Employment Dynamics, Growth and Institutions: Empirical Evidence from OECD Countries

Giovanna Vallanti
PhD Thesis, Department of Economics
London School of Economics and Political Science
University of London

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Abstract

This thesis focuses on the determinants of unemployment in the OECD countries. In particular, we look at three different explanations of unemployment and analyse their potential impact on labour market dynamics. The three explanations under consideration are technological factors, capital flows and capital market integration, and labour market institutions.

Chapter 1 and 2 focus on the relationship between technological progress and unemployment. We specify and estimate a structural model of labour demand, wage setting, and capital accumulation, for a panel of EU countries, the United States and Japan over the period 1960-1995. The adjustment paths of unemployment, following a shock to productivity growth, are traced explicitly in simulation exercises.

Chapter 3 focuses on the labour market effects of high international (physical) capital mobility. The aim of this part of the thesis is to assess whether, and to what extent, capital flows contribute to unemployment volatility. We test the effects of capital mobility on unemployment persistence and on the adjustment dynamics of unemployment in response to TFP shocks.

Finally, Chapters 4 and 5 examine job flows characteristics in the 1990s for a sample of 16 European countries. Using unique homogenous firm-level data, we provide comparable estimates of job flows and identify cross-country differences and similarities. We also look at the impact of institutional differences on job reallocation. The effects of the business cycle on job flows, and to what extent firing restrictions may affect the cyclicality of job flows, are also considered.

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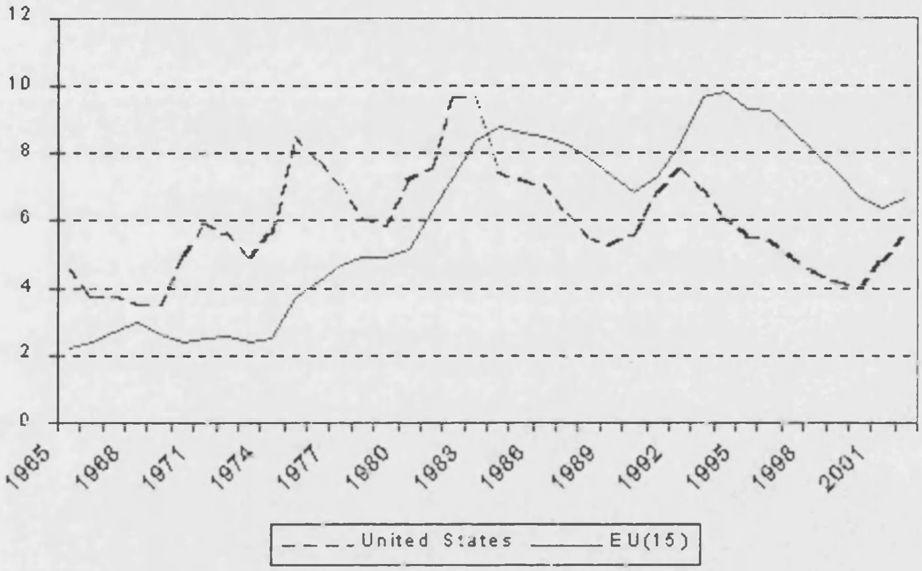
Introduction

The high level of unemployment in the European countries is still an open question in empirical macroeconomics, despite a large number of theoretical and empirical studies which try to address this issue. During the 1960's and the early 1970's the unemployment rate in the European countries was well below the unemployment rate in the United States, but in the mid 1970's the situation started to change with European countries experiencing significant increases in unemployment relative to the US (Figure 1).

Previous studies explained the persistent high rates of unemployment experienced by the EU countries in the last three decades by assessing the inflexibility of the labour market (Layard et al., 1991; OECD, 1994, Nickell et al., 2003). Despite a widely accepted evidence of the role played by labour market imperfections in explaining high levels of unemployment, explanations entirely based on labour market institutions may tell only part of the story. Most of the institutions were already present in the early 60s when unemployment was low and have not changed too much in the last decades. Moreover, after a decade of labour market deregulation in several EU countries, the empirical evidence on the relationship between labour market rigidities and firms employment decisions appears to be still unclear (OECD, 1999; Mardsen et al., 2001). More recently, the attention has been shifted from labour market rigidities to the potential impact of interest rate, capital accumulation and technological progress on employment (Blanchard, 1998, 2000; Arestis

Figure 1: Unemployment rate dynamics



and Marsical, 2000; Cristini, 1999; Phelps, 1994).

High and persistent unemployment is only one aspect of the poor labour market performance in many OECD countries in the last decades. Between the 1980s and 1990s the increase in unemployment has been accompanied by an increase in labour market instability and job insecurity (OECD, 1997). This has coincided with significant increases in international capital mobility among industrialised countries. Despite higher international capital mobility can produce undesirable welfare effects, the impact of capital flows on unemployment dynamics has been largely overlooked in the literature. It has been argued that in a world in which labour is intrinsically less mobile than capital, workers have to face greater instability in earnings and hours worked in response to country-specific shocks when international capital mobility increases. This implies bigger and sharper fluctuations in the aggregate labour demand and real wages. In absence of perfect insurance market, this results in an increase of the risk associated to labour income and a reduction in the welfare of individuals investing in human capital (Azariadis and Pissarides, 2003).

Job flows statistics are particularly important in capturing the dynamics underlying aggregate employment fluctuations. A growing body of research shows how the good or bad performance of an economy is related to its capacity to adjust quickly to shocks and reallocate resources among competing activities and locations. Job creation and job destruction are an important part of this process of adjustment, reallocation and growth. It has been shown that market economies exhibit high rates of job turnover (the sum of job creation and job destruction) in almost every sector and regardless of the cycle phase. This provides evidence of the complexity of the dynamics underlying the adjustment process in the labour market and the heterogeneity in the behavior of both workers and firms. The main limitation of the existing studies on job flows is the lack of internationally comparable job flows statistics (OECD, 1994). Differences in definitions, sampling intervals, sectoral coverage and sampling frames may lead to misleading interpretations of cross-country differences in estimated job flows.

