On the interaction between unemployment and inter-regional mobility in Spain.

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Abstract

The aim of the paper is to examine the interaction between unemployment and inter-regional mobility in presence of asymmetric productivity shocks. We present an intertemporal two-regions equilibrium model. Firms’ labour demand behaviour depends on trade on the labour market. Only unemployed are allowed to migrate from one region to another. There exist failures in the labour market, as an uncoordinated activity between vacancy and unemployment. This allocative process is however subject to different incentives that slow down this migration process. We also analyze the wage setting procedure by introducing Nash bargaining between firms and employees. Finally, we calibrate the model for the Spain and we analyse the relevance of the model quantifying the importance of mobility in unemployment dynamics.

JEL classification: J51, J61, R23.

Keywords: Dynamic of Unemployment, Nash bargaining, regional migration.

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1 Introduction

Inter-regional mobility and unemployment are usually related in regional migration literature. However in Europe workers do not seem to move across regions in response to regional specific shocks as much as workers in USA. In spite of persistent differences of the unemployment rates across European regions, European inter-regional migration rates are relatively low in comparison with USA, ranging from 0.6% in countries such as Italy and Spain and 1% - 2.5% in other European community countries to 3% in USA during the nineties (see Overman and Puga, (1999), Bentolila, (2001)).

The theoretical literature on the interactions between migration and unemployment begins with Harris and Todaro (1970). They present an economy with two-sectorial regions in a static framework. The wages are exogenously determined in the region which receives migration. They conclude that migration has a negative effect on the latter region. Workers decide to migrate according to their expected income. And the number of jobs has to be shared between a higher number of workers. A positive relationship between unemployment rates and wages is shown to arise. The model does not take into account the different employment opportunities in each region. Other models uses the same framework with wage bargaining as Schmidt et al. (1994) concluding that there is a positive effect of migration, however their analysis is limited by an exogenous migration.

Blanchard and Katz (1992), Decressin and Fatas (1995) and Muet (1995) show that migrations can decrease regional unemployment disparities. These papers link the regional unemployment rate with labour supply, labour demand and wage-setting factors in an econometric model. They observe a negative relationship between unemployment rates and wages when the economy faces asymmetric shocks. Blanchard and Katz (1992) study the role of regional migrations in USA putting forward the importance of wage flexibility in this context. They observe a negative relationship between unemployment rates and wages when the economy faces asymmetric shocks. The relationship between unemployment and inter-regional mobility is therefore unclear. Decressin and Fatas (1995) and Muet (1995) adapt the same framework of Blachard and Katz (1992) to study the European case. They conclude that in Europe most of the shock is absorbed by changes in the participation rate while in the USA, it is reflected in mobility. However, these models omit the analysis of the relationship between labour force behaviour and differences in employment probabilities.

Other related literature based on matching models study the relationship between migration and unemployment. Following Pissarides (1990), this approach has the advantage of providing a basic structure for the labour market that is manageable with coordination failures, which is useful to analyse regional movements. In this framework we find several studies empirical oriented as Pissarides and Wadsworth (1989), Pissarides and McMaster (1990) and Jackman and Savouri (1992). They use the job-matching approach to consider the probability of the unemployed to find a job.

In this paper we address the following issues: i) to which extent mobility
is an important factor for unemployment stability? ii) what is the relationship between unemployment and inter-regional mobility as well as its relationship with wages? and finally iii) to which extent workforce mobility can contribute to diminish regional disparities?

Following Pissarides (1990), we try to shed a light on the effects of inter-regional migration and mobility of the unemployed. We develop a dynamic partial equilibrium model with two regions. The paper aims at analysing labour market with migration. In particular we focus on unemployment, the inter-regional mobility, wages and employment dynamics.

The model is based in Ortega (2000)’s and Chéron (1999)’s papers. Ortega (2000) studies the properties of the matching process in a model with two countries where the wage is determined in a Nash bargaining process, which the migration is a Pareto optimum. Workers decides whether to search in their country or look for a job abroad. Migrants have additional costs. He shows migration as Pareto optimum and the positive effect of migration since immigration leads to an increased job creation in the country which receives workers. However this paper is entirely done in steady state. Chéron (1999) builds a dynamic equilibrium matching model for two countries. He finds a negative effect of migration generated by a positive relationship between unemployment and wages as Harris and Todaro (1970). However the migration is endogenous through a migration cost which depends on population corrected by an exogenous parameter and wages are exogenously determined.

The goal of the paper is build a matching model in dynamic equilibrium where labour force mobility is endogenous and the wage setting procedure is determined by Nash bargaining between firms and employees in each region. There are different opportunities of employment across regions and unemployment is subject to asymmetric shocks. Each region faces a specific productivity shock, which introduces regional heterogeneity. Only the unemployed people are allowed to migrate from one region to the other. Hiring is a matching process between vacancies and unemployment in each region. This mechanism allows us to observe the influence of migrations in unemployment dynamics when there are coordination failures in the labour market. A regional specific negative shock lowers productivity in a region, increasing the incentives to move to the other region. This allocative process occurs by the different employment opportunities through the probabilities and the different value functions of workers, through wages and probabilities of finding a job. The probability of finding a job in a given region constitutes the mechanism of adjustment in the model. The choice of localization by unemployed workers determines the dynamics of the labour force through the wage setting procedure, which induces migration by introducing Nash bargaining. We compare two different scenarios. The case of a country where there is no mobility with unemployment persistence versus the same economy when mobility is allowed.

We calibrate the model for the Spanish economy. A vast empirical literature has shown that the low inter-regional mobility as well as the unemployment persistence in Spanish regions has been comparatively higher than in other European countries in the past (see Bentolila and Dolado, (1992), Rodenas (1994),
Antolín and Bover (1997), Bover and Velilla (1999) and Bentolila S. (2001)). We simulate the response of unemployment and migration to asymmetric shocks considering two alternative versions of the model, with and without migration. We conclude that mobility may allow the labour market to adjust under asymmetric shocks, causing positive effects in both regions, and a reduction in the unemployment growth compared to no mobility.

