Labour Market Reforms and Unemployment Dynamics*

Fabrice Murtin† Jean-Marc Robin‡

Abstract

In this paper, we quantify the contribution of labour market reforms to unemployment dynamics in nine OECD countries (Australia, France, Germany, Japan, Portugal, Spain, Sweden, the United Kingdom and the United States). We build and estimate a dynamic stochastic search-matching model with heterogeneous workers, where aggregate shocks to productivity fuel up the cycle, and unanticipated policy interventions displace the stationary stochastic equilibrium by shifting structural turnover parameters. We show that the heterogeneous-worker mechanism proposed by Robin (2011) to explain unemployment volatility by productivity shocks works well in all countries. The volume of resources devoted to placement and employment services and the

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†OECD

‡Science-Po and University College London

degree of product market regulation are found to be the most prominent determinants of the rate of unemployment.

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1 Introduction

A large number of economic studies have been devoted to the question of how labour markets respond to economic policy in a changing environment. Thus, comparative studies of European and American labour markets usually search the source of long-term European unemployment in different labour market institutions. Beginning with Bruno and Sachs (1985), economic research initially consisted in running pooled cross-section and time-series regressions of unemployment on various macroeconomic indicators (like GDP growth) and many labour market institutional indices for a large number of OECD countries (see Layard and Nickell, 1999, for a survey). This approach culminated in the work of Blanchard and Wolfers (2000) and Bertola, Blau and Khan (2007) who showed that different policy mix induce different responses of unemployment to world-wide shocks (like an oil shock) and country-specific productivity shocks, while Bassanini and Duval (2009) examine and demonstrate the existence of complementarity effects between labour market policies. In parallel, in order to understand the mechanisms of these interactions, an active research area spawned a collection of small dynamic stochastic equilibrium models focussing on one particular labour market policy at a time. For example, the influential work of Ljungqvist and Sargent (1998) emphasizes the link between long-term unemployment and welfare policies, while Prescott (2004) and Rogerson (2008) highlight the role of labour taxes.

In this paper we explore an intermediate path. We will try to incorporate the rich reduced forms of the former approach into a small equilibrium model of the latter kind. The idea is to identify a small set of parameters of the dynamic equilibrium model governing the response to aggregate shocks of unemployment and turnover, and channelling a wide range of labour market policies at the same time. The number of institutions may be large but the number of parameters through which they impact the economy should be kept small. The intuition behind this assertion is that the number of intervention channels should not be larger than the number of independent series used in the analysis. Specifically, if we use series of unemployment stocks and flows and vacancies as labour market variables, we argue that it will be difficult to identify more than three separate channels for policy intervention.[1]

The model used in this paper is a dynamic stochastic search-matching model with heterogeneous workers, where aggregate shocks to productivity fuel up the cycle, and unanticipated policy interventions displace the stationary stochastic equilibrium by shifting structural turnover parameters. It is estimated for 9 different countries (Australia, France, Germany, Japan, Portugal, Spain, Sweden, the United Kingdom and the United States) over the period 1985-2007. The estimation procedure is in two steps: First, a steady-state version without policy effects is estimated on detrended series by the Simulated Method of Moments. Aggregate shocks are filtered out by minimising the sum of squared differences between actual and simulated aggregate output series. Second, policy effects are estimated by minimising the sum of squared residual errors for the series of the **actual** (i.e. trend plus cycle)unemployment rate, its turnover components and job vacancies.

Our model belongs in the search-matching tradition (Pissarides, 1990, Mortensen and Pissarides, henceforth MP, 1994) but yet is immune to Shimer's (2005) critique.[2] Shimer showed that in the MP model Nash bargaining converts most of the cyclical volatility of aggregate productivity into wage volatility, leaving very little volatility to the key variable driving unemployment, namely market tightness. Our model builds on Robin (2011) who offers a simple solution to Shimer's puzzle. The model has two main ingredients that make it distinct from the MP model. First, workers differ in ability.[3] In good states of the economy, all matches are profitable and all workers are thus employable. In bad states, low-skill workers fail to generate positive surplus and are thus laid off or stay unemployed longer. With a thick left tail of the ability distribution, small adverse aggregate shocks to the economy lead a disproportionately high

[1]The change in unemployment is the difference between the inflow and the outflow. So stocks and flows are not independent series.

[2]Shimer's paper gave rise to a large literature. See e.g. Hagedorn and Manovskii (2008), Hall and Milgrom (2008), Gertler and Trigari (2009).

[3]Lise and Robin (2012) also allow firms to differ in technology.

number of low-skill workers into the negative surplus region and into unemployment. We show that this amplification mechanism fits unemployment volatility well in all nine major OECD countries used in the empirical analysis.

Second, following Postel-Vinay and Robin (2002), we assume that wage contracts are long term contracts that are renegotiated by mutual agreement only. Wage renegotiation is either induced by on-the-job search and Bertrand competition between employers, or by aggregate shocks big enough to threaten match disruption. As a consequence, wages in new jobs are more volatile than ongoing wages—an empirical fact that was recently emphasized by Pissarides (2009), which he viewed as a reason for not believing in the sticky-wage explanation for large unemployment volatility (Hall, 2005).

We assess the impact of labour market reforms on actual (i.e. not detrended) rates of unemployment. To this end, we simulate the reaction of steady-state unemployment to a one-standard-deviation change in policy settings. We find large, significant effects for active labour market policies—especially those affecting the amount of resources devoted to placement and employment services and to training—and product market (de)regulation. Interventions on the replacement rate of unemployment benefits, the amount of public resources devoted to employment incentives, the degree of employment protection and the tax wedge have negligible effects on unemployment.

The paper is organized as follows. In Section 2, a dynamic sequential-auction model with heterogeneous workers and identical firms is developed. Section 3 describes the data and Section 4 the estimation procedure. In Section 5, the model is estimated to account for cyclical unemployment in six OECD countries. In Section 6, labour market policy effects are estimated using the actual, observed, quarterly series of the rate of unemployment for each of the nine OECD countries. Section 7 examines transitory short-term dynamics. The last section concludes.

2 The model

The model extends Robin's (2011) by endogenising labour demand through a matching function and vacancy creation. We here proceed to a brief description.

2.1 Timing, aggregate shocks and individual heterogeneity

Time is discrete and indexed by $t \in \mathbb{N}$. The global state of the economy is an ergodic Markov chain $y_t \in \{y_1 < ... < y_N\}$ with transition matrix $\mathbf{\Pi} = (\pi_{ij})$. We use y_t to denote the random variable and y_i or y_j to denote one of the N possible realisations. There are M types of workers and ℓ_m workers of each type, with $\ell_1 + ... + \ell_M = 1$. Workers of type m have ability x_m, with $x_m < x_{m+1}$. All firms are identical. Workers and firm are paired into productive units. The per-period output of a worker of ability x_m when aggregate productivity is y_i is denoted as $y_i(m)$.

We let $S_t(m)$ denote the surplus of a match with a worker of type x_m at time t, that is, the present value of the match minus the value of unemployment and minus the value of a vacancy (assumed to be nil). Only matches with positive surplus $S_t(m) \geq 0$ are viable.

2.2 Turnover and unemployment

Matches form and break at the beginning of each period. Let $u_t(m)$ denote the proportion of unemployed in the population of workers of ability x_m at the end of period $t-1$, or at the beginning of period t, just before revelation of the aggregate shock for period t, and let $u_t = u_t(1)\ell_1 + ... + u_t(M)\ell_M$ define the aggregate unemployment rate.

The moment y_t is realised a fraction $\mathbf{1}\{S_t(m) < 0\}[1 - u_t(m)]\ell_m$ of employed workers is laid off because the match surplus becomes negative, and another fraction $\delta\mathbf{1}\{S_t(m) \geq 0\}[1 - u_t(m)]\ell_m$ is destroyed for unspecified reason. In addition, a fraction $\lambda_t\mathbf{1}\{S_t(m) \geq 0\}u_t(m)\ell_m$ of employable unemployed workers meet with a vacancy. Finally, we also allow employees to meet with alternative employers, and move or negotiate wage increases (more on this later).