Cross-country comparisons of job turnover rates provide the basis for an investigation of the link between job flows and labour market institution and policies. For example, barriers to the layoff of workers are expected to hinder both job creation and destruction, resulting in an ambiguous effects on the average level of the unemployment rate (Bertola, 1990). However, if job turnover is one of the factors that influence the dynamism of an economy, countries with more strict firing restrictions are more likely to suffer during periods of rapid economic change.

This thesis focuses on the determinants of unemployment in the OECD countries. In particular, we look at three different explanations of unemployment and analyse their potential impact on labour market dynamics. The three explanations under consideration are technological factors (Chapters 1 and 2), capital flows and capital market integration (Chapter 3), and labour market institutions (Chapters 4 and 5).

In the first part of the thesis (Chapters 1 and 2) the focus of the analysis is on factors largely unexplored in the empirical literature on unemployment: the role of technological growth in explaining the unemployment patterns in the US and Europe.

Chapter 1 is a comprehensive survey of the economic literature on the relationship between technological progress and unemployment. First, we discuss the economic models behind the major findings in literature, with particular attention to models with frictions and quasi-rents (among others Pissarides, 1990; Aghion and Howitt, 1994; Mortensen and Pissarides, 1998). Next, we survey and discuss the findings of some recent empirical studies on the relationship between technological growth and unemployment (among others Blanchard and Wolfers 2000; Phelps 1994).

In Chapter 2, we specify and estimate a structural model of labour demand, wage setting and capital accumulation for a panel of EU countries, the United Sates and Japan over the period 1960-1995. The methodology followed by previous empirical studies has been based on the estimation of a reduced form equation for unemployment, neglecting interactions among the variables of interest and assuming capital stock as exogenous (e.g. Blanchard and Wolfers, 2000; Phelps, 1994). Our empirical model makes explicit the essential interactions among the variables of interest and the channels through which they affect employment, and allows for short run dynamics. Moreover, the long-run neutrality of capital stock and TFP and other restrictions implied by economic theory are tested and then imposed in the estimation, while TFP growth is allowed to affect the steady state unemployment rate as suggested by search equilibrium models. The adjustment paths of unemployment following a shock to productivity growth are traced explicitly in simulation exercises. The empirical model does a good job in attributing the rise in unemployment in the United States after 1973 and its subsequent decline to the productivity slowdown and subsequent recovery. It is also fairly successful at tracking other dynamics in the US unemployment rate. The slowdown in productivity growth in Europe was bigger than the US slowdown, and the model attributes a substantial rise in the European unemployment to it. However, a large fraction of European unemployment remains yet to be explained.

Chapter 3 focuses on the labour market effects of high international mobility of physical capital. Specifically, the aim of this part of the thesis is to assess whether and to what extent capital flows contribute to unemployment volatility. The benefits of capital mobility are well known: the removal of barriers to factor mobility increases efficiency and by lowering the cost of financial transactions, improves saving and investment both from a quantitative and qualitative point of view. In the long run, higher capital mobility enhances capital accumulation and then economic growth. However, in a world in which labour is less mobile than capital, perfect capital mobility will also amplify the impact on the domestic unemployment rate of country-specific productivity shocks (Rodrik, 1997; Azariadis and Pissarides, 2003).

On the empirical side, little attention has been devoted to the effects of international market integration on labour market volatility and the existing empirical results are far from conclusive. In this part of the thesis, we present econometric evidence of the effect of capital mobility on unemployment persistence and on the adjustment dynamics of unemployment in response to TFP shocks as predicted by Azariadis and Pissarides model (2003). The empirical analysis is based on macro data from the OECD and the IMF for a panel of 20 countries. As predicted by the theory, the empirical evidence suggests that countries characterized by larger penetration of international capital are more responsive to idiosyncratic shocks (and consequently experience amplified fluctuations in employment) though the duration of the response is shorter. Moreover, simulations based on the empirical model show that an economy with more capital mobility exhibits higher unemployment volatility than an economy with no capital mobility.

Studies in the US have stressed the importance of looking at the net changes in employment and unemployment as the resultant of gross job flows of job creation and job destruction. Despite a large amount of empirical evidence for the United States, only a limited number of studies of job flows are available for EU countries. This is mainly due to a lack of comparable data across European countries at an appropriate level of disaggregation.

Chapter 4 examines job flows characteristics in the 1990s for a sample of 15 European countries and the potential impact of labour market institutions and policies on firms' job turnover. Using unique homogenous firm-level data that covers the whole spectrum of productive sectors, we provide some comparable estimates of job flows for a panel of European countries and examine cross-country differences and regularities. Job flow magnitude and persistence in relation to some firm characteristics (e.g. size, relevant sector, capital intensity, etc.) is reported as well in order to identify if patterns of job reallocation if any among different groups of firms across countries. We also focus on the impact of institutional factors on job reallocation. The theory suggests that job turnover is partly determined by labour market policies such as employment protection legislation (EPL) and unemployment insurance. Consistently with previous studies, bivariate analysis shows little or no association between unemployment and employment protection strictness. However, there is evidence of a strong correlation between EPL and job turnover in the economy. The evidence on the correlation between job turnover and EPL still persists when multivariate techniques are used to control for other factors influencing job creation and job destruction decisions.

The relationship between job flows and the business cycle is examined in Chapter 5. The prevailing view in the business cycle literature predicts an unambiguous procyclical behavior of job creation and counter-cyclical behavior of job destruction. As a consequence, the effects of the cycle on job reallocation (the sum of job creation and job destruction) remain undetermined. Previous evidence regarding the cyclical patterns of job reallocation is far from conclusive. Davis and Haltinwanger (1992) and Davis et al. (1996) find a negative relationship between job reallocation and the cycle in the US manufacturing sector. The same cyclical pattern in job reallocation has been observed for Canada (Baldwin et al., 1994) and the UK (Konings, 1995). For the countries of Continental Europe the evidence is mixed and in general job reallocation has been found to be largely a-cyclical. According to Garibaldi (1998), differences in employment protection legislation between countries may explain the dichotomy in the cyclical behavior of job flows between Anglo-Saxon and European countries. He shows that when costs associated with dismissals are negligible, job destruction is instantaneous while job creation takes time. As a consequence, job destruction varies more than job creation and job reallocation should move counter-cyclically.