The paper is organised as follows. First, we present the model. Second, we present data and calibration results. Third, simulation results are analysed in the two alternative cases: when there is no mobility and when mobility is allowed between regions. Finally, we conclude and present some possible extensions.

2 The model

We first describe the matching model with two regions. Next, we present the maximization problems of the firm and the workers. Then, we describe the labour contract. Finally, we show the mobility of workers.

2.1 Trade on the labor market

The economy is divided into two regions. The size of the labour force is normalized to one: \( \ell_{1,t} + \ell_{2,t} = 1 \), where \( \ell_{j,t} \) denotes the labour force in region \( j \in \{1, 2\} \). At any time \( t \), workers can be unemployed or employed (denoted \( u_{j,t} \) and \( n_{j,t} \) respectively, for region \( j \)). Unemployment in each region can be expressed in terms of employment \( n_{j,t} \) and labour force \( \ell_{j,t} \):

\[
\begin{align*}
u_{1,t} &= \ell_{1,t} - n_{1,t} \quad (1) \\
u_{2,t} &= 1 - \ell_{1,t} - n_{2,t}. \quad (2)
\end{align*}
\]

The firm has access to a region-specific technology: it cannot transfer its vacancies from one region to another. Finally, \( v_{j,t} \) is the vacancy rate in the region \( j \) at period \( t \). More precisely, investment decision is not taken into account. Capital of firms and size of fixed capital stock is given. We assume that only unemployed workers can apply to a posted vacancy.

Following Pissarides (1990) we assume that trade in the labor market is an uncoordinated and costly activity. Each region is described by a collection of workers and employers: meetings take place according to a matching technology (see Saint Paul, 1992). We further assume that only the unemployed can migrate. The flow from unemployment to employment is represented in each region with a Cobb-Douglas constant returns to scale matching function. Coordination failures imply that the match \( h_{j,t} \), which associates vacancies \( v_{j,t} \) and unemployed workers \( u_{j,t} \) is not perfect. In particular

\[
h_{j,t} = h(u_{j,t}, v_{j,t}) = \overline{h} v_{j,t}^{\gamma} u_{j,t}^{1-\gamma}, \quad (3)
\]
where $\gamma$ represents the elasticity of hirings with respect to vacancies and $\bar{v}_j$ is a scale factor for region $j$.

The transition probabilities between these different states are assumed to be Poisson rates. The probability for a vacancy to be filled $q_{j,t}(\theta_{j,t}) = h_{j,t}/v_{j,t}$ is a function of $\theta_{j,t}$, the ratio of vacancies to unemployment in region $j$. This ratio describes the tightness on the labour market. Hence, the transition probability for an unemployed worker (to become employed) in region $j$ is $p_{j,t}(\theta_{j}) = h_{j,t}/u_{j,t} = \theta_{j} q_{j,t}(\theta_{j})$. The evolution of employment in each region is given by

$$n_{j,t+1} = q_{j,t} v_{j,t} + (1 - s_j) n_{j,t},$$

where $s_j$ is the exogenous separation rate: the probability for an employed to become unemployed. Equation (4) depends on the probability of filling a vacancy times vacancies in the labour market plus the employment from the previous period that with probability $1 - s_j$ remains in the same firm.

Figure 1 illustrates the dynamics of regional migration in this model. Employed in each region can become unemployed with an exogenous separation rate $s_j$ and unemployed either can find a job in her region with a probability $p_{j,t}$ or to consider the possibility of moving to the other region.
Aggregate variables are defined as follows: aggregate employment is \( n_t = \sum_j n_{j,t} \) while unemployment is \( u_t = \sum_j u_{j,t} \). In order to keep homogeneity \( v_t = \sum_j v_{j,t} \) are vacancies. Consequently, and since each regional labour force is \( l_{j,t} = n_{j,t} + u_{j,t} \) aggregate labour is \( l_t = n_t + u_t \) where \( h_t = \sum_j h_{j,t} \).

2.2 The firm

Firm \( i \) in region \( j \) has access to constants returns to scale (CRS) production function with only employment as productive factor,

\[
y_{i,j,t} = (a + r_j)n_{i,j,t}^\alpha,
\]

where \( \alpha = 1 \). We assume an exogenous interest rate with an instantaneous adjustment of the capital stock. We introduce exogenous shocks, \( a \) and \( r_j \): an aggregate-specific shock, \( a \), and \( r_j \) is a regional-specific shock. The latter can be interpreted as the reflect of the different sectorial specialization and the former as an aggregated shock.

Each firm \( i \) maximizes the expected discounted sum of its profit flows over the control variable \( v_{i,j,t} \). Employment, \( n_{i,j,t} \), is the firm’s state variable. Firms have discount factor \( 0 < \beta < 1 \). Then, the firm’s program can be written as a recursive problem as

\[
\Upsilon^F(n_{i,j,t}) = \max \{ \Pi_{i,j,t} + \beta E_t \Upsilon^F(n_{i,j,t+1}) \}
\]

where the maximization is constrained by

\[
\Pi_{i,j,t} = (a_t + r_{i,j,t})n_{i,j,t}^\alpha - w_{j,t}n_{i,j,t} - \omega_j v_{i,j,t}
\]

\[
n_{i,j,t+1} = q_{i,j,t} v_{i,j,t} + (1 - s_j)n_{i,j,t}
\]

the equation (7) is the present profit flow of the firm denoting by \( \Pi_{i,j,t} \), which depends on the production function, (5). Minus their costs; the real wage times the employment in region \( j \), and the cost of having vacancies, \( \omega_j \), times vacancies posted on the labour market. The other constraint is equation (8), the evolution of employment. \( X_{i,j,t}^{\Pi} \) denotes the Lagrange multiplier associated to the budget constraint. The first order condition\(^2\) of (6) with respect to \( v_{i,j,t} \), implies

\[
\beta \frac{\partial \Upsilon^F(n_{i,j,t+1})}{\partial n_{i,j,t+1}} = \frac{\omega_j}{q_{i,t}}
\]

The firm will post a vacancy when the left part of equation (9), the discounted marginal revenue from filling a vacant job in the region \( j \) is equal to the marginal

\(^1\)Cahuc and Wasmer (1999) show with CRS production function the usual results of the standard matching model are fully consistent with firm wage bargaining in the matching model the same as in Pissarides standard model. By contrast, they find that out of constant returns to scale case the wage is a function of employment.