Aggregate shocks thus determine unemployment by conditioning job destruction and the duration of unemployment. The law of motion for individual-specific unemployment rates is

$$\begin{aligned} u_{t+1}(m) &= 1 - [(1-\delta)(1-u_t(m)) + \lambda_t u_t(m)]\mathbf{1}\{S_t(m) \geq 0\} \\ &= \begin{cases} 1 & \text{if } S_t(m) < 0, \\ u_t(m) + \delta(1-u_t(m)) - \lambda_t u_t(m) & \text{if } S_t(m) \geq 0. \end{cases} \end{aligned}$$

The dynamics of unemployment by worker type depends on the dynamics of the whole match surplus, not on how the surplus is split between the employer and the worker.

Define the exit rate from unemployment (or job finding rate) as the product of the meeting rate and the share of employable unemployed workers,

$$f_t = \lambda_t \frac{\sum_m u_t(m)\ell_m \mathbf{1}\{S_t(m) \geq 0\}}{u_t}. \tag{1}$$

Define the job destruction rate as the sum of the exogenous and the endogenous layoff rates,

$$s_t = \delta + (1-\delta)\frac{\sum_m (1-u_t(m))\ell_m \mathbf{1}\{S_t(m) < 0\}}{1-u_t}. \tag{2}$$

Aggregate unemployment then satisfies the usual recursion

$$u_{t+1} = u_t + s_t(1-u_t) - f_t u_t.$$

It is important to stress here that both the job finding rate f_t and the job destruction rate s_t mix structural parameters (in λ_t and δ) with endogenous variables: the share of employable unemployed workers ($\frac{\sum_m \mathbf{1}\{S_t(m)\geq 0\}u_t(m)\ell_m}{u_t}$) and the share of unemployable employed workers ($\frac{\sum_m \mathbf{1}\{S_t(m)<0\}(1-u_t(m))\ell_m}{1-u_t}$). For that reason, standard least-squares estimates of matching functions or layoff rates will not provide consistent estimators. A structural estimation is required.

2.3 Rent sharing

We assume that employers have full monopsony power with respect to unemployed workers. They keep the whole surplus in this case and unemployed workers leave unemployment with a wage that is only marginally greater than their reservation wage.

Employed workers search on the job. When they meet an employed worker, we assume that Bertrand competition between the two identical firms transfers the entire surplus to the worker, leaving nothing to employers, whether incumbent or poacher.

Note that we could easily allow for Nash bargaining between unemployed workers and firms. Bertrand competition between incumbent and poacher is the main simplifying assumption.

2.4 Vacancy creation and market tightness

Firms posts vacancies v_t until ex ante profits are exhausted. The total vacancy cost is cv_t. Vacancies can either meet with an unemployed worker or with an employed worker. However, only the meetings with unemployed workers generate a rent to the firm. Free entry then ensures that

$$cv_t = \lambda_t \sum_{m=1}^{M} u_t(m)\ell_m S_t(m)^+, \tag{3}$$

where we denote $x^+ = \max(x, 0)$.

Define market tightness as the ratio of vacancies and workers' aggregate search intensity:

$$\theta_t = \frac{v_t}{u_t + k(1 - u_t)}, \tag{4}$$

where k is the relative search intensity of employees with respect to unemployed.[4] The meeting rate λ_t is related to market tightness via the meeting function: $\lambda_t = f(\theta_t)$, where f is an increasing function.

2.5 The value of unemployment and the match surplus

Let $U_i(m)$ denote the present value of remaining unemployed for the rest of period t for a worker of type m if the economy is in state i. It solves the following linear

[4]We use $k = 0.12$ as in Robin (2011) but imposing a zero search intensity for employees has little influence on the estimation outcome.

Bellman equation:

$$U_i(m) = z_i(m) + \frac{1}{1+r}\sum_j \pi_{ij} U_j(m). \tag{5}$$

This equation is understood as follows. An unemployed worker receives a flow-payment $z_i(m)$ for the period. At the beginning of the next period, the state of the economy changes to y_j with probability π_{ij} and the worker receives a job offer with some probability. We assume that employers offer unemployed workers their reservation wage on a take-it-or-leave basis, thus taking the whole surplus. As a consequence, the present value of a new job to the worker is only marginally better than the value of unemployment. Hence, the continuation value is the value of unemployment in the new state j whether the workers stays unemployed or not.

Let us now turn to the surplus value. After a productivity shock from i to j all matches yielding negative surplus are destroyed. Then, either on-the-job search is vain, and the match surplus only changes because the macroeconomic environment changes; or the worker is poached and Bertrand competition gives the whole match surplus to the worker, whether she moves or not. As everything that the worker and the firm expect to earn in the future contributes to the definition of the current surplus, the surplus of a match with a worker of type m when the economy is in state i thus solves the following (almost linear) Bellman equation:

$$S_i(m) = y_i(m) - z_i(m) + \frac{1-\delta}{1+r}\sum_j \pi_{ij} S_j(m)^+. \tag{6}$$

This almost-linear system of equations can be solved numerically by value function iteration. As for the unemployment value, the match surplus only depends on the state of the economy.

2.6 Steady-state equilibrium

If the economy stays in state i for ever,

- the equilibrium unemployment rate for group m is

$$u_i(m) = \frac{\delta}{\delta+\lambda_i}\mathbf{1}\{S_i(m) \geq 0\} + \mathbf{1}\{S_i(m) < 0\} = 1 - \frac{\lambda_i}{\delta+\lambda_i}\mathbf{1}\{S_i(m) \geq 0\},$$

where $\lambda_i \equiv f(\theta_i)$;

- the aggregate unemployment rate is

$$u_i = \sum_{m=1}^{M} u_i(m)\ell_m = 1 - \frac{\lambda_i}{\delta + \lambda_i} L_i,$$

where $L_i = \sum_{m=1}^{M} \ell_m \mathbf{1}\{S_i(m) \geq 0\}$ is the number of employable workers;

- the free entry condition takes the following form:

$$c\theta_i = \lambda_i \sum_{m=1}^{M} \frac{u_i(m)\ell_m}{u_i + k(1-u_i)} S_i(m)^+ = \frac{\delta\lambda_i}{\delta + [1 - L_i + k(1-\delta)L_i]\lambda_i} \overline{S}_i^+,$$

with $\overline{S}_i^+ = \sum_{m=1}^{M} \ell_m S_i(m)^+$ being the aggregate surplus value. Therefore, the exit rate from unemployment is the following fixed point:

$$\lambda_i = f\left(\frac{\delta\lambda_i}{\delta + [1 - L_i + k(1-\delta)L_i]\lambda_i} \frac{\overline{S}_i^+}{c} \right).$$

2.7 Parametrisation and functional forms

This section describes the functional forms that will be used in the estimation.

Unemployment exit rate and the matching function. The meeting rate, and hence the unemployment exit rate, are related to market tightness θ_t via a Cobb-Douglas matching technology:

$$\lambda_t = f(\theta) = \phi\theta^\eta. \tag{7}$$

A standard cross-country OLS-regression of job finding rates on market tightness (simply defined as v/u) delivers parameter estimates $\phi = 0.712$ and $\eta = 0.289$, in tune with the empirical literature (e.g. Murtin and de Serres, 2012).

Aggregate shocks. We assume that aggregate log-productivity follows a Gaussian AR(1) process:

$$\ln y_t = \rho \ln y_{t-1} + \sigma\varepsilon_t, \tag{8}$$

where innovations are iid-normal $N(0,1)$. This simple specification happened to yield a very good fit of total output.

Note that the aggregate productivity shock y_t is a latent process that does not a priori coincide with observed output or output per worker. Indeed, observed output is the aggregation of match output $y_t(m)$ across all active matches, say

$$Y_t = \sum_m (1 - u_t(m))\ell_m y_t(m), \tag{9}$$

and is thus endogenous. Therefore, the structural parameters (ρ, σ) cannot be directly inferred from the observed series of cyclical output per person.

We discretise the aggregate productivity process y_t as follows. Let F denote the estimated equilibrium distribution of y_t.[5] The joint distribution of two consecutive ranks $F(y_t)$ and $F(y_{t+1})$ is a copula C (i.e. the cdf of the distribution of two random variables with uniform margins). To discretise the aggregate productivity processes we first specify a grid $a_1 < ... < a_N$ on $[\epsilon, 1-\epsilon] \subset (0,1)$ of N linearly spaced points including end points ϵ and $1-\epsilon$. Then we set $y_i = F^{-1}(a_i)$ and $\pi_{ij} \propto c(a_i; a_j)$, where c denotes the copula density and we impose the normalisation $\sum_j \pi_{ij} = 1$. In practice, we use $N = 150$, $\epsilon = 0,002$; F is a log-normal CDF and c is a Gaussian copula density, as implied by the Gaussian AR(1) specification.