We analyse the effects of the cycle on job flow rates and to what extent firing restrictions may affect the cyclicality of job flows. More stringent employment protection legislation is found to increase the cyclical volatility of job creation relative to job destruction, making job reallocation more pro-cyclical. This finding sheds further light on the importance of employment protection in shaping employment dynamics in these countries, and provides empirical support to the theoretical insights discussed by Garibaldi (1998).

Part I

Productivity Growth and Unemployment

Chapter 1

Unemployment and Growth: A Survey

1.1 Introduction

Does productivity growth have any impact on equilibrium unemployment? While the neoclassical theory postulates that there is no long run relationship between growth and unemployment, the more recent endogenous growth theory provides a number of reasons why productivity growth may affect the equilibrium unemployment rate.

This chapter reviews the most relevant theoretical literature in order to identify the channels through which higher productivity growth affects firms' employment decisions. On the labour demand side, two competing effects have been detected. On the one hand, the *capitalization effect* boosts job creation by increasing the present discounted value of job matches. On the other, the *creative destruction effect* increases unemployment through the destruction of jobs that become obsolete.

Supply-side incentives identified in the literature are likely to strengthen any positive influence of growth on employment. As a result, the sign of the relationship remains undetermined and even the available empirical evidence does not provide clear evidence.

The chapter is organized as follows. Section 1.2 reviews the core literature on the relationship between growth and unemployment. Both the demand side and supply side aspects are considered. Section 1.3 discusses the most relevant empirical evidence. Section 1.4 concludes.

1.2 Theoretical foundations

1.2.1 Productivity growth and job creation: the capitalisation effect

In the last decade, the question of how technological progress affects unemployment has received a lot of attention in the equilibrium unemployment literature. The first theoretical study that derives a long run relationship between technological change and unemployment is that of Pissarides (1990, ch.2).[1] Using a conventional matching model of technological change, he shows that faster technological progress reduces the long run unemployment rate by boosting job creation. Intuitively, this is due to the intertemporal nature of the firm's employment decision. The firm incurs some hiring cost today in order to acquire a worker who will yield some profits in the

[1] As Aghion and Howitt (1994) pointed out, before the Pissarides' model little attention was paid to economic growth as a potential determinant of long run employment. For example, the seminal paper of Phelps (1968) concludes that the natural rate of unemployment does not depend on the rate of productivity growth.

future. If hiring costs grow at the same rate as profits, the firm will find profitable to anticipate some hiring in order to economize on future hiring costs. An increase of labour augmenting technological progress will then increase the present value of a worker, leading to more job openings and lower unemployment in equilibrium (*capitalisation effect*).[2]

As in the standard neoclassical framework, the basic feature of Pissarides' model is that technological progress increases productivity uniformly in *all* jobs (disembodied technology) without affecting the job destruction rate. However, if the allocative aspect of the growth process is explicitly accounted for by assuming that productivity gains are embodied in new jobs at the expense of old jobs[3], faster growth rate may increase the unemployment rate through the "creative destruction" of skill - obsolescent jobs and their replacement by new high productive ones. As a consequence, two competing effects on unemployment may arise from faster technological progress. First, as in Pissarides (1990), faster growth reduces the rate at which firms discount the future profits from opening new vacancies and then has a positive impact on job creation (*capitalisation effect*). Second, it leads to faster obsolescence of skills and technologies, thus reducing the duration of job match and then increasing the equilibrium unemployment (Shumpeterian *creative destruction effect*).

In the following section, we discuss the effects of growth on unemployment when technological progress is embodied in new capital. In this case, either only new jobs

[2] The term *capitalization effect* was firstly introduced by Aghion and Howitt (1994).

[3] The idea that technological change can have a negative impact on unemployment is not recent, being a concern of both economists and policy makers since the beginning of the Industrial Revolution. However, only recently economic theory has sistematically investigated the relation between technological progress and unemployment.

may benefit from technological progress (Aghion and Howitt, 1994) or firms can still implement the new technology in the existing jobs by incurring a fixed renovation cost (Mortensen and Pissarides, 1998). A more general view is taken in a recent paper by Pissarides and Vallanti (2003), in which productivity grows in new jobs as well as in existing jobs, though only at a lower rate.

1.2.2 Job destruction through obsolescence: capitalisation effect vs. creative destruction effect

Aghion and Howitt (1994) examine the relative strength of the capitalisation effect and the creative destruction effect by using a variant of the conventional search model developed by Pissarides (1990). They adopt the Schumpeterian assumption of embodied technology and interpret it as implying that existing jobs cannot benefit from new technology. Therefore, new ideas have to be embodied in new machines matched with appropriate workers in order to be implemented.

Inside each firm, the production of the final good at any point in time takes place within a continuum of "production units"[4] according to the following production function:

$$y_s = A_t \cdot \psi(x_s - a) \tag{1.1}$$

where x is human capital, a is the minimum amount of human capital in the production process, $\psi(.)$ is a standard production function[5], and $A_t = A_0 e^{gt}$ is a pro-

[4]Each "production unit" consists of a machine embodying a technology of some vintage t, a worker and a given amount of human capital.

[5]$\psi(.)$ is such that $\psi(z) = 0$ for all $z \leq 0$, $\psi' > 0$ and $\psi'' < 0$, and the standard Inada conditions hold (i.e. $\psi'(0) = +\infty$ and $\psi'(+\infty) = 0$).

ductivity parameter which depends on some exogenous innovation process.