\(^2\)More detail information of firm optimization in the Appendix A.1
cost to create a new job. Let us denote hereafter \( \Upsilon^F(n_{i,j,t}) = \frac{\sigma^F(n_{i,j,t})}{\eta_{i,j,t}} \). To simplify we suppose that all firms are the same in each region \( j \), so that the subscript \( i \) can be omitted.

### 2.3 Workers with migration

Workers in each region are infinitely lived and supply inelastically one unit of employment. Individuals cannot insure themselves against the unemployment risk. Workers are risk neutral. We suppose that unemployed can migrate and they can look for a job in the other region.

The expected value of an employee

\[
V_{j,t}^E = w_{j,t} + \beta E_t \left[ (1 - s_j) V_{j,t+1}^E + s_j V_{j,t+1}^U \right].
\]

(10)

It depends on the current wage \( w_{j,t} \) as well as the discounted future value. Future value is discounted by a factor \( 0 < \beta < 1 \). We denote by \( s_j \) the exogenous quit rate, the probability to become unemployed, while \( V_{j,t+1}^U \) is the expected value of being unemployed at period \( t + 1 \) in region \( j \). Then, \( 1 - s_j \) is the probability to continue working in the firm the next period, with associated expected value \( V_{j,t+1}^E \).

Unemployed workers are allowed to migrate: their decision stems from the comparison between the value of being unemployed in their region \( V_{1,t}^U \) and the value to migrate \( V_{1\rightarrow2,t}^M \). For instance, if we consider workers in region 1:

\[
\nabla_{1,t} = \max \left\{ V_{1,t}^U, V_{1\rightarrow2,t}^M \right\}.
\]

We suppose that the value of migrating is equal to the value of being unemployed in the other region, i.e., there are no mobility cost. Hence \( V_{1\rightarrow2,t}^M = V_{2,t}^U \). Individuals have rational expectations and they can anticipate the equilibrium of migrations. At equilibrium, unemployed migrates until the value of being unemployed to region 1 is equal to the value of being unemployed in region 2, \( V_{1,t}^U = V_{2,t}^U \).

The value of being unemployed in region \( j \) is:

\[
V_{j,t}^U = b_{j,t} + \beta E_t \left[ p_{j,t} V_{j,t+1}^E + (1 - p_{j,t}) V_{j,t+1}^U \right]
\]

(11)

where \( b_{j,t} \) is the instantaneous gain of an unemployed worker. The future expected value depends on the probability to be employed in the following period or to continue unemployed. Notice that the incentive to migrate will depend on the probabilities to find a job in other region, hence it will depend on population and unemployed people in the other region compared to his own region. More precisely, the non-arbitrage condition:

\[
V_{1,t}^U = V_{2,t}^U = V_t^U, \quad \forall \ t
\]
\[ V_t^U = b_{1,t} + \beta E_t [p_{1,t}V_{1,t+1}^E + (1 - p_{1,t})V_{1,t+1}^U] \]  \tag{12}

\[ = b_{2,t} + \beta E_t [p_{2,t}V_{2,t+1}^E + (1 - p_{2,t})V_{2,t+1}^U] \]

Therefore, the value of unemployed, which decide to migrate must be compensated by the unemployment benefit, \( b_{j,t} \), the probabilities of finding a job \( p_{j,t} \) in both regions and the future values of being employment and unemployment.

### 2.4 Wage determination

Wages are determined by a bargaining process between the firm and the workers. Every period, employees and firm simultaneously re-negotiate wages. Otherwise there will be many wages as workers. The solution criterion is the Nash solution as proposed by Pissarides (1990). If the bargaining is successful the employee receive the wage at the end of the period. If it fails, the worker becomes unemployed. In other words, there is employment adjustment in the firms. Afterwards, when unemployed, the worker may choose to migrate.

Both parts take into account their marginal values when negotiate. Marginal value for the worker is the difference of earnings obtained when she is employed and when she is unemployed. Then, the marginal value of employment for a worker may be expressed as:

\[ \Upsilon^W_{j,t} = V_{j,t}^E - V_{j,t}^U. \]  \tag{13}

The marginal value of current employment for a representative firm is\(^3\)

\[ \Upsilon^F_n(n_{j,t}) = \alpha(a_t + r_{j,t})n_{j,t}^{\alpha-1} - w_{j,t} + (1 - s_j)\beta E_t \Upsilon^F_n(n_{j,t+1}). \]  \tag{14}

Let \( 0 < \xi < 1 \) denotes the worker’s share of the marginal value of a new job that it is equivalent to the bargaining power of the worker. The Nash bargaining criterion maximizes over wages the marginal values value of a match for a representative firm and a representative worker:

\[ \max_{\Upsilon^W_{j,t}} \left\{ \left( \Upsilon^F_n(n_{j,t}) \right)^{1-\xi} \left( \Upsilon^W_{j,t} \right)^{\xi} \right\} \],  \tag{15}

where the first order condition states that:

\[ \Upsilon^F_n(S_{j,t}^F) = \frac{1 - \xi}{\xi} \Upsilon^W_{j,t}. \]  \tag{16}

If we replace by the value of \( V_{j,t}^W \) above, considering that workers’ non-arbitrage condition implies \( V_t^U = V_{1,t}^U = V_{2,t}^U, \ \forall \ t \), we have the following expression:

\[ \xi \Upsilon^F_n(n_{j,t}) = (1 - \xi) \left[ w_{j,t} - b_{j,t} + \beta E_t \{(1 - s_j - p_{j,t}) (V_{j,t+1}^E + V_{1,t+1}^U - V_{2,t+1}^U)\} \right]. \]  \tag{17}

\(^3\)Recall \( \Upsilon^F_n(n_{j,t}) = \frac{\partial \Upsilon^F_n(n_{j,t})}{\partial n_{j,t}} \).
Substituting the value of $\mathcal{Y}_F(n_{j,t})$ from equation (14) and rearranging, we have the wage evolution equation:\(^4\)

\[ w_{j,t} = \xi \left[ \alpha(a_j + r_{j,t})n_{j,t}^{\alpha-1} + p_{j,t}X_{j,t}n_{j,t} \right] + (1 - \xi)b_{j,t}. \]  

(18)

The wage is determined by a rent sharing mechanism, which depends on the bargaining power of each agent. This proportion multiplies the part that the firm acquires as gain in labor productivity plus the discounted marginal value of a new job times the probability $p_{j,t}$. The share the employee retains is the probability for a worker of having unemployment benefits.