Worker heterogeneity. Match productivity is specified as $y_i(m) = y_i x_m$, where $(x_m, m = 1, ..., M)$ is a grid of M linearly spaced points on the interval $[C, C+1]$. The choice of the support does not matter much provided that it is large enough and contains one. A beta distribution is assumed for the ability distribution, namely

$$\ell_m \propto \text{betapdf}\left(x_m, \mu, \nu\right), \tag{10}$$

with the normalisation $\sum_m \ell_m = 1$. The beta distribution allows for a variety of shapes for the density (increasing, decreasing, non monotone, concave or convex). We use a very dense grid of $M = 500$ points to guarantee a good resolution in the left tail.

[5] That is, with white-noise innovations, $\ln y_t \sim N\left(0, \frac{\sigma^2}{1-\rho^2}\right)$.

Leisure and vacancy costs. The opportunity cost of employment $z_i(m)$ (aggregating the utility of leisure, unemployment insurance and welfare) is specified as a constant z^0.

Labour market institutions. Because of the feed-back effects implied by the model, it is important for identification that we restrict the channels of policy interventions. For example, any policy that directly impacts matching efficiency (ϕ) immediately changes the meeting rate (λ_t) and, subsequently, the number of created vacancies (v_t) via the free entry condition. Both effects contribute to change the job finding rate (f_t). If one makes the cost of posting a vacancy (c) another intervention channel for this policy, there will be two competing ways for this policy to change vacancies, which will be difficult to separately identify.

Because we only have independent data information on turnover flows (f_t and s_t) and vacancies (v_t) we decided to introduce labour market institutions through only three structural parameters, which look like the most direct intervention channels for f_t, s_t and v_t: matching efficiency, ϕ (via equation (1)), the job destruction rate, δ (equation (2)), and the cost of posting a vacancy, c (equation (3)).

Formally, we let parameters ϕ, δ and c in country n at time t be log-linear indices of country-specific institutional variables $X_{nt}^1, ..., X_{nt}^K$. Specifically,

$$\phi_{nt} = \phi_n^0 \exp\left(\sum_k \phi^k X_{nt}^k\right), \tag{11}$$

$$\delta_{nt} = \delta_n^0 \exp\left(\sum_k \delta^k X_{nt}^k\right). \tag{12}$$

$$c_{nt} = c_n^0 \exp\left(\sum_k c^k X_{nt}^k\right). \tag{13}$$

In the above equations, the LMP semi-elasticities (ϕ^k, δ^k, c^k) are common to all countries. However, intercepts $(\phi_n^0, \delta_n^0, c_n^0)$ are country-specific. This framework thus identifies institutional effects from policy *change*.

For each parameter, we further impose exclusion restrictions based on economic reasoning and available empirical evidence. The exact conditioning structure will be detailed in the next section after listing the policy variables contained in the data.

Table 1: Unemployment and Turnover Cycle - Descriptive Statistics

	Period	Unemployment			Job Destruction Rate			Job Finding Rate		
		mean	std		mean	std		mean	std	
			trend	cycle		trend	cycle		trend	cycle
Australia	1979Q1-2009Q4	5.69	1.19	1.10	3.78	0.36	5.69	47.74	6.62	5.69
France	1976Q1-2010Q1	6.18	1.58	0.77	2.41	0.43	2.78	22.59	3.64	2.78
Germany	1984Q1-2010Q1	6.09	1.27	1.06	1.81	0.06	2.71	18.71	0.88	2.71
Japan	1978Q1-2007Q4	2.65	0.92	0.49	1.51	0.27	4.83	42.78	4.21	4.83
Portugal	1987Q1-2010Q2	5.70	0.84	1.22	1.45	0.20	3.55	20.58	0.99	3.55
Spain	1978Q1-2010Q2	12.76	1.94	2.78	3.88	0.73	5.55	21.67	8.04	5.55
Sweden	1972Q1-2010Q1	4.81	2.20	1.85	2.84	0.75	6.31	56.06	10.14	6.31
UK	1967Q2-2010Q1	6.25	1.86	1.29	3.06	0.48	5.35	43.87	15.22	5.35
US	1960Q1-2010Q2	5.95	0.75	1.14	4.82	0.68	5.21	76.59	6.03	5.21

Note: All figures are in percent. Series were detrended using the HP-filter with smoothing parameter 10^5.

3 The data

This section describes the data assembled for nine OECD countries (Australia, France, Germany, Japan, Portugal, Spain, Sweden, United Kingdom and Unites States).

3.1 Unemployment and turnover cycle

Table 1 provides descriptive statistics on the rate of unemployment as well as the probability of entering and exiting unemployment. All series are quarterly. These variables come from a collection of data sources that are described in detail in the companion appendix (Appendix A). The trend and cyclical components were extracted by HP-filtering with a smoothing parameter equal to 10^5, as in Shimer (2005).

The volatility of unemployment and turnover are very different across countries. Japan displays lower and less volatile unemployment, due to lower job destruction rates, than any other country. The US exhibit more turnover and higher exit rates from unemployment. France, and Japan to a lesser extent, display particularly low cyclical volatility in unemployment turnover.

Interesting patterns emerge from trends (Figure 1). Unemployment culminates in the 1980s in the UK and the US, and in the 1990s in Australia, France, Spain and Sweden. Japan displays a monotonic, increasing trend throughout the 1960-2010 period. Unemployment rebounds in the early 2000s in Portugal and the US.

Long-term unemployment trends hide strikingly different trends in turnover rates. Job destruction rates tend to increase in France, Japan, Portugal, Spain and Sweden, and to decrease in Australia, the UK and the US since the mid-1980s. Job-finding rates tend to increase in Australia, France and Spain, and to decrease in Japan, Sweden, the UK and the US.

These patterns are potentially associated with important labour market reforms that we now briefly discuss.

3.2 Labour market policies

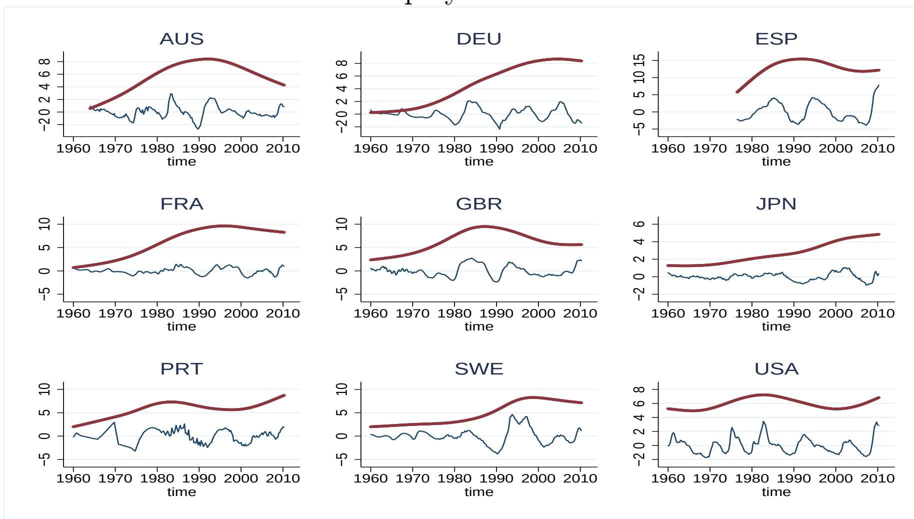
The set of labour market policy variables (LMPs) used as potential determinants of unemployment stocks and flows in the empirical analysis are the following:[6] i) the replacement rate used to calculate unemployment benefits at first date of reception; ii) public expenditure on active labour market policies per unemployed worker (denoted as ALMPs) normalised by GDP per worker, and broken down into three sub-categories (placement and employment services, employment incentives[7] and training); iii) the OECD index of product market regulation; iv) the OECD index of employment protection for regular contracts; v) the tax wedge (personal income tax plus payroll taxes and social security contributions). The construction of these variables and data sources are detailed in Appendix A.