In this framework unemployment occurs because of *labour reallocation across firms.* When a technological shock hits a firm at time t, this will open access for that firm to the leading technology A_t. Thus, provided the firm incurs a fixed implementation cost, it will be able to establish a new productive unit of vintage t and employ a suitable skilled worker. However, since in each production unit productivity remains fixed at the level of job creation time while the price of human capital increases in steady state at the economy growth rate ($P_s = P_0 e^{gs}$)[6], the surplus flow generated by each unit (i.e. the output minus the rental cost of human capital) declines over time until it eventually becomes zero at time T. At that time the production unit shuts down forcing the worker into unemployment. T is thus the life-time of a production unit or, equivalently, the duration of the match between a worker and the corresponding production unit. Therefore, higher g will lead to a faster decline in profits during the life-time of a production unit and consequently to a reduction of the life-time of the unit. Following the conventional search theory, the equilibrium rate of unemployment is defined as

$$u = 1 - T \cdot p(v) \tag{1.2}$$

where $p(v)$ is recruiting-success rate as defined in Pissarides[7] (1990, Chap.1), v is

[6] All fixed cost have to grow at the economy growth rate in order to guarantee the consistence of a steady state equilibrium.

[7] The variable $p(v)$ is determined by the matching function as follows

$$p(v) = \frac{m(1,v)}{1}.$$

the number of vacancies in the economy (with $p(v)$ increasing in v) and 1 is the total mass of worker in the economy, each of them endowed with one unit of labour services and X units of human capital.

Equation 1.2 shows that an increase in the rate of growth (g) can affect unemployment through a number of channels. First, it reduces the life-time of production units T and then, holding the number of vacancies constant, raises the job-destruction rate and the equilibrium unemployment rate (*direct creative-destruction effect*). In addition to the direct effect which works through job destruction, a indirect effect can be identified working through job creation ($p(v)$ in equation 1.2). The decrease in T implies a faster decline of profits associated to a given production unit and then of the benefits of creating new vacancies. This indirect creative destruction effect reinforces the direct effect of increasing the unemployment.

So far, the relationship between unemployment and growth is unambiguously positive, due to the fact that jobs are created by production units which cannot benefit from productivity growth. The presence of a fixed set-up cost $D_t = D_o e^{gt}$, which is paid by the firm in order to enter the market, allows however to identify a negative capitalisation effect of growth on unemployment similar to that in Pissarides (1990). The explanation is simple to understand. When the firm incurs a fixed set-up cost, any increase in the growth rate g reduces the discount rate at which the firm capitalises the expected future profits and therefore increases the benefit of entering the market. The capitalisation effect works in the direction of increasing the equilibrium number of vacancies and hence decreasing unemployment. Whether the overall effect will be to rise or reduce unemployment depends on the relative strength of the conflicting forces and more precisely on the parameters of the model. In particular, the comparative static results from the steady-state analysis suggests an inverted U-shape relationship between equilibrium unemployment and growth rate (that is decreasing for small value of g and then increasing for values of g sufficiently large).

The relationship between growth and unemployment has been recently re-examined by Mortensen and Pissarides (1998). They use a standard matching model to show that growth may have either a positive or negative impact on unemployment depending on the particular technological assumption adopted. As in Aghion and Howitt (1994), new jobs embody the most advanced known technology and job destruction occurs when existing jobs are no longer profitable.[8] The two models differ in the way the new technology can be adopted. While in Aghion and Howitt (1994) firms can update their technology only by closing the existing jobs and opening new vacancies, in Mortensen and Pissarides firms can always update their technology by incurring some fixed renovation costs and continue producing with the same worker. As a result, the effect of productivity growth on unemployment crucially depends on the size of the cost of updating. If the technological choice of the firm is totally irreversible (i.e. renovation costs tend to infinity), Aghion and Howitt's creative destruction effect occurs, and an increase in productivity growth unambiguously leads

[8] In Mortensen and Pissarides, jobs are also destroyed because of the arrival of some exogenous shock, governed by a known Poisson process.

to higher unemployment.[9] The mechanism through which unemployment occurs is similar to that illustrated in Aghion and Howitt model. Wages of *existing jobs* grow in line with the growth rate of wages of more productive *new jobs* induced by technical progress. This wage growth, which is in part independent from the path of the worker's own productivity, leads to a decrease in the profitability of existing jobs and eventually to job destruction.

Formally, given that jobs are destroyed either because they reach the age of obsolesce or they experience a shock that arrives at the exogenous rate s, the total job destruction flow (JD) is $ns + JC \exp\left\{-\delta T^0\right\}$, where T^0 is the equilibrium optimal age of job destruction and n is the number of employed workers. Job creation and job destruction are the same in steady state and job creation is simply equal the rate at with workers are matched the job, that is

$$JC = m(\theta^0, 1)u = ns + JC \exp\left\{-sT^0\right\} = JD \tag{1.3}$$

where $m(\theta^0, 1)$ is a standard matching function and θ^0 is market tightness defined as the vacancy to unemployment ratio. From equation 1.3 and defining unemployment as $u = 1 - n$, the equilibrium unemployment rate is

$$u = \frac{s}{s + [1 - \exp\{-sT^0\}]\, m(\theta^0, 1)} \tag{1.4}$$

[9] Notice that, when firms cannot take advantage of growth because renovation costs are too high, the negative capitalization effect of growth on unemployment is absent due to the fact that the model does not impose any positive setup costs.

According equation 1.4, an increase in the economy growth rate negatively affects the steady state unemployment rate both directly by lowering the life time of existing jobs (T^0), and indirectly by reducing the incentive of opening new vacancies, which in turn leads to a reduction in market tightness.