### 2.5 Mobility of workers

As we have seen in the previous sections, only unemployed can migrate. From the non-arbitrage condition, unemployed worker migrates when the present value of an unemployed worker in region $1$ is equal to the present value of an unemployed worker in region $2$, given by the equation (11):

\[ V_{1,t}^U = V_{2,t}^U. \]  

(19)

After solving it, we obtain the net value of migrating for an unemployed person to move from region $1$ to region $2$ is given by the following expression:\(^5\)

\[ b_{1,t} - b_{2,t} = \frac{\xi}{1 - \xi} \left\{ p_{2,t} \frac{\omega_2}{q_{2,t}} - p_{1,t} \frac{\omega_1}{q_{1,t}} \right\}. \]  

(20)

or rewritten as

\[ b_{1,t} - b_{2,t} = \frac{\xi}{1 - \xi} \left\{ \omega_2 \theta_{2,t} - \omega_1 \theta_{1,t} \right\}. \]  

(22)

where $\theta_{j,t} = \frac{v_j}{w_j}$. Unemployment benefits relationship between regions depends on the ponderation of the bargaining power of the workers and firms in the wage negotiation, times the regional differences of both discounted marginal values for a firm in the region $j$ to create a new vacancy taking into account the probabilities in both regions for an unemployed to find a job. This implies that depends on the different tightness labour market in the two regions, their unemployment benefits and costs of posting vacancies in both regions as equation 22 shows. In sum, migrate will stabilize with the different probabilities to find a job and tightness of labour market as well as the wages mechanism in both regions.

From the definition of $q_{j,t}$, we substitute

\[ \frac{\omega_j}{q_{j,t}} = \frac{\omega_jv_{j,t}}{p_{j,t}(\ell_{j,t} - n_{j,t})}. \]  

(23)

\(^4\)For more details see appendix A.2.  
\(^5\)More details in appendix A.3
in expression (20), to determine labour force in region 1:

\[
\ell_{1,t} = n_{1,t} + \frac{\omega_1 v_{1,t}}{\frac{1}{\gamma}(b_{2,t} - b_{1,t}) + p_{2,t}X_{2,t}}.
\]  

(24)

As we know that \(\ell_{1,t} + \ell_{2,t} = 1\), we can observe movements in the population in the whole economy. Migration of unemployed depends on employment in the own region. As well as the ratio between the vacancies posted in your region time their cost. This term over difference in the unemployment benefits in both regions pondered by the power of bargaining of workers plus the discounted value for a new job in the other region time the probability to find a job in the other region being unemployed.

3 Data and Calibration

We want to analyse the response of some key variables of the labour market to exogenous permanent shocks: a specific regional shock. We first perform a static exercise assessing the steady state implications of such changes in the model. We then study the transitional dynamics delivered by the model in face of the same shocks. This comparative analysis enables us to offer some insights on the role of the regional mobility as an important variable to study unemployment dynamics. We solve the partial equilibrium model under the hypothesis of rational expectations. The model is non-linear. Since the model does not admit any analytical solution, we rely on numerical simulations of the model. This is achieved using the software DYNARE developed by Juillard (1996)\(^7\). This implies that numerical values have to be assigned to deep parameters. The model is applied to the Spanish data. As we suppose symmetry across regions, we have the same values in the model for the different variables and parameters.

Table 1 reports the behavioural parameters. As we discuss in section 4.2.2 the elasticity of the production function with respect to labour is constant returns to scale, \(\alpha\). The worker’s bargaining power in the Nash bargaining process \(\xi\) is set to \(1 - \gamma\). As shown in Hosios (1990), this implies that the Nash bargaining process yields a Pareto optimal allocation of resources. We set these parameters given the same weight to vacancies as to unemployment. The discount rate, \(\beta\), is set to 0.99. The ratio of recruiting expenditures to output \(\omega V/Y\) is taken from Andolfatto (1996), 1%. The cost to post a vacancy is equal to 1% of the regional production. The cost of posting \(\omega\) is get from the steady state using the first order condition equation of the firm over vacancy variable. The parameter of the efficiency of the matching function \(\Pi\), is imposed using the matching function, equation (3) in steady state. The total factor productivity is set such that in steady state and the regional factor productivity is set to

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\(^6\)This exercise is undertaken relying on the software DYNARE developed by Juillard (1996).

\(^7\)More about DYNARE and resolution of forward-looking models can be seen in Laffargue (1990) and Boucekkine (1995).
### Behavioural Parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>elasticity of production function to labour $\alpha$</td>
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</tr>
<tr>
<td>elasticity of hiring function to vacancies $\gamma$</td>
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<td>bargaining power $\xi$</td>
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<tr>
<td>discount factor $\beta$</td>
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<tr>
<td>cost of posting vacancies $\omega$</td>
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<tr>
<td>efficiency factor of matching function $\eta$</td>
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<tr>
<td>total factor productivity $a$</td>
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<tr>
<td>regional factor productivity $r$</td>
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### Table 1: Behavioural Parameters

<table>
<thead>
<tr>
<th>Labour Market Variables and Probabilities</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>separation rates $s$</td>
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</tr>
<tr>
<td>prob. of a firm fills a vacancy $q$</td>
<td>0.6554</td>
</tr>
<tr>
<td>prob. of an unemployed finds a job $p$</td>
<td>0.1681</td>
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<tr>
<td>wages $w$</td>
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<tr>
<td>unemployment benefits $b$</td>
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</tr>
<tr>
<td>employment rate $n/l$</td>
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<tr>
<td>unemployment rate $u/l$</td>
<td>0.1934</td>
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<tr>
<td>hiring rate $h/l$</td>
<td>0.0325</td>
</tr>
<tr>
<td>vacancy rate $v/l$</td>
<td>0.0496</td>
</tr>
</tbody>
</table>

### Table 2: Labour market variables and probabilities

Zero in our benchmark case, but a change in this parameter will be considered to introduce asymmetries in the regions.