Table 2 displays the mean and the standard deviation of all policy variables be-

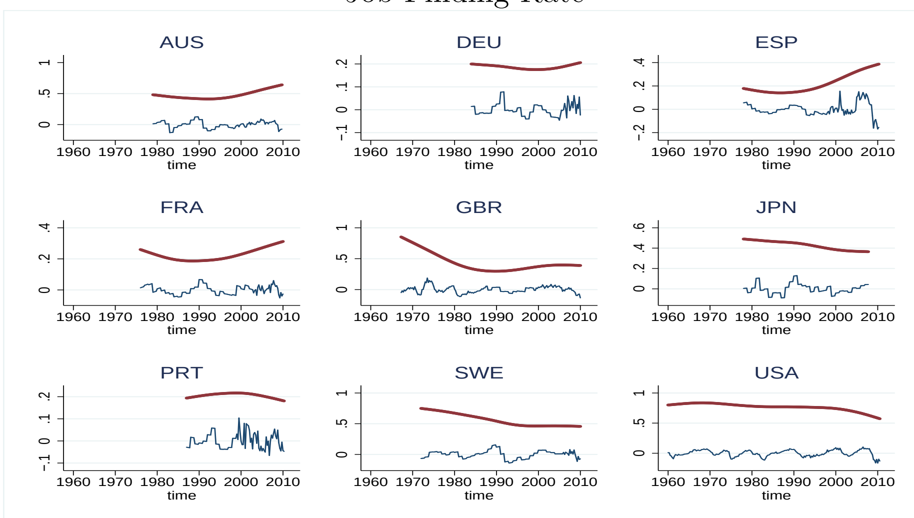
[6]Other institutions have been empirically tested, such as the minimum wage and some characteristics of the wage bargaining process, and proved to be non-significant in most cases.

[7]These expenditures include incentives to private employment, direct job creation, job sharing and start-up incentives.

Unemployment Rate



Job Finding Rate



Job Destruction Rate

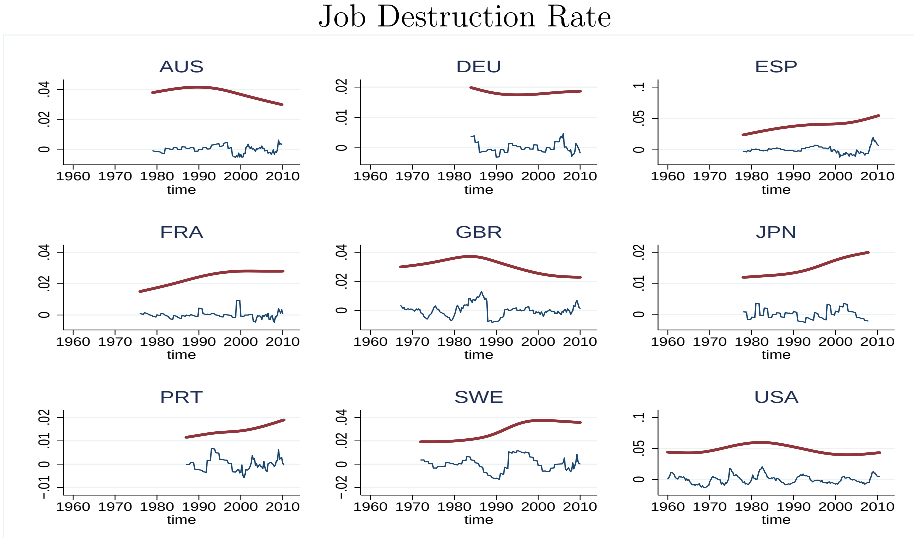


Figure 1: Unemployment Rate and Turnover - Trend and Cycle

Table 2: Labour Market Institutions - 1985-2007

	Initial Replacement Rate (RR)		Placement and Employment Services (PES)		Training		Employment Incentives		Product Market Regulation (PMR)		Employment Protection Regular Contract (EPR)		Tax Wedge	
	mean	std	mean	std	mean	std	mean	std	mean	std	mean	std	mean	std
Australia	24.0	1.9	0.025	0.009	0.006	0.005	0.024	0.005	3.02	1.03	1.26	0.25	27.3	2.8
France	59.5	1.2	0.020	0.004	0.039	0.004	0.048	0.015	4.04	1.05	2.39	0.06	41.7	1.0
Germany	38.0	1.3	0.031	0.004	0.055	0.017	0.056	0.015	3.43	1.52	2.70	0.15	35.4	2.2
Japan	32.1	4.8	0.067	0.031	0.010	0.002	0.007	0.002	3.76	1.06	1.87	0.00	20.2	4.4
Portugal	65.8	2.3	0.022	0.004	0.038	0.009	0.038	0.009	4.03	1.09	4.42	0.27	27.0	2.1
Spain	67.9	5.7	0.008	0.003	0.013	0.004	0.032	0.012	3.94	1.24	3.10	0.64	29.7	1.8
Sweden	81.7	5.3	0.051	0.025	0.121	0.075	0.201	0.112	3.68	1.14	2.87	0.02	50.1	4.7
United Kingdom	21.2	2.8	0.035	0.018	0.018	0.014	0.009	0.007	2.29	1.27	1.01	0.08	29.3	1.7
United States	28.1	3.3	0.008	0.001	0.013	0.003	0.008	0.000	2.56	0.58	0.17	0.00	21.6	3.1
Average	46.5	3.2	0.030	0.011	0.035	0.015	0.047	0.020	3.4	1.1	2.2	0.2	31.4	2.6

tween 1985 and 2007 (the period over which we have gathered a balanced sample of institutional variables). France, Portugal, Spain and Sweden offer relatively high support to the unemployed and high employment protection at the same time, whereas the US, the UK, Australia and Canada are on the low side. Germany and Japan are somewhere in-between. Note that some institutions show no change in the period (such as employment protection in the United States). The associated policy effects cannot be identified in this case.

As already emphasized, it is important for identification to keep the channels of policy interventions in moderation. After some experimentation with various alternatives, we ended up restricting the mapping between LMPs and structural parameters as follows.

Unemployment subsidisation (replacement rate) potentially has a structural effect on turnover through matching efficiency (parameter ϕ) as it determines the job search intensity of unemployed workers. More and better placement and employment services should similarly improve matching efficiency (ϕ) and induce better match quality (hence a reduction in job destruction (δ). Whereas more training provided to unemployed workers should raise match quality and hence limit job destruction (δ), its impact on matching efficiency through parameter ϕ is ambiguous as participation to the training programme may also delay the exit from unemployment. Employment incentives subsidise vacancy creation, yielding a lower vacancy cost (c) and sustaining weaker job matches that terminate more often (higher δ).

Product market regulation conditions firms' profits and affects vacancy creation via the free entry condition (3). To keep the model simple, we model after-tax price effects, equivalently, as a shock to the vacancy cost c. We also open an intervention channel through job destruction (δ). A lower profit margin, say, renders firms less resilient to idiosyncratic shocks to productivity. However, we let matching efficiency (ϕ) unaffected by product market regulation and taxes.[8]

Employment protection renders separation more costly and so should affect job destruction via δ. Employment protection does not condition vacancy creation by a direct effect on vacancy costs (c), but it does indirectly because of lower expected profit.

The set of labour market policies is complemented by a handful of socio-demographic variables, namely the shares of workers aged 15-24 and 55-64 in the 15-64 population, and mean years of higher education among the 15-64 population. They are assumed to have an impact on turnover parameters ϕ and δ.

4 Estimation procedure

The estimation is in two steps. A restricted version of the model with time-constant structural parameters is first estimated to fit the cycle components of the series. This first stage is useful, in particular, to filter out the series of aggregate shocks y_t driving the business cycle. In a second step, the structural parameters of the policy variables governing unemployment turnover rates are estimated so as to fit the trends. This

[8]Murtin and de Serres (2012) provide empirical evidence that product market regulation hardly affects matching efficiency. So this channel is excluded from the analysis.

estimation procedure is considerably easier to implement than any other method, Bayesian or frequentist, for nonlinear state-space models.