In a more general case with finite positive renovation costs, firms have the option of updating their technology at a given date t, after incurring a fixed cost $I(t) = Ie^{gt}$. When a firm chooses to renovate, the value of its job jumps from $J(\tau, t)$ to $J(t, t)$ where τ is the time at which the job has been created (job vintage).[10] When all the firms decide to renovate, the job destruction rate is exogenous and equal to s. In this case the steady state unemployment rate is simply

$$u = \frac{s}{s + m(\theta^0, 1)} \tag{1.5}$$

and faster growth affects unemployment only through its effect on market tightness. Thus, the relevant question is in what direction growth affects job creation. As before job creation depends on the value of creating a new job. But now the increase in the economy growth has two opposite effects on the value of new jobs. On the one hand, it increases the growth rate of wages and then, given the technology, reduces the net surplus from that particular job. On the other, since firms have always the opportunity of updating their technology, faster technological progress implies higher future productivity and then higher discounted value of future profits from opening new

[10] Since firms have the option of adopting new technology through creative destruction as well, the optimality of the updating strategy requires the relevant "renovation horizon" T to be lower than the "destruction horizon" T^0.

jobs. The relative strength of these two opposite forces depends on the size of $I(t)$. If $I(t)$ tends to zero, the updating process occurs continuously ($T = 0$) precluding technological obsolescence. In general, if renovation costs are small enough, growth has a pure capitalisation effects and by boosting job creation reduces equilibrium unemployment. In an extension of the model which allows different job-updating costs among firms, Mortensen and Pissarides find that faster technological progress increases the job reallocation rate both across firms and sectors without necessarily implying a lower equilibrium number of jobs. However, when heterogeneity among firms is taken into account, the model does not provide an unambiguous prediction about the relationship between economy-wide productivity growth and unemployment.

A more general view is taken in a recent model by Pissarides and Vallanti (2003). As in the previous models, growth influences job creation through capitalisation effects and job destruction through obsolescence. The precise influence on each depends, however, on whether new technology can be introduced into ongoing job relationships, or whether it can only be embodied in new jobs. If technology is fully disembodied (neoclassical Solow model) existing jobs can take full advantage of new technological improvements. As in Pissarides (1990), this makes existing jobs more valuable during periods of fast growth, because their creation cost is sunk, and so faster growth increases employment. When technology is fully embodied as in Aghion and Howitt (1994) existing jobs cannot benefit from new technology. In this case faster growth decreases employment because profit opportunities outside the firm rise faster and existing jobs become less valuable.

Pissarides and Vallanti (2003) re-interpret the Schumpeterian assumption of creative destruction as saying that although some major technological advances require the establishment and growth of new jobs and new sectors, firms can still increase the productivity of existing jobs by investing more and implementing new technologies on the job. This is formalized assuming that a fraction λ of productivity gains arising from new technology is disembodied and can be beneficial to *all* jobs and a fraction $(1-\lambda)$ is embodied in new jobs only. The main implication of this hypothesis is that both the capital-labour ratio and productivity can grow in existing jobs, but productivity growth in existing jobs is below the productivity growth in new jobs when technology is not fully disembodied ($\lambda < 1$).

In this framework, the mechanism through which obsolescence occurs is similar to that illustrated in Aghion and Howitt (1994). Wage growth in existing jobs depends on two components: an inside component that grows at rate λg (where g is the overall rate of technological progress) and depends on labour productivity inside the firm and an outside component that grows at the rate g and depends on the rate of the overall technological progress because all new jobs are created on the technological frontier. Since inside the firm wages grow faster than the labour output, the profit flow generated by each job declines over time and eventually becomes negative leading to job destruction through obsolescence.

Formally, the model yields the following steady state conditions for the three unknowns of the model, namely the destruction age T, the market tightness θ and the unemployment rate u[11]

$$T = \frac{\ln \phi - \ln \omega}{(1-\lambda)g}. \tag{1.6}$$

$$(1-\beta)(y(\lambda g)\phi - y(g)\omega) = \frac{c\theta}{m(\theta)}. \tag{1.7}$$

$$u = \frac{n+s}{\left(1-e^{-(n+s)T}\right)m(\theta)+n+s}. \tag{1.8}$$

Equation 1.6 determines the optimal life of the job. Intuitively, a job is destroyed when the reservation wage of the worker (ω) becomes equal to the marginal product (ϕ).[12] It follows from (1.6) that if all technology is of the Solow disembodied type ($\lambda = 1$), the firm will never want to destroy a job through obsolescence. Job destruction in this case takes place only because of the exogenous separation process.[13] But if $\lambda < 1$, some technology is embodied in new jobs and jobs become obsolescent through competition from new jobs, which pushes wages up at a faster rate than the marginal product of labour in existing jobs. Faster growth leads in this case to more job destruction, as by differentiation of (1.6), $\partial T/\partial g < 0$.

[11] A more detailed derivation of the model is available upon request.

[12] The reservation wage is defined as

$$\omega = b + \frac{\beta}{1-\beta}m(\theta)V$$

where b is unemployment income, β is the surplus share of labour, $m(\theta)$ is the rate at which job matches occur, and V is the present discounted value of expected profits from a vacant job.

Note that the reservation wage captures the external influences on wages, which make attractive quitting the job, namely the unemploymnet compensation (b) and the remuneration in new jobs.

In the case of Cobb-Douglas production function, ϕ is defined as

$$\phi \equiv (1-\alpha)\left(\frac{\alpha}{r+\delta}\right)^{\frac{\alpha}{1-\alpha}}.$$

where r is capital rental cost, δ is the depreciation rate and α is the share of capital in the Cobb-Douglas production function.

[13] As in Mortensen and Pissarides (1998) jobs, in this model jobs are destroyed because either they become obsolete or they experience a negative shock that arrives at the exogenous rate s.

Equation 1.7 is a standard job creation condition and corresponds to a marginal condition for the demand of labour. If $m(\theta)$ is a standard matching function and c is the cost of opening a vacancy, $\frac{c\theta}{m(\theta)}$ is the expected value of the firm's hiring costs. Equation 1.7 says that that the expected gain from a new job must be equal to the expected hiring cost that the firm has to pay.[14] Differentiation of equation 1.7 with respect to g shows that the effect of growth on market tightness (θ) can be either positive or negative. At $\lambda = 0$, when all technical progress is embodied, the sign is negative, whereas at $\lambda = 1$, the sign is positive. It can be shown that there is a unique λ^*, such that for values of $\lambda < \lambda^*$ faster growth reduces market tightness and for values of $\lambda > \lambda^*$ it increases it. At $\lambda = \lambda^*$ growth has no effect on θ.