Labour market variables and probabilities of the model are reported in 2. The separation rate $s$ is kept constant and calibrated by referring to Antolín (1997) who estimates this value for the Spanish economy 1977–1996 yearly. Unemployment, employment, hiring and vacancy rates are reproduced in the model to replicate the average for Spanish data for the period 1977-1999, yearly. Endogenous probabilities to fill a vacancy, $q$ and to find a job, $p$, are settled in steady state with $q = h/v$ and $p = h/u$ respectively. Unemployment benefit is calibrated with equation (20) and endogenous wage is evaluated in steady state.
4 Results

The aim of this section is to examine the effect of labour mobility when adjusting for asymmetric shocks. We will present a model, which applies to two different scenarios. First, we will introduce the case where is no possibility for workers to move from a region to others. Then, we will study the case where workers have the possibility to move across regions. Finally, we will compare both cases and analyse their results. In both instances, we will assume that regions are symmetric. This assumption will enable us to study the impact of an asymmetric shock in one region for each case and then compare both results. Thus, only the labour force mobility assumption will differ from a case to the other.

We apply the model to Spain. Spanish labour market is characterized by unemployment persistence, low labour mobility and regional unemployment differences.

4.1 Unemployment persistence and no mobility

This section presents results of the model previously stated when there is no labour mobility. The heretofore simulation represents an economy characterized by low mobility and unemployment persistence as may be the case of Europe during the past years, and more specifically for Spain. We assume coordination failures on the labour market, which are formalized by a matching function between vacancies and unemployment in each region. We suppose an infinite cost of mobility, which prevents unemployed workers from moving to the other region. It can be interpreted as lack of mobility due to a rigid housing market in Spain, are supported by empirical research (see Antolín and Bover (1997)), which shows lack of mobility due to a rigid housing market.

Inter-regional migration rates have been low in Spain during the last decades (see Bover and Velilla (1999) and Bentolila S. (2001)). During the late 1970’s and early 1980’s there was a decline in the inter-regional migration, 0.32% in 1982. Even if until mid 1990’s this rate increases, for 1995 the gross inter-regional rate in Spain is 0.62% (see Bover and Velilla (1999)) Moreover, as we have explained in the introduction these rates are low in comparison with other European countries (see Bentolila S. (2001)). However there exists persistence in the national level unemployment rates, 21.65% in 1985 and 14.05% in 2000. As well as persistence at regional level. Some regions are persistently above the average (i.e; Andalucia 29.64% in 1985 and 24.48% in 2000) while some other regions always below (i.e. La Rioja 17.29% and 8.14% respectively).

Our interest is to observe the impact of a shock in one of the regions. We therefore introduce a negative permanent regional shock of 1%. We assume that each region is isolated so that the shock has no economic effect on the other region. One example of a likely permanent negative regional shock could be illustrated by a regional industrial restructuring as it has been the case in the north of Spain in the late seventies with the mining industry. (A positive shock would lead to the opposite conclusions).

The objective of this section is represent a situation like Spanish case, a
country with low mobility between regions and unemployment persistence. The aim is to analyse the effects of a negative technological change defined as a 1% permanent decrease of the productivity, $r_j$ for a region.

A permanent decrease in $r_j$ reduces the marginal value of labour of region $j$, making less worthy for firms to post vacancies in region $j$. Hence the employment level is lower and the labour market tightness decreases (the ratio $v/u$). This leads to two effects: (i) it decreases the competition among firms and creates a congestion effect, which increases the probability of filling up a vacancy and (ii) a negative trade externality that decreases the probability for a unemployed to find a job. As a result, the unemployment rate increases. For instance, a 1% permanent decrease in the productivity factor of one region leads to a growth of 18.42% in the regional unemployment rate. Finally, the reduction of the marginal productivity of labour lowers the value of the surplus accrued by workers, which makes the real wage to fall.

We aim at analysing the dynamic adjustment of employment, unemployment, vacancies and real wages given a 1% permanent decrease of a regional productivity shock. The transitional dynamics of the aforementioned variables are reported in Figure 2. Due to the decrease in the marginal productivity of employment, the marginal value of employment is instantaneously reduced. Therefore, it is no worthwhile for firms to post vacancies. For instance, vacancies decrease by 22.85%. Therefore, employment decreases and unemployment rate increases. Then the dynamics of employment and unemployment is monotonic towards their new steady state levels. According to the wage setting mechanism, wages are closely related to both the marginal productivity of employment and the tightness of the labour market. The dynamic adjustment described hence explains the decreasing of wages in a 1.73%.

At country level, we observe that between both region there is a regional disparity, one region has an unemployment rate of 22.9% while the region no affected by the shock has 19.34%. In this case, there is no possibility of moving across regions. The total unemployment growth is 9.21%. We can interpret it as an increasing in regional unemployment rates persistence in a country without possibility to move between regions.

### 4.2 The role of inter-regional mobility

We analyse now the regional model with mobility across regions described in the second section. We have seen the model without mobility in our framework to the Spanish economy. Now, we introduce the negative shock in a region and we analyse what happen if unemployed workers can move without any restriction in this economy.

Blanchard and Katz (1992), Decressin and Fatás (1995) and Muet P.A. (1995) support the idea of a large flexibility of the labour force adjusting the dynamic of unemployment. The first paper is applied to USA and the others are applied to European countries. These studies debate about the macroeconomic adjustments to achieve stabilization and coordination in order to absorb asymmetric shocks in the different regions. A policy of mobility is studied in
Figure 2: Impulse-response function of employment variables
these papers looking for stability, a better assimilation of asymmetric shocks in the economy or as an alternative to share shocks among regions.