4.1 First step: business-cycle (BC) parameters

The estimation of the parameters of the model controlling for the short-term response of the economy to business cycle shocks closely follows the method in Robin (2011). In this first-stage estimation, we assume that HP-filtered series follow the model of this paper as in a stationary environment (but not fixed) exempt from any institutional change. Hence, we impose $\phi^k = \delta^k = c^k = 0$ to each policy variable ($k \geq 1$) and each country. Ten parameters remain to be estimated: the country-specific vacancy creation cost c^0, the exogenous layoff rate δ^0, the two parameters of the matching function (ϕ^0, η), the leisure cost parameter z^0, the three parameters of the distribution of worker heterogeneity (C, μ, ν), and the two parameters of the latent productivity process (ρ, σ). The number of aggregate states is set to $N = 150$, the number of different ability types is taken equal to $M = 500$.

The BC parameters $\theta_{BC} = (c^0, \delta^0, \phi^0, \eta, z^0, C, \mu, \nu, \rho, \sigma)$ are estimated using the Simulated Method of Moments, separately, country by country. In practice, we simulate very long series ($T = 5000$ observations) of aggregate output, unemployment rates, unemployment turnover and vacancies, and we search for the set of parameters θ_{BC} that best matches the following 18 country-specific moments: i) the mean, standard deviation and autocorrelation of log GDP; ii) the mean, standard deviation and kurtosis of unemployment;[9] iii) the mean and standard deviation of unemployment entry and exit rates and of market tightness; iv) four elasticities with respect to output: log unemployment, its turnover rates and market tightness regressed on log output; v) two other elasticities: log job-finding rate regressed on log market tightness, and log job finding rate regressed on log unemployment rate.

Once these structural parameters have been estimated, we filter out the series of aggregate shocks y_t so as to minimise the sum of squared residuals for log GDP.

[9]Matching the kurtosis of time-series observations forces the simulated trajectories to be smooth.

4.2 Second step: policy effects

In the second step, we take the series of aggregate shocks y_t as given, and we estimate the policy parameters $\theta_P = (\phi^k, \delta^k, k = 1, ..., K)$ (and we reestimate intercepts ϕ^0, δ^0, c^0) by Simulated Least Squares (SLS) over the period 1985-2007, namely we minimise the sum of squared residuals (i.e. the difference between simulated and observed series) for the *actual series* (i.e. not HP-filtered) of unemployment, turnover rates and market tightness, weighing observations by the inverse volatility (standard deviation) of each series. Contrary to the first step, the estimation of policy parameters is done jointly for all countries. Once θ_P parameters have been estimated, θ_{BC} parameters are re-estimated as they correspond to filtered series and are not necessarily consistent with the dynamics of actual series. This sequential estimation is repeated until estimates convergence.

The economy is simulated assuming myopic expectations on policy interventions. Whenever a policy variable X^k is changed, which only happens infrequently, we recalculate the values of unemployment and of match surplus for all aggregate states, together with the values of job finding and job destruction rate, and keep them set to these levels until the next policy intervention.

We calculate standard errors for the estimates of LMPs parameters θ_P as follows. Rather than estimating the Jacobian matrix and using the "sandwich" formula, which is numerically cumbersome and not much reliable given the amount of numerical simulations involved, we instead note that equation (1) implies that

$$\log f_t - \eta \log \theta_t - \log \left(\frac{\sum_m u_t(m) \ell_m \mathbf{1}\{S_t(m) \geq 0\}}{u_t} \right) - \log \phi^0 = \sum_k \phi^k X_{nt}^k.$$

So we calculate standard errors for the parameters ϕ^k using the standard OLS formula when regressing the simulated left-hand side component on LMPs. This calculation may severely overestimate the precision of the estimation by neglecting the estimation errors induced by using the parameter estimates instead of the true values to calculate the left hand side. But it nevertheless provides a good indication of how much the simulated series are changed by a small change in the policy parameters at the estimated values. We use a similar approach for the other policy parameters based on equations (2) and (3).

5 The dynamics of cyclical unemployment

5.1 Parameter estimates

The results of the first-stage estimation are reported in Table 3. The parameter ϕ^0 capturing matching efficiency is higher in Australia and Sweden. The rate of exogenous job destruction δ^0 is higher in the United States, Australia and Spain, and lower in Japan and Portugal. This inference is broadly in line with micro and macroeconomic evidence on job turnover rates (see Jolivet et al., 2006, Elsby et al., 2012, Murtin et al., 2012). The opportunity cost of employment z^0 is higher in Portugal and lower in Japan, but otherwise does not differ much from 0.7 in all countries. Finally, the cost of posting a vacancy is estimated much lower in the United States and in Germany, and much higher in Portugal and Spain.

Note that the elasticity of the matching function was arbitrarily fixed at 0.5 in all country-level estimations. Indeed, we could fit all moments well for any preset value of η. We explain this lack of identification as follows. The duration of unemployment is controlled by three components: matching efficiency (ϕ), the meeting elasticity with respect to market tightness (η) and worker employability (the sign of the match surplus). It seems that the latter two components are not separately identified. If one increases the frequency of meetings in response to vacancies (by increasing the elasticity η), one can cancel this effect by simultaneously recalibrating the fraction of workers at risk of unemployability (i.e. by putting more mass in the left tail of the ability distribution).

5.2 Fitting the cycle

Table 4 shows how the model fits the 8 moments used in estimation and Table 5 reports the correlations between actual and simulated HP-filtered series. Figure 2 shows the actual and simulated unemployment cycle. Appendix B contains similar

Table 3: Estimates of Business Cycle Parameters

	AUS	FRA	DEU	JAP	PRT	ESP	SWE	GBR	USA
Productivity									
ρ	0.970	0.940	0.927	0.946	0.858	0.969	0.961	0.970	0.960
σ	0.0190	0.0200	0.0266	0.0268	0.0268	0.0295	0.0289	0.0255	0.0205
Worker heterogeneity									
C	0.701	0.679	0.529	0.517	0.827	0.707	0.704	0.695	0.664
μ	3.965	4.607	3.286	2.102	5.900	4.644	3.995	4.529	4.019
ν	1.613	2.101	2.724	1.874	1.197	1.757	1.603	1.865	1.879
Unemployment benefit									
z^0	0.716	0.716	0.679	0.560	0.834	0.746	0.726	0.721	0.695
Vacancy cost									
c	21.242	22.511	13.051	20.100	34.759	40.082	18.016	18.120	4.962
Matching function									
ϕ	2.218	1.287	1.219	1.803	1.756	1.794	2.519	1.886	1.685
η	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500	0.500
Job destruction rate									
δ	0.0372	0.0233	0.0175	0.0146	0.0121	0.0354	0.0250	0.0285	0.0440

plots for all other series (turnover rates and vacancies).

The fit is generally good (at least for such a simple model). In particular, the model has no problem fitting both the volatility of output and the volatility of unemployment. The mechanism is simple. In good times, unemployment is low and stable and all separations follow from exogenous shocks. When aggregate productivity falls, low-skilled workers start losing their jobs because their match surplus becomes negative. The thicker the left tail of the distribution of worker heterogeneity, the stronger the amplification of unemployment variations from productivity shocks. Note that worker employability also determines the duration of unemployment. So, after a positive productivity shock, a fraction of previously unproductive workers becomes productive, and in absence of any additional friction such as human capital depreciation, heterogeneous ability also works as an amplification mechanism for job creation.

The fit of job finding rates is also good, with accurate volatility estimates. However, the elasticity of job finding rates with respect to tightness (resp. to unemployment) is greatly over-estimated (resp. under-estimated). Although the correlation between actual and predicted series of tightness is good (around 65%), we generally greatly under-estimate its volatility. These two findings (the excess sensitivity of the job finding rate to market tightness and the under-estimation of the volatility of tightness) are related. The response of vacancy creation to productivity shocks has to be attenuated because of that high elasticity, or job finding rates would not be well fitted. Additional friction (such as negative dependence of job finding rates to unemployment duration) is therefore required to make the job finding process more sluggish in recovery times.

Finally, the job destruction rate that is predicted by the model is too unevenly dented, and its correlation to actual series is poor. This may happen again because the process of endogenous job destruction is too lumpy. Following a negative productivity shocks, a mass of workers is instantly laid off, and the job destruction rate is immediately after reverted to the frictional rate of exogenous job destruction unless aggregate productivity keeps going further down.