Finally, equilibrium unemployment in equation 1.8 is simply obtained from the equality of the flow into unemployment (JD) and out of it (JC).[15]

According to equations 1.6-1.8, an increase in the rate of growth has the following effect on firm's employment decisions:

- It rises the job destruction rate because the age of obsolescence T increases with g; and
- It has an ambiguous effect on job creation depending on whether and to what extent the new technology is embodied in new jobs or can be incorporated in existing jobs.

[14] The present discount factors $y(\lambda g)$ and $y(g)$ are equal to $\frac{1 - e^{-(r+s-\lambda a)T}}{r+s-\lambda a}$ and $\frac{1 - e^{-(r+s-a)T}}{r+s-a}$ respectively.

[15] Notice that equation 1.8 is identical to equation 1.5 in Mortensen and Pissarides (1998). In equation 1.8 n is the exogenous labour force growth rate. In Mortenen and Pissarides (1998) labour force is assumed to be constant.

Thus, the overall effect of growth on unemployment crucially depends on the fraction λ of technological progress that can be adopted by existing jobs. The smaller λ, the more likely is to obtain a positive effect of growth on unemployment.

1.2.3 Capitalisation effect with endogenous interest rate

In the models considered so far the interest rate is assumed to be exogenous and constant. If this hypothesis is plausible for a small open economy with perfect capital mobility, this can not be the case in a closed economy or in a large open economy, where the interest rate is likely to depend on the economy growth rate. Eriksson (1997) considers the *capitalisation effect* of growth on unemployment when the interest rate is no longer exogenous but it is endogenously derived from a Ramsey model. The job creation side of the model is similar to that in Pissarides (1990) but now the consumer's behavior is endogenized by introducing utility maximizing individuals. Solving both consumer and firm's optimization problems, market tightness in equilibrium (θ) turns to depend negatively on the effective discount rate defined as $(r-g)$ where r is real interest rate and g is the (exogenous) productivity growth rate. Similar to Pissarides (1990), a change in the economy growth rate has an impact on market tightness θ (and consequently on the equilibrium unemployment rate) through the effective discount rate (capitalisation effect).

The relationship between market tightness and unemployment is still negative: more vacancies lead to a higher probability for the unemployed workers to find a job, and thus reduce unemployment.

However, when the interest rate is endogenous the total effect of an increase in g on the effective discount rate is ambiguous. On the one hand, keeping r constant, it lowers $(r - g)$ and then increases the present value of profits from creating new vacancies. On the other, faster growth reduces the amount of capital available per efficiency unit of labour and increases the interest rate with a negative impact on $(r-g)$. The overall effect of g on unemployment depends on the value of the elasticity of intertemporal substitution. Eriksson shows that if the elasticity of intertemporal substitution is small enough[16], the relationship between the economic growth rate and unemployment turns to be positive.

1.2.4 Reverse causality: does unemployment affect growth?

In the above literature, causality runs in one direction, from growth to unemployment. However, there are several theoretical reasons to assess causality running in the opposite direction. In a learning-by-doing framework high and prolonged unemployment can negatively affect growth by leading to a loss in skills and human capital. Incorporating unemployment into a generalized augmented Solow-type growth model, Brauninger and Pannenberg (2000) show that, when human capital enters the production function and productivity growth is endogenously determined in the economy, an increase in unemployment leads to a decline in the long run productivity growth rate. Conversely, efficiency wage theories such as Rebitzer (1987) suggest that greater unemployment reduces the probability of re-employment and

[16] A low elasticity of intertemporal substitution implies that individuals' consumption patterns exhibit small reactions when the intertemporal prices change. As a consequence, the interest rate has to change a lot when the growth rate varies, for the household to be in optimum.

thus increases worker's effort and productivity growth.

Another channel through which higher unemployment can affect growth is by reducing savings available for investment. Bean and Pissarides (1993) develop this argument using a simple overlapping generations model modified to allow for endogenous growth and equilibrium unemployment[17], where both capitalisation and creative destruction effects are absent.[18] In this framework, they show how the potential co-movement of growth and unemployment, that are *both endogenously* determined in the model, can be seen more as the result of changes in the underlying economy, than the result of a causality relationship between the two. More specifically, a reduction in hiring costs or an increase in taxation to finance government spending is found to have a positive effect on employment and, through the impact of unemployment on workers' savings, it fosters capital accumulation and growth. This implies a negative correlation between growth and unemployment even in absence of capitalisation and reallocation effects. However, if changes in the growth rate are caused by changes in variables which do not have a direct impact on employment (e.g. saving rate in the model), no correlation between growth and unemployment can be detected. This is not really surprisingly from a theoretical point of view and suggests that any observed relationship between growth and unemployment can be due to variations in other factors that are responsible for changes in unemployment and growth rate.

[17]Endogenous growth is obtained by adopting a Romer (1986)-style production function that exhibits constant return to scale in reproducible inputs. Equilibrium unemployment arises because of matching frictions into the labour market which make the match between workers and jobs costly.

[18]This is equivalent to the neoclassical assumption that economic growth does not affect equilibrium unemployment.

The findings in Eriksson (1997) are in line with those in Bean and Pissarides (1993). According to Eriksson's model the correlation between growth and unemployment depends on what kinds of changes one is considering. There is a trade-off between employment and growth, as long as changes that directly affects growth rate are considered. This holds both when there is endogenous and exogenous growth and happens through a variation in the effective discount rate as shown above. With this exception, however, it seems like changes that promote employment also promote growth. When such changes happen (i.e. changes in capital tax or unemployment compensation) what is good for employment is also good for growth.

1.2.5 Supply-side effects of growth

Supply-side incentives are likely to strengthen any positive influence of growth on employment. Two hypotheses have been put forward in the literature. Phelps (1994) argues that the supply of labour depends on the ratio of wage to non-wage income.[19] Using a general equilibrium incentive-wage model, he shows that an unexpected increase in the rate of technological progress decreases the nonwage-income-to-wage ratio, and so increases the incentives to work and then increases employment. In a closed economy this effect is temporary. In the long run, faster technological progress induces an equal increase in the interest rate. This restores the equilibrium relation between the two types of income and incentives (and so employment) return

[19] Nonwage income per worker is defined as the maximum amount of income from wealth that can be consumed under the contraint that individual wealth ω keeps growing at the steady state growth rate g. Formally, this is equal to $(\theta + r - g)w$ where θ is the job-worker exogenous separation rate and r the real interest rate (Hoon and Phelps, 1997).

to their initial level. This may not, however, be the case in a small open economy. When the domestic interest rate is exogenously determined, an increase in the rate of technological progress leads to a permanent fall in the non-wage income relative to wage income, reducing the equilibrium unemployment rate.