**Steady State**

As in the case of no mobility we analyses a permanent decrease of the productivity of a region, which might be seen as a recession with a permanent effect in this region, or a pure labour demand shock. We analyse the effects of a shock of 1% on the steady state of some key variables of the dynamics of the labour market.

A first effect of a permanent decrease of productivity is a downward of the probability of workers to find a job of this region. Indeed, the effect is the same in both regions though the reason is different. In the affected region by the negative shock, a lower marginal productivity of employment and a high cost of posting vacancies make the firm to hire less workers in this region, decreasing employment. As result the probability to find a job decreases. However, a significant quantity of unemployed move to the other region with better employment opportunities. In the second region, without negative shock, the labour force increases as well as the number of unemployed people. In both cases, labour creates a congestion effect on the supply side which, via the matching process, makes it much harder for unemployed workers to find a job. For instance, the probability for an unemployed worker to find a job decreases by 5.18%.

On the other hand, it has a positive trade externality that benefits firms and makes higher the probability to fill up a vacancy. This effect does exist for both regions one ($q_1$) and region two ($q_2$), because the mechanisms of the model adjusts through wages and probabilities. The growth of $q_j$ increases around 5.46%.

The marginal values of employment depend on the tightness of the labour market (the ratio between vacancy and unemployment) through the wage setting mechanism decrease. Therefore firms advert less number of vacancies and the number of unemployed increases. This, together with the evolution of the probability to fill up vacancies, leads to an employment decrease in both regions. Unemployment increases in both regions but, as probabilities by different reasons. For instance, a 1% permanent decrease in the productivity factor of one region leads to growth of 4.37% in the unemployment rate of this region (lower than the regional rate in the model with no mobility 18.42%). After the shock, both regions have an unemployment rate of 20.18%.

If we consider the addition of both regions, the unemployment growth is 8.72%, while unemployment growth without mobility is 9.21%, higher than with mobility of workers. Moreover, the shock is shared by both regions in an economy with mobility.

**Dynamics on the labour market**

Figures 3-5 show the transitional dynamics of both regions when there is a negative productivity shock in region 1. Mobility across regions adjusts labour
force through wages due to different marginal productivities of employment and employment opportunities.

We observe that agents adjust in one period. Agents have rational expectations and any cost of migration. When the shock occurs, workers move and adjust immediately to the new steady state. This happens due to how is model the mobility of labour force.

Figure 3 shows the impulse response function of labour variables. Firms in region 1 are affected by the negative shock via the marginal productivity of employment which at the same time changes the value of advertising a vacancy. As a result, firms in region 1 reduces the number of vacancies advertised. This creates a migration from region 1 to region 2 increasing labour force in the region 2 (the one without productivity change). The same decrease occurs in labour force of region 1. There exists an employment reduction in the region affected by negative shock. On the other hand, there is a symmetric growth of the number of vacancies posted in region 2. And an increase in employment of region 2.

Both regions increase their unemployment rates by different reasons. At short term unemployment rates of region 2 increase because of a growth their labour force. However, at short term, the increase in unemployment rate in region 1 is larger than unemployment rate in region 2, due to the decrease in the marginal productivity of employment.

Figure 4 shows wage reduction in region 1 and region 2. At short term, we also observe the wage reduction is larger at in region 1. Region 2 absorbs migration from region 1 reducing wages in this region, but less than in region 1. Both regions come back to a new steady state the same for both of them. Region 2 shares the negative productive shock of region 1, and as a result both unemployment rates end up at the same level. However, the dynamic of employment rates is different in both regions. Employment rates in region 1 decreases while employment level in region 2 increases at short term. Hence, region 1 decreases his output and region 2 increases it.

Figure 5 shows changes at short term of the probability of filling a vacancy (increasing in region 1, decreasing in region 2) and of the probabilities to find a job (decreasing in region 1, increasing in region 2). Due to the symmetric framework, regions adjust to find the same new steady state.

Our conclusion in this section is that there is a cost of adjustment at short term in both regions but by different reasons. However at long term, both regions share the shock and the impact in unemployment growth is lower than the no mobility scenario.

4.3 Analysis of mobility case versus no mobility case

Our aim is to analyse the interaction between unemployment and inter-regional mobility in a country experiencing asymmetric shocks. As example, we take the Spanish economy as a case of low mobility between regions and unemployment persistence. The objective is compare this case with the case of mobility in the same economy.
Figure 3: Impulse-response functions of employment variables when mobility of labour force
Figure 4: Impulse-response functions of economic variables when mobility of labour force
Figure 5: Impulse-response functions of probabilities and employment variables
In sum, if mobility is allowed after a regional negative shock, the labour force of one region moves to the other. As a result, unemployment rates increase in both regions. However the effect in regions is different because at short term unemployment increases more in region 1 and employment and output increases in region 2 while decreases in region 1. Hence output in the region without any shock increases due to the positive effect of migration. At short term when the shock occurs, there is a disequilibrium in the economy as unemployment grows in region 2. In order to compensate, there are more vacancies, more production and the wages will not decrease as much as that in region 1. At long term both regions are equal.

Comparing unemployment rates with the case of no regional migration. Unemployment growth increases 5.6% more in an economy without migration than in an economy with migration. At country level the unemployment rate for the case of no migration is 21.62% and for the mobility case is 20.18%. Other important result is as the shock is shared in the economy. In the fist case, the region affected by the shock faces all effects alone. However, when there exists mobility without restrictions the shock is share for both regions.

The wage setting is analysed in literature of migration. The relationship between unemployment and wages is also studied. Harris and Todaro (1970) find a positive correlation between wages and unemployment. By contrast, Blanchflower and Oswald (1994) find a negative relationship between wages and unemployment. Our contribution to this field is to combine an analysis with migration in a dynamic equilibrium model and a Nash bargaining process. The model has an explicit dynamic of the labour force with endogenous probabilities to find a job.

