	0.114	0.588	0.189
UN	0.134	0.093	0.180	0.593

Source: Authors' Estimations.
Note: FT= full time employment, PT= part time employment, TEMP= temporary employment, UN= unemployment.

Table1, The One-Step Transition Probability Matrix (continued)

Ireland	FT	PT	TEMP	UN
FT	0.676	0.246	0.046	0.031
PT	0.229	0.629	0.088	0.054
TEMP	0.143	0.090	0.644	0.122
UN	0.151	0.078	0.107	0.664
Italy	FT	PT	TEMP	UN
FT	0.733	0.096	0.040	0.131
PT	0.146	0.637	0.143	0.075
TEMP	0.172	0.104	0.658	0.066
UN	0.152	0.115	0.065	0.667
Luxembourg	FT	PT	TEMP	UN
FT	0.846	0.039	0.094	0.021
PT	0.194	0.605	0.064	0.138
TEMP	0.130	0.162	0.611	0.097
UN	0.166	0.106	0.071	0.657
Netherlands	FT	PT	TEMP	UN
FT	0.634	0.078	0.233	0.055
PT	0.260	0.653	0.056	0.032
TEMP	0.125	0.155	0.604	0.116
UN	0.123	0.159	0.101	0.617
Portugal	FT	PT	TEMP	UN
FT	0.856	0.085	0.043	0.016
PT	0.124	0.595	0.159	0.121
TEMP	0.088	0.242	0.636	0.033
UN	0.111	0.095	0.199	0.595
Spain	FT	PT	TEMP	UN
FT	0.765	0.087	0.110	0.038
PT	0.108	0.608	0.176	0.107
TEMP	0.154	0.096	0.592	0.158
UN	0.114	0.110	0.172	0.604
Sweden	FT	PT	TEMP	UN
FT	0.713	0.077	0.186	0.023
PT	0.243	0.632	0.072	0.054
TEMP	0.090	0.170	0.570	0.170
UN	0.145	0.127	0.078	0.651
UK	FT	PT	TEMP	UN
FT	0.588	0.343	0.058	0.012
PT	0.289	0.613	0.051	0.048
TEMP	0.099	0.156	0.593	0.152
UN	0.102	0.146	0.107	0.645

Source: Authors' Estimations.

Note: FT= full time employment, PT= part time employment, TEMP= temporary employment, UN= unemployment.

The off diagonal matrix elements in Table 1 are quite substantial in magnitude also in the case of transition from the state of temporary employment to the case of unemployment, five countries (Austria, Denmark, Finland, France, Greece) have probability close to or above 20 percent. There exist some countries that are exceptions, see Italy and Portugal with probability of 6.1 percent and 3.3 percent respectively. There is also high transition probability from full time to part time employment for the countries; Austria, Denmark, Ireland, and UK.

Note the pattern in off diagonal elements that emerges is that the less rigid in terms of regulation labour markets appear to exhibit high transition probabilities between the different states. This pattern could be interpreted as essentially some convergence of the labour markets in the EU for those countries that have liberalized their labour markets, see UK, Ireland, Denmark, Netherlands, and Austria.

In the case of transition probability from full time to temporary employment, Germany, Netherlands and Sweden are the only countries that take high values, ranging from 17 percent to 23 percent, while the rest do not exceed 12 percent. Finally, the transition probabilities from full time to unemployment are uniformly low in magnitude. They take values close to 3 percent, with the exception of the southern countries Greece and Italy that take values of 8% and 13% respectively.

The above reported transition probabilities appear to explain why some certain European countries such as Finland, Denmark, UK, Ireland, and the Netherlands have been consistently experiencing high employment, and low levels of unemployment, and appear to be most able to meet the demands of changing market conditions and rapid technological progress. Flexible working patterns in these countries mean that they have been more able to meet the rapidly changing market conditions and technological progress. However, note that in the case of UK, and to less extend in the case of Ireland and the Netherlands, the persistence for full time employment is lower than the rest of the countries, implying that flexible labour markets do not always imply higher rates of full time employment.

An interesting case is Ireland that although in the past suffered from high rates of unemployment, in recent years they actively persuaded labour market reforms that resulted to high rates of employment. In contrast, the labour markets reforms in southern European countries either have not been successful or have been absent. It is no surprise that in Italy, Greece and Spain, there were relatively low rates of employment and high rates of unemployment. Portugal, in contrast to other southern European countries, has enjoyed high employment rates and relatively low rates of unemployment. Despite the lack of labour market reforms in the EU south, in recent years due to strong growth performance, employment rates have sharply increase in both Spain and Greece. Notice also, that for these countries our results show that the persistence of unemployment is reported much lower in comparison with countries such us Finland, UK and Ireland.

Overall, the results pinpoint that there are substantial variations in the transition probabilities across countries, implying that the convergence process of the EU-15 labour markets is far from completed. However, it appears that countries with flexible labour markets exhibit similar transition probabilities between different states of the labour market. For example, in the case of UK, Ireland and the Netherlands the persistence of full time employment is lower than in rest of the countries.

In terms of economic policy, the identification of the underlying labour market dynamics is useful for economic policy as it highlights an ongoing process of convergence across countries. Therefore, a message that emerges is that the European Employment Strategy, aiming at boosting employment and thus lowering unemployment, could benefit from a process of prioritising policy actions that facilitate convergence.

5. CONCLUSIONS

This paper focuses on the evolution of some key states of labour market. We model the evolution of labour market states using Markov Chains for proportions of aggregate data. This approach uncovers the entire empirical posterior distribution of transition probabilities from employment to part employment, temporary employment and unemployment respectively, for which statistical inferences are readily available.

The results reveal marked differences between countries. Some common patterns, however, are also present as the less rigid in terms of the underlying regulation framework labour markets exhibit higher transition probabilities between the different states. Also, the estimation of transition probabilities shows that an ongoing process of convergence in the EU labour markets is underway, especially for the countries that have liberalized their labour markets.

References

Christiano, L., M. Eichenbaum and R. Vigfusson (2004), The Response of Hours to a Technology Shock: Evidence Based on Direct Measures of Technology, *Journal of the European Economic Association,* 2 (May), pp. 381-395.

Christodoulakis, G. A. (2007), Markovian Credit Transition Probabilities under Inequality Constraints: the US Portfolio 1984-2004, *Journal of Credit Risk*, Vol. 3, 3, pp. 25-39,

EU Commission, (2008), The Commission Draft of the Joint Employment Report 2007/8, Brussels.

EU Commission, (2005), The Commission Draft of the Joint Employment Report , Brussels.

Gali, J. (1999), Technology, Employment, and the Business Cycle: Do Technology Shocks Explain Aggregate Fluctuations, American Economic Review, 249-71.

Kloek, T. and H. K. van Dijk (1978), Bayesian Estimates of Equation System Parameters: an Application of Integration by Monte Carlo, *Econometrica*, 46 (1), 1-19

Mortensen, D. and C. A. Pissarides (1994), Job Creation and Job Destruction in the Theory of Unemployment, Review of Economic Studies 61(3), 397-415.

van Dijk, H. K. and T. Kloek (1980), Further Experience in Bayesian Analysis Using Monte Carlo Integration, *Journal of Econometrics*, 14, 307-328