Nevertheless, we will see in the next section that this apparent failure at fitting some aspects of turnover and vacancies may be an artifact of the detrending operation using the Hodrick-Prescott filter. If total output is clearly trended and easily detrended, long-term trends in labour market variables are much more difficult to filter out. This is the reason why Shimer (2005), and his followers, including us, used the HP filter with a smoothing parameter of 10^5, much greater then the standard value of $1,024$ usually suggested for quarterly series. Using $1,024$ yields a trend of unemployment that undulates like a cycle... In this paper, we want to argue that a better way of removing trends from labour market variables is to model structural change using intervention variables (policy or demographics). As a matter of fact, we shall see in the next section that this lack of fit of turnover variables essentially disappears when policy and demographic changes are accounted for.

Table 4: Fit of the Business Cycle Moments

	AUS		DEU		ESP		FRA		GBR		JPN		PRT		SWE		USA	
	true	sim.	true	sim.	true	sim.	true	sim.	true	sim.	true	sim.	true	sim.	true	sim.	true	sim.
Mean productivity	0.998	0.999	0.998	1.000	0.994	1.000	0.999	1.000	1.001	1.000	0.997	0.998	1.003	1.000	1.000	0.999	1.000	0.991
Std productivity	0.019	0.023	0.023	0.027	0.031	0.035	0.019	0.022	0.027	0.032	0.028	0.033	0.031	0.028	0.029	0.032	0.025	0.023
Autocorr. productivity	0.917	0.984	0.913	0.937	0.969	0.983	0.964	0.955	0.936	0.985	0.955	0.967	0.966	0.879	0.968	0.973	0.941	0.976
Mean unemployment	0.074	0.074	0.090	0.090	0.158	0.158	0.096	0.094	0.069	0.067	0.034	0.034	0.066	0.067	0.048	0.048	0.056	0.056
Std unemployment	0.128	0.122	0.119	0.116	0.200	0.197	0.083	0.082	0.185	0.170	0.127	0.122	0.180	0.184	0.306	0.255	0.188	0.161
Kurtosis unemployment	2.352	2.972	2.844	3.052	1.780	2.030	1.817	2.258	2.070	2.432	2.274	2.482	2.527	3.154	3.179	2.747	2.355	2.383
Prod. elasticity of unempl.	-4.127	-4.843	-2.768	-3.961	-5.143	-5.299	-2.221	-3.438	-4.596	-4.848	-3.427	-3.585	-4.252	-4.262	-7.062	-7.108	-6.595	-6.474
Prod. elasticity of JFR	5.143	5.025	2.399	5.239	5.246	6.218	5.321	4.049	3.780	4.979	2.289	3.747	2.857	4.328	3.435	7.032	2.644	6.728
Prod. elasticity of JDR	-1.333	-0.415	-1.437	-0.408	-2.114	-0.544	-0.332	-0.443	-2.810	-0.442	-1.722	-0.246	-4.717	-2.978	-5.401	-0.883	-4.706	-0.374
Prod. elasticity of tight.	14.714	7.870	11.260	5.424	8.338	9.213	5.990	5.430	12.819	7.751	7.898	4.631	8.072	6.020	18.247	9.514	13.150	9.063
Mean JFR	0.472	0.479	0.187	0.187	0.202	0.203	0.222	0.231	0.415	0.417	0.425	0.430	0.205	0.188	0.551	0.549	0.779	0.774
Std JFR	0.129	0.124	0.140	0.142	0.213	0.226	0.129	0.091	0.130	0.173	0.108	0.124	0.168	0.164	0.124	0.250	0.075	0.164
Mean JDR	0.038	0.038	0.018	0.018	0.038	0.036	0.024	0.024	0.030	0.029	0.015	0.015	0.014	0.013	0.027	0.026	0.046	0.045
Std JDR	0.065	0.025	0.086	0.076	0.116	0.057	0.079	0.033	0.124	0.039	0.108	0.033	0.195	0.194	0.222	0.070	0.138	0.026
Mean tightness	0.132	0.129	0.148	0.148	0.027	0.027	0.082	0.081	0.161	0.157	0.353	0.342	0.033	0.034	0.220	0.220	0.813	0.819
Std tightness	0.356	0.185	0.397	0.150	0.481	0.328	0.164	0.122	0.412	0.258	0.263	0.154	0.380	0.219	0.672	0.322	0.388	0.217
Tight. elasticity of JFR	0.283	0.662	0.183	0.906	0.249	0.681	0.363	0.736	0.273	0.659	0.271	0.795	0.164	0.658	0.167	0.758	0.172	0.747
Unempl. elasticity of JFR	-0.758	-1.001	-0.582	-1.088	-0.794	-1.110	-0.945	-1.032	-0.506	-0.991	-0.556	-0.983	-0.455	-0.707	-0.317	-0.944	-0.362	-0.997

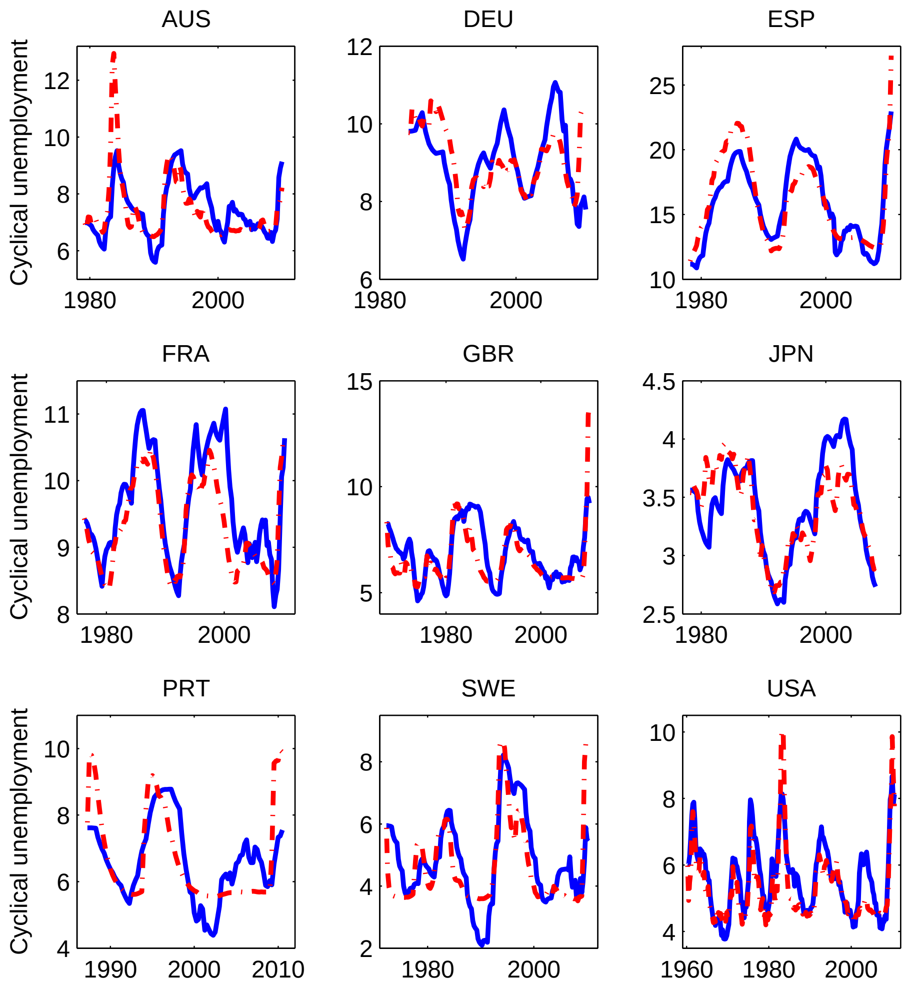


Figure 2: Unemployment Cycle - Actual (solid line) and Simulated (dotted)

Table 5: Correlation Between Actual and Simulated Detrended Series

	AUS	FRA	DEU	JAP	PRT	ESP	SWE	GBR	USA	Average
Productivity	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Unemployment	0.69	0.85	0.57	0.80	0.68	0.87	0.75	0.73	0.86	0.76
Job Finding Rate	0.74	0.78	0.50	0.59	0.39	0.77	0.77	0.78	0.87	0.69
Job Destruction Rate	0.10	0.03	0.03	0.14	0.33	0.42	0.07	0.22	0.50	0.20
Market Tightness	0.74	0.62	0.62	0.84	0.39	0.46	0.63	0.77	0.81	0.65

6 The impact of labour market reforms

This section reports the estimates of policy effects, and provides simulations of the long-term effects of labour market reforms.