A temporary (but long-lasting) effect of growth on employment may also arise from the slow adjustment of worker's wage aspirations to an *unanticipated* change in the productivity growth rate. It has been argued that when productivity growth changes unexpectedly "aspirations" of wage growth do not adjust immediately, creating a gap between the new rate of productivity growth and wage growth. This gap temporarily increases the "non-accelerating inflation rate of unemployment" when there is a productivity slowdown and decreases it when there is an acceleration of productivity growth. In the long run, aspirations (and wages) adjust and eventually the unemployment rate will move toward the previous level of steady-state.[20]

In contrast to the previous models, who posit permanent links between productivity growth and employment, the link that has been emphasized in the "wage aspirations" approach is just temporary.[21] Such a temporary link, however, may be used as further reasons for the existence of deviations between the long-run and short-run effects of changes in growth rates.

[20] Many authors have interpreted the relationship between unemployment and growth along this lines. Recent example include Blanchard and Katz (1997), Stiglitz (1997), Blanchard (2000) and Ball and Moffitt (2002). However, a comprehensive theory on wage aspirations has not been fully developed yet.

[21] This temporary effect could be long-lasting, depending on the time "wage aspirations" adjust to the new productivity levels (Blanchard, 2000).

1.3 Empirical findings

The previous section outlined the relationships existing between the equilibrium unemployment and growth from a theoretical perspective. There are a number of reasons why the unemployment rate might be affected by a change in the rate of productivity growth due to technological developments. The relative importance of the links and channels emphasized by the different models is however ambiguous and no definite conclusions can be reached. As a result, searching for more definitive results is an empirical matter.

There are few empirical studies which try to estimate the direct impact of productivity growth on unemployment.

Grubb et al. (1982) estimate conventional wage and price equations of a partial equilibrium system for 19 OECD countries, and use the estimated equations to simulate the events of the late 70s. According to their study, the fall in productivity growth experienced by almost every country since the early 70s has not been followed by a corresponding decrease in the target growth rate of wages at a given level of employment. As a consequence, lower real wage growth has been obtained through a mixture of higher unemployment and, since the economy is characterized by some nominal inertia, higher inflation.

Dreze and Bean (1990) estimate wage and price equations derived from a general macro model that includes productivity growth. They do not test any direct effect of productivity growth on unemployment. However, they find that changes in productivity growth are quickly incorporated in wages in European countries, while this phenomenon is less evident for the United States. From a theoretical point of view, the incorporation of productivity gains into real wages leads to capital-labour substitution which turns to be wasteful when the economy is operating with an unemployment above its natural level. They argue that this can explain the differences in relative job creation over the 80s.

More recently, Wilson (1995) examines the dynamic response of unemployment to shocks in productivity growth for five G7 countries. She estimates a reduced unemployment equation which relates unemployment to productivity growth. Simulations show that temporary increases in productivity growth have a positive even if small impact on unemployment in the short run. This suggests that wages and prices are slow to adjust to technological shocks. On the contrary, there is no evidence of any long-run relationship, being the effects of permanent productivity shocks on unemployment not significant. The presence of feedbacks from unemployment to productivity growth is also tested using VAR methodology.[22] The estimated impulse response function shows that the impact of unemployment on productivity is small and, in general, not significant.

A VAR methodology is also used by Zagler (2000) to detect a possible relation of causality between equilibrium unemployment and productivity growth for four European countries. The causal implications of three different models of endogenous growth and unemployment, namely a matching model, an efficiency wage model and a union model, are tested using standard bivariate Granger causality tests.[23] The

[22] Apart from the unemployment rate and the productivity growth rate, the VAR includes demand variables, oil price, and labour supply.

[23] The three models have different implications on the relationship between unemployment and

results of the analysis are not conclusive and a clear pattern for this relationship across Europe cannot be identified.

To account for both the long run and short run relationships between unemployment and growth rate, Zagler (2003) uses data from four European countries to estimate a vector error correction model of economic growth and unemployment. The results indicate that, in the long run, economic growth and unemployment appear to be positively correlated, while,in the short run, an increase in the equilibrium employment rate has a negative impact on the economic growth rate. The main drawback of the above analysis is that both Granger causality tests and the vector autoregression analysis do not control for other variables influencing both productivity growth and unemployment. As a result, it is possible that additional factors, such as low aggregate demand or high interest rate, can drive this correlation.

Blanchard and Wolfers (2000) use aggregate data but panel techniques to assess the long run impact of productivity growth on unemployment. They estimate a reduced unemployment equation for a panel of OECD countries and focus on the impact of different "shocks"[24], namely productivity growth, real interest and labour demand, on the equilibrium unemployment rate.[25] Moreover, they interact these "shocks" with labour market institutions in order to verify a possible role of labour market institutions in amplifying the effects of negative macroeconomic events. They

growth. More specifically, matching models predict a causal relationship from growth to unemployment, efficiency wage models predict the opposite direction of causality, and finally union models indicate causality in both ways. See Zagler (2000) for a brief review of the three classes of models.

[24] As Nickell et al (2001) point out, it is not really appropriate to define the long run changes in TFP growth, real interest rate and labour demand as shocks, since they are not mean reverting over the length of the sample.

[25] They use five year averages of the data to capture the long run effects of their variables of interest on unemployment.

show that long-run changes in the level of TFP growth have a negative impact on unemployment, with the impact being bigger in some countries because of institutional differences. A similar approach is followed in Fitoussi et al. (2000). Their specification differs from the one used by Blanchard and Wolfers in the way they try to estimate a separate impact of institutions on both the size and the persistence of the effect of TFP growth on unemployment. The effect of growth is in line with the that obtained by Blanchard and Wolfers (2000), though its magnitude appears to be substantially higher.