Domingues Dos Santos (1998) and Ortega (2000) also introduce migration and determine wages in Nash bargain process. However, both studies have exogenous probabilities of finding a job. The former concludes that the wage rule is the same with or without migrations, the wage is determined by a trade union and the firm. The wage bargained depends on the differences between the expected values of individuals given that if negotiation fails the wage will be constant along time and proportional to the negotiation power of workers. In Ortega’s paper is entirely done in steady state. Both papers find a negative relationship between wages and unemployment rate.

In the study of Chéron (1999), in a similar framework to our model, the wages are exogenously determined. After the advertisement of vacancies, the firm determines the wages, constrained to the employees on the labour market. He finds a short term a positive relationship between wages and unemployment rate.

In our model, the wages depend on a share mechanism between the agents where the worker’s bargaining power \( \xi \). Wages depend positively on the worker’s bargaining power. The worker gets a larger part of the surplus when \( \xi \) is larger. In Pissarides’model when wages are determined by Nash bargain mechanism is

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As Ortega (2000), we find that mobility leads to an increase in vacancies in region which receives migration.
Changes in $\xi$

<table>
<thead>
<tr>
<th>Changes in $\xi$</th>
<th>$UR$</th>
</tr>
</thead>
<tbody>
<tr>
<td>case 1: $\xi = 0.2$</td>
<td>no mob</td>
</tr>
<tr>
<td>no mob</td>
<td>43%</td>
</tr>
<tr>
<td>inter-mob</td>
<td>9.21%</td>
</tr>
<tr>
<td>case 2: $\xi = 0.5$</td>
<td>no mob</td>
</tr>
<tr>
<td>no mob</td>
<td>3.73%</td>
</tr>
<tr>
<td>inter-mob</td>
<td>9.21%</td>
</tr>
<tr>
<td>case 3: $\xi = 0.7$</td>
<td>no mob</td>
</tr>
<tr>
<td>no mob</td>
<td>3.73%</td>
</tr>
<tr>
<td>inter-mob</td>
<td>9.21%</td>
</tr>
</tbody>
</table>

Table 3: Growth of unemployment to changes in $\xi$ (%)

that wages do depend not only on marginal productivity of employment as in neoclassical models, but also positively on the discounted valued of filling a job and the labour market tightness. When there is a negative shock in a region, every value decreases. In our model, adjustments come from the wages dynamic, through endogenous probabilities of finding a job.

We can differentiate when workers have a weak position or not in the share of the part of surplus. Until now, we have supposed that $\xi = 0.5$. We can compare to results when $\xi = 0.2$ and when $\xi = 0.7$.

In table 3, we show that the growth of the unemployment rates after a negative shock is greater when worker’s bargaining power is weaker. In the case where workers have more power of negotiation, unemployment growth decreases more than when workers have a weak position.

Comparing no mobility scenario with mobility one, we observe that unemployment rates growth is larger in the case of no mobility and this difference increases when the values of $\xi$ is lower.

Contrary to Harris and Todaro (1970) and Chéron (1999), we find a negative relationship both at short and long term between unemployment and wages. As other studies (see Blanchflower and Oswald (1994)).

5 Conclusion

This paper aims at studying the interaction between unemployment and inter-regional mobility in a country against asymmetric shocks. We build a model with inter-regional migration of the labour force with matching model in a framework of dynamic equilibrium. Individuals measures this present discounted values face to their different job opportunities in different regions. Wage setting mechanism is determined with a Nash bargaining criterium. We compare the case of an economy characterised by low mobility and unemployment persistence as the case of Spain and we compare this case when we allows workers to move.

When mobility of the labour force is allowed, asymmetric shocks have effects in both regions. With a permanent negative shock, unemployment rates of both regions increase. When we compare an economy with and without migration, unemployment growth is higher when workers cannot migrate. But there exists an important adjustment that both regions must support at a short-term.
Therefore, the mobility effect is instabilities at short-term while that both regions share the shock at long-term.

We show that the unemployment rate growth is larger when the negotiation power of worker is lower and that these differences are higher in the case of no mobility than when there is inter-regional mobility. We also find negative correlation between wages and unemployment.

We conclude that inter-regional mobility is an alternative or/and a complement to other policies. Since regions share the effect of the asymmetric shocks through the migration and then, the unemployment.

Further research at theoretical level is to consider heterogeneous workers in terms of skill, as Gil and Jimeno (1993). Pissarides and Wadsworth (1989) examine the relation between unemployment and the inter-regional migration of labour.
6 Appendix

6.1 Appendix A.1: The firm.

The firm maximizes the value function taking into account their discounted future profits, with $0 < \beta < 1$:

$$ T^F(n_{i,j,t}) = \max \{ \Pi_{i,j,t} + \beta T^F(n_{i,j,t+1}) \} \tag{25} $$

where the maximization is constrained by

$$ \Pi_{i,j,t} = (a_t + r_{i,j,t})n_{i,j,t}^\alpha - w_{j,t}n_{i,j,t} - \omega_j v_{i,j,t} \tag{26} $$

$$ n_{i,j,t+1} = q_{i,j,t}v_{i,j,t} + (1 - s_j)n_{i,j,t} \tag{27} $$

where equation (26) the present profit flow of the firm, which depends on the production function minus the real wage times the employment in region $j$, and minus the cost of having vacancies times vacancies. The other constraint is equation (27), the evolution of employment. $X^n_{i,j,t}$ the Lagrange multiplier associated to the budget constraint. The problem stated as a Lagragian is

$$ \mathcal{L} = \left( (a_t + r_{i,j,t})n_{i,j,t}^\alpha - w_{j,t}n_{i,j,t} - \omega_j v_{i,j,t} + \beta E_t T^F(n_{i,j,t+1}) \right) + X^n_{i,j,t} [q_{i,j,t}v_{i,j,t} + (1 - s_j)n_{i,j,t} - n_{i,j,t+1}] $$