6.1 Parameter estimates

The estimated policy parameters are reported in Table 6. For each country, LMP variables were centered around the country-specific mean and standardised by the cross-country and cross-time standard deviation of the LMP. Policy parameters are thus semi-elasticities that quantify the relative increase in parameters ϕ, δ, c when LMPs are increased by one standard deviation around the country-specific mean of the policy variable.

Overall, we estimate 11 LMP effects, among which 6 are significant at the 1% confidence level and 3 at the 5% confidence level. All of them have the expected sign. Large effects are recorded for the ALMP employment incentives, as an additional one-standard deviation decreases the vacancy cost c by 15.2%. Similarly, an additional one-standard deviation of placement and employment services (respectively training) yields a 11.2% (resp. 10.1%) decrease in δ. Product market regulation is another LMP that displays strong impact, as an additional one-standard deviation yields a 12.1% increase in c. The replacement rate, employment protection and the tax wedge also have significant effects, although of lower magnitude, on ϕ, δ and c respectively.

The bottom part of Table 6 reports the estimated effects of education and demographic variables. Educational achievement is found to reduce moderately the pace of job destruction as an additional 0.4-year of higher education (one standard deviation) yields a 4.5% reduction in the job destruction rate.[10] A younger working-age population has an unexpected negative, yet small impact on job destruction (which we view as a statistical anomaly), while an older working-age population slightly reduces both job creation through matching efficiency and job destruction.

[10] For comparison, the number of years of higher education has on average increased by 0.33 years over the period 1985-2007.

Table 6: Estimates of Policy Effects

	ϕ	δ	c
Initial replacement rate	-0.037		
	(0.009)		
ALMP Placement and Employment Services	0.027	-0.112	
	(0.007)	(0.007)	
ALMP Training	-0.026	-0.101	
	(0.018)	(0.019)	
ALMP Incentives		0.061	-0.152
		(0.020)	(0.059)
Product Market Regulation		-0.018	0.121
		(0.018)	(0.052)
Employment Protection (regular contracts)		-0.031	
		(0.008)	
Tax wedge			0.047
			(0.025)
Mean Years of Higher Education	-0.009	-0.045	
	(0.009)	(0.009)	
Share 15-24 population	0.015	-0.025	
	(0.011)	(0.012)	
Share 55-64 population	-0.024	-0.044	
	(0.007)	(0.007)	

Note: Standard errors in parenthesis.

Table 7: Correlation Between Actual and Simulated Unfiltered Series

	AUS	FRA	DEU	JAP	PRT	ESP	SWE	GBR	USA	Average
Productivity	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Unemployment	0.96	0.79	0.67	0.97	0.75	0.81	0.98	0.89	0.47	0.81
Job Finding Rate	0.86	0.90	0.56	0.84	0.37	0.86	0.90	0.92	0.71	0.77
Job Destruction Rate	0.68	0.27	0.39	0.87	0.41	0.33	0.95	0.54	0.49	0.55
Market Tightness	0.94	0.90	0.71	0.81	0.58	0.90	0.92	0.97	0.05	0.75

6.2 Fitting the trends

Figure 3 shows how the dynamic simulation of our hybrid model, with rational expectations of aggregate productivity shocks but myopic expectations of policy interventions, compares to the actual series. Table 7 displays the correlations between actual and simulated series. Actual and simulated unemployment rates are highly correlated for all countries, with an average correlation equal to 0.81. The best fit is obtained for Australia, Japan, Sweden and the United Kingdom with correlations close to or above 0.90, while the model performs less well for the United States with correlations close to 0.5. Incidentally, the LMP model has a slightly better fit for actual unemployment than the BC model for cyclical unemployment. Said differently, the HP-filter may fail to some extend to remove the structural changes related to policy reforms.

The fit of job destruction rates is greatly improved as the correlation between predicted and observed series jumps from 0.20 in the BC model to 0.55 in the LMP model. The fit of job finding rates, which are well predicted except for Germany and Portugal, and the US to a lesser extent, has also improved. Market tightness is well fitted for all countries but the US and Portugal.

Overall, these results suggest that LMPs help predict the permanent shifts in unemployment and its turnover components in a satisfactory manner. The model is also able to disentangle cyclical variations induced by productivity shocks from the structural changes induced by labour market reforms. The immediate question that comes to mind is then: Which LMPs can better help bringing unemployment down?

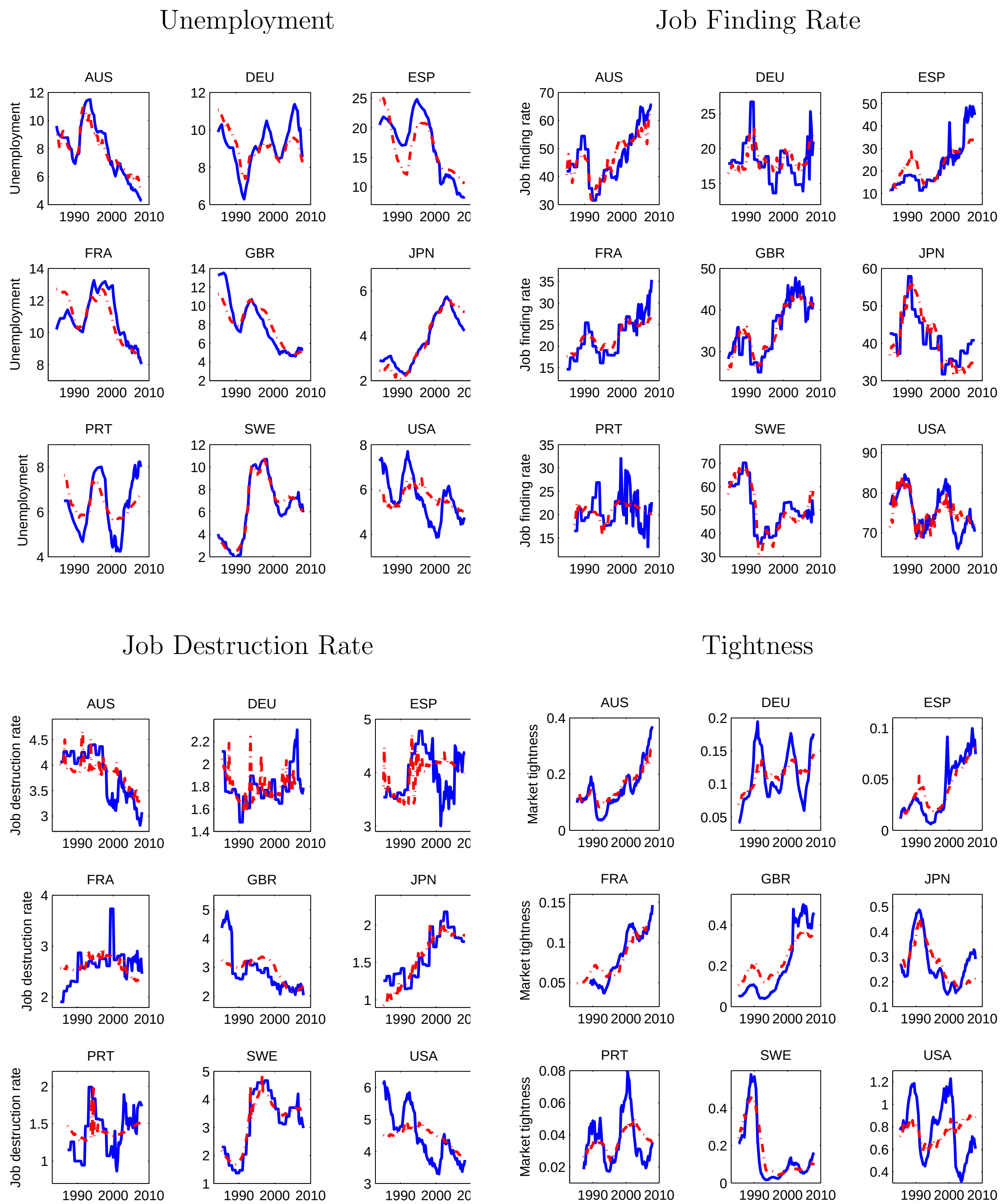


Figure 3: Actual (solid line) and Simulated (dotted) Trends

6.3 What are the most effective LMPs?

The analysis of cumulative LMP effects is conducted as follows. For each country, we simulate very long series of productivity shocks and calculate the resulting mean unemployment rate assuming that the institutional environment remains fixed for ever at its country-specific average level. It is a convenient benchmark against which the effect of policy changes can be assessed. As another possible benchmark, we run the same simulations with LMPs set at their last observed level (2007).

In a second step, we calculate the counterfactual steady-state unemployment rates that result from a one-standard deviation change in the LMPs (in the direction that is likely to be favourable to unemployment reduction). This standard deviation is calculated as the average value of all within-country specific standard deviations (see Table 2. Namely, we simulate a 3.2-percentage-point reduction of the replacement rate; the volume of per unemployed resources devoted to placement and employment services (respectively training and employment incentives) as a fraction of GDP per worker is increased by 0.011 (resp. 0.015 and 0.020); the OECD index of product market regulation (respectively employment protection of regular contracts) is lowered by 1.11 (resp. 0.16) points; the tax wedge is reduced by 2.6 percentage points.

Table 8 reports the results. At the mean point of labour market institutions, steady-state unemployment varies from 4.0% in Japan to 16.8% in Spain.[11] Average steady-state unemployment is equal to 8.3%. We also report steady-state values of unemployment turnover rates and the standard deviations of all series. Then, the bottom part of Table 8 reports unemployment changes resulting from individual labour market reforms.

In so far as the size of LMP-changes do represent commensurate and comparable policy reforms, the LMPs most conducive to unemployment reduction appear to be, by decreasing order, placement and employment services (-0.47 percentage points on average), product market regulation (-0.32 percentage points), and to a lesser extent, training (-0.16). The replacement rate, employment incentives, employment

[11] Respectively, 5.5% and 14.4% with 2007 LMPs.

protection and the tax wedge display negligible unemployment effects, either because they display lower relative elasticities, or because within-country changes in these LMPs have been relatively smaller in the past (due for instance to differences in political feasibility).

At the bottom of Table 8, we report the sum of individual LMP-effects, as well as the calculated unemployment effect arising from the simultaneous change in all LMPs (labelled as the "policy mix"). We do not find evidence of policy complementarity, as the sum of individual effects is always slightly larger than the impact of the policy mix. This finding contrasts with the one described in Bassanini and Duval (2009), who find positive interaction effects assessed on the basis of panel data reduced-form regressions.

Finally, we find that identical labour market reforms trigger very different unemployment changes across countries, with high-unemployment countries such as Spain or France witnessing larger unemployment reductions. This result is partly expected from the multiplicative relationships linking unemployment to its turnover rates, and the latter to LMPs (see equations and 11 to 13). Said differently, a broadly similar relative decrease in unemployment mechanically yields a larger absolute reduction.

These results bring about some nuances to previous findings of reduced-form studies. Like us, Blanchard and Wolfers (2000) find significant effects for ALMPs and product market regulation, but unlike us, they find a positive correlation between employment protection and unemployment. We are more in line with Cahuc and Postel-Vinay (2002) who argue that employment protection has little effect on the rate of unemployment. The small effect found for the tax wedge can be further explained by the missing interaction between tax and wage bargaining systems or the minimum wage as underlined by Murtin et al. (2012).

7 Conclusion

We have proposed a non-stationary dynamic search-matching model with worker heterogeneous abilities and labour market reforms. Worker heterogeneity interacts with

Table 8: Assessing the Cumulative Impact of Labour Market Reforms

	AUS	FRA	DEU	JAP	PRT	ESP	SWE	GBR	USA	Average
Steady-state labour market outcomes										
Unemployment – as in 2007										
mean	5.92	8.91	8.67	5.48	7.14	14.36	6.92	6.11	5.53	**7.67**
std	1.01	0.76	0.79	0.41	0.68	3.35	1.06	0.85	0.50	1.05
Unemployment – mean policy setting										
mean	7.95	10.63	9.09	4.02	6.41	16.85	5.91	8.04	5.95	**8.32**
std	1.16	0.81	0.80	0.37	0.58	3.50	0.97	1.01	0.54	1.08
Jog finding rate – mean policy setting										
mean	44.88	22.20	18.15	40.55	20.93	20.59	48.95	33.19	71.12	**35.62**
std	6.31	2.01	2.19	3.92	1.35	5.20	6.74	4.04	6.15	4.21
Job destruction rate – mean policy setting										
mean	3.80	2.62	1.80	1.68	1.43	3.96	3.01	2.86	4.47	**2.85**
std	0.12	0.08	0.12	0.04	0.16	0.27	0.14	0.11	0.07	0.12
Change in steady-state unemployment after pro-employment policy reforms										
Initial replacement rate	-0.05	-0.06	-0.04	-0.02	-0.04	-0.09	-0.03	-0.05	-0.04	**-0.05**
ALMP: Placement and Employment Services	-0.49	-0.63	-0.36	-0.21	-0.38	-0.93	-0.35	-0.50	-0.38	**-0.47**
ALMP: Training	-0.17	-0.21	-0.12	-0.07	-0.12	-0.33	-0.12	-0.17	-0.13	**-0.16**
ALMP: Incentives	-0.06	-0.08	-0.06	-0.03	-0.06	-0.11	-0.04	-0.06	-0.04	**-0.06**
Product Market Regulation	-0.32	-0.44	-0.27	-0.15	-0.29	-0.61	-0.24	-0.34	-0.25	**-0.32**
Employment Protection (regular contracts)	0.03	0.04	0.02	0.01	0.02	0.06	0.02	0.03	0.02	**0.03**
Tax wedge	-0.06	-0.07	-0.05	-0.03	-0.05	-0.11	-0.04	-0.06	-0.04	**-0.06**
Sum of individual policy effects	-1.11	-1.46	-0.87	-0.49	-0.92	-2.11	-0.81	-1.15	-0.86	-1.09
Policy mix (all reforms)	**-1.04**	**-1.38**	**-0.83**	**-0.47**	**-0.86**	**-2.00**	**-0.77**	**-1.10**	**-0.81**	**-1.03**

Note: Each LMP is shifted by the same amount across countries with the aim of reducing unemployment. We use the average within-country standard deviation of LMPs as a benchmark for the size of labour market reforms. This corresponds to a decrease in 3.2 percentage points in the replacement rate, an increase by 0.011 (respectively 0.015 and 0.020) in the normalized volume of resources devoted to placement and employment services (resp. training and employment incentives), a decrease in 1.11 (respectively 0.16) points in the OECD index of product market regulation (resp. employment protection for regular contracts), and a 2.6 percentage points increase in the tax wedge.

aggregate productivity shocks in a way that allows for endogenous job destruction. It suffices that a small fraction of the total workforce be at risk of a shock that renders the match surplus negative to amplify this productivity shock and generate the observed volatility of cyclical unemployment. Moreover, shifts in labour market institutions imply changes in the level of potential unemployment. Within each of the 9 OECD countries, the model displays an impressive fit of cyclical and actual unemployment dynamics. The amount of resources injected into placement and employment services as well as the degree of product market regulation stand out as prominent policy levers in view of reducing unemployment. We also find that the magnitude of the latter effects are larger among high-unemployment countries.

As a final caveat, it is important to remember that the identification of institutional effects depends on the structure of interaction that the model assumes. While this restriction guarantees a proper identification, it also implies that other models may come up with different conclusions as regards the influence of policy reforms. For instance, *hysteresis effect* in the form of a decline in job search intensity along the unemployment spell is an important channel through which labour market institutions (such as the maximal duration of unemployment benefits) could creep in. Hysteresis could further be regarded as a complementary source of amplification of business cycle shocks to the labour market, as it potentially increases unemployment turnover sluggishness. So our simple model could be enriched to capture more complex relationships between the business cycle, labour market institutions and labour market outcomes. We raise that possibility in view of future investigation.

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