The first order condition of this optimization with respect to $v_{i,j,t}$, implies

$$ X^n_{i,j,t} = \frac{\omega_j}{q_{j,t}} \tag{28} $$

The firm will post a vacancy when the left part of equation (28), the marginal revenue from filling a vacant job in the region $j$ is equal to the marginal cost to post a vacancy. The marginal value of the employment for the firm is given by the envelope theorem:

$$ \frac{\partial T^F(n_{i,j,t})}{\partial n_{i,j,t}} = \alpha(a_t + r_{i,j,t})n_{i,j,t}^{\alpha-1} - w_{j,t} + (1 - s_j)X^n_{i,j,t} \tag{29} $$

Both envelope condition and the first order condition yield Euler equation related to employment:

$$ X^n_{i,j,t} = \beta \frac{\partial T^F(n_{i,j,t+1})}{\partial n_{i,j,t+1}} \tag{30} $$

6.2 Appendix A.2: Wage determination

Both parts take into account their net marginal values when negotiate. The net marginal value of employment for a worker may be expressed as:
\[ \Upsilon^W_{j,t} = V^E_{j,t} - V^U_{j,t}. \]  

(31)

The net marginal value of current employment for a representative firm is\(^9\)

\[ \Upsilon^F_n(n_{j,t}) = \alpha(a_t + r_{j,t})n^{a-1}_{j,t} - w_{j,t} + (1 - s_j)\beta E_t \Upsilon^F_n(n_{j,t+1}). \]  

(32)

Let \(0 < \xi < 1\) denotes the bargaining power of the worker. The Nash bargaining criterion maximizes over wages their net marginal values:

\[ \max_{w_j} \left\{ \left( \Upsilon^F_n(n_{j,t}) \right)^{1-\xi} \left( \Upsilon^W_{j,t} \right)^{\xi} \right\}, \]

(33)

where the first order condition states that:

\[ \Upsilon^F_n(n_{j,t}) = \frac{1 - \xi}{\xi} \Upsilon^W_{j,t}. \]  

(34)

We substitute (31) in equation (34) to obtain:

\[ \xi \Upsilon^F_n(n_{j,t}) = (1 - \xi) \left[ V^E_{j,t} - V^U_{j,t} \right]. \]  

(35)

If we replace by the values of \(V^E_{j,t}\) and \(V^U_{j,t}\) from equations 10 and 11, considering the workers’ non-arbitrage condition implies \(V^U_t = V^U_{t+1}\), \(V^E_t = V^E_{t+1}\), \(\forall t\), we have the following expression:

\[ \xi \Upsilon^F_n(n_{j,t}) = (1 - \xi) \left[ w_{j,t} - b_{j,t} + \beta E_t \left( 1 - s_j - p_{j,t} \right) \left( V^E_{j,t+1} - V^U_{t+1} \right) \right]. \]  

(36)

Rearranging, we get

\[ \Upsilon^F_n(n_{j,t}) = \frac{1 - \xi}{\xi} (w_{j,t} - b_{j,t}) + (1 - s_j - p_{j,t})\beta E_t \Upsilon^F_n(n_{j,t+1}). \]  

(37)

As we know from equation (30), \(X^u_{j,t} = \beta \Upsilon^F_n(n_{j,t+1})\), we can rewrite the equation above as:

\[ \Upsilon^F_n(n_{j,t}) = \frac{1 - \xi}{\xi} (w_{j,t} - b_{j,t}) + (1 - s_j - p_{j,t})X^u_{j,t}. \]  

(38)

Sustituying the value of \( \Upsilon^F_n(n_{j,t}) \) from equation (32) and rearranging, we have the wage evolution equation:

\[ w_{j,t} = \xi \left[ \alpha(a_t + r_{j,t})n^{a-1}_{j,t} + p_{j,t}X^u_{j,t} \right] + (1 - \xi) b_{j,t}. \]  

(39)

\(^9\)Recall \( \Upsilon^F_n(n_{j,t}) = \frac{\partial \Upsilon^F_n(n_{j,t+1})}{\partial n_{j,t+1}} \).
6.3 Appendix A.3: Mobility

The adjustment of the mobility will happen when the present value of an unemployed in region 1 is equal to the present value of an unemployed in region 2:

\[ V_{1,t}^U = V_{2,t}^U. \] (40)

After solving it we obtain from equation 11,

\[ b_{1,t} - b_{2,t} = \beta E_t \left[ p_{2,t} \left[ V_{2,t+1}^W \right] - p_{1,t} \left[ V_{1,t+1}^W \right] + \left[ V_{2,t+1}^U - V_{1,t+1}^U \right] \right]. \] (41)

Considering the non-arbitrage condition \( E_t V_{2,t+1}^U = E_t V_{1,t+1}^U \), the last term disappears. Then, we substitute the first order condition of the Nash program, equation (16), in the expression \( V_{j,t+1}^E - V_{j,t+1}^U \). Taking into account that the first order condition of the firm \( \beta \tilde{T}_n^F(S_{j,t+1}) = \tilde{X}_{j,t}^n \), we obtain the net value of migrating for an unemployed person to move from region 1 to region 2 is given by the following expression:

\[ b_{1,t} - b_{2,t} = \frac{\xi}{1 - \xi} \left\{ p_{2,t} X_{2,1,t}^n - p_{1,t} X_{1,1,t}^n \right\} \] (42)

by the fist order condition of the firm \( X_{n,j,t}^n = \omega_{j,t} q_{j,t} \), we substitute above and we get

\[ b_{1,t} - b_{2,t} = \frac{\xi}{1 - \xi} \left\{ p_{2,t} \frac{\omega_2}{q_{2,t}} - p_{1,t} \frac{\omega_1}{q_{1,t}} \right\}. \] (43)

From the definition of \( q_{j,t} \), we substitute

\[ \frac{\omega_j}{q_{j,t}} = \frac{\omega_j v_{j,t}}{p_{j,t}(\ell_{j,t} - n_{j,t})} \] (44)

in expression (43), to determine labour force in region 1:

\[ \ell_{1,t} = n_{1,t} + \frac{\omega_{1} v_{1,t}}{\frac{1 - \xi}{\xi} (b_{2,t} - b_{1,t}) + p_{2,t} X_{2,1,t}^n}. \] (45)

References