In a recent study for the OECD countries Nickell et al. (2001) introduce "genuine" productivity shocks in a reduced-form unemployment equation in order to capture real wage resistance to an unexpected change in productivity growth. In accordance with the hypothesis of "wage aspirations", they find that an adverse productivity shock, which leads to a persistent decrease in trend productivity growth, has a positive impact on real wages and, consistently, a temporary positive effect on unemployment.

Finally, Ball and Moffitt (2002) explicitly model real-wage aspirations in an otherwise standard model of the Phillips curve in order to explain the apparent improvement in the unemployment-inflation trade off occurred in the last ten years. Using aggregate US annual data for the period 1962-2000, they find that productivity growth relative to wage aspirations has a negative and significant effect on inflation. They also use their estimates to forecast inflation over the period 1996-2000 and they conclude that inflation remains low despite the low unemployment rate because productivity acceleration leads to an increase of the productivity-wage aspiration gap.

1.4 Conclusions

In this chapter we discussed the theory and empirical evidence underlying the relationship between growth and equilibrium unemployment. Several channels have been suggested in the literature. The overall effect of growth on unemployment remains undetermined from a theoretical point of view and the empirical studies do not provide clear evidence on the sign and magnitude of the relationship.

In the light of the above theoretical and empirical findings, in Chapter 2 of the thesis we further investigate the effects of productivity growth on employment by specifying and estimating a structural labour market model where employment, wage and capital accumulation are endogenous choice variables. Differently from previous empirical studies based on the estimation of a reduced form unemployment equation, our empirical model allows to test and impose long run restrictions derived from the theory such as the long run neutrality of capital stock and TFP, and to investigate the main channels through which technological progress may affect unemployment. The key objective of the analysis is to see to what extent the dynamics of productivity growth from the 1960s to the 1990s can explain the US-Europe differences in the unemployment experience in the last thirty years.

Chapter 2

Unemployment and Growth: Panel Estimates

2.1 Introduction

The purpose of this chapter is to examine the relation between exogenous growth in total factor productivity (TFP) and employment, when wages and capital are both endogenous choice variables. We estimate a three-equation system with annual data from 1964 to 1995 for a panel of countries consisting of the United States, Japan and thirteen of the countries of the European Union.

The aim of the analysis is not to provide any definite evidence for a theory, since more than one theory can be consistent with the data. We specify a broadly general empirical model which allow to test and impose long run restrictions and identify the channels through which productivity growth affects unemployment.

The empirical model draws heavily on models with frictions and quasi-rents by Pissarides (2000, Chapter 3), Aghion and Howitt (1994), Mortensen and Pissarides (1998), Pissarides and Vallanti (2003) and others.

The methodology followed by previous empirical studies has been based on the estimation of a reduced form equation for unemployment, neglecting interactions among the variables of interest and assuming capital stock as exogenous (e.g. Blanchard and Wolfers, 2000, Phelps 1994). Moreover short run dynamics have been neglected and the analysis has been mainly focused on the long run effects of growth on unemployment. Our empirical model makes explicit the essential interactions among the variables of interest and the channels through which they affect employment and allows for short run dynamics. Moreover, the long-run neutrality of capital stock and TFP and other long run restrictions implied by economic theory are tested and then imposed in the estimation, while TFP growth is allowed to affect the steady state unemployment rate as suggested by search equilibrium models.

There has been virtually no work on the out-of-steady-state properties of growth models with frictions.[1] This poses a problem for econometric work, since the data that we use to estimate the model are generated in real economies, whose adjustment to the steady state in response to TFP shocks may take several years. Our approach is to test and impose the long run restrictions on the steady-state solution of the estimated empirical model. But in the estimation we allow for data-driven unrestricted adjustment to the steady state. We then simulate the estimated ad-

[1] A notable exception is the recent paper by Postel-Vinay (2002), which calibrates the out-of-steady-state behavior of the Schumpeterian model discussed in the previous chapter.

justment paths and show that although steady states are stable and satisfy the long run restrictions, the simulated adjustment paths can be very long.

A much-discussed empirical question in the literature is whether the slowdown in TFP growth after 1973 can explain the rise in unemployment that followed. A related question is whether the acceleration of productivity growth in the 1990s has reduced, or is likely to reduce, the unemployment rate.[2] The simulation shows that the productivity slowdown and subsequent recovery in the United States can account for virtually the entire dynamics of unemployment, save for the extremes of cyclical peaks and troughs. But in Europe, although productivity growth can account for bigger changes in unemployment, the productivity slowdown of the 1970s fails to track the full rise in unemployment in the 1980s, and more the recent productivity recovery fail also to explain the persistence of unemployment into the 1990s.

The chapter is organized as follows. Section 2.2 explains the derivation of the three estimated equations. Section 2.3 describes the data and the growth accounting that we used to calculate TFP growth for each country in the sample, and discusses some econometric issues. Section 2.4 presents the results of the econometric analysis and uses the results to simulate the effects of the observed productivity changes. This section also calculates the fraction of TFP growth embodied in new jobs as defined in Pissarides and Vallanti (2003), and finds it to be a very small number. Section 2.5 concludes.

[2]This discussion goes back to Bruno and Sachs (1985) and several other authors. For more recend discussions of the role of producitivity slowdowns see Phelps (1994), Blanchard and Wolfers (2000), Fitoussi et al (2000) and Krueger and Solow (2002).

2.2 Empirical specification

The aim of the empirical analysis is to estimate the productivity growth effects implied by the equations for the capital stock, wages and employment. We estimate the structural equations and allow for unrestricted short-run adjustment lags by including up to two lags of the dependent variables and TFP. The following long run restrictions are tested and then imposed on the estimated model:

1. The rate of growth of wages and the capital-labour ratio in the steady state are equal to the average rate of growth of TFP:

$$\frac{\dot{k}}{k} = \frac{\dot{w}}{w} = a. \tag{2.1}$$

2. Changes in the capital stock and TFP do not affect steady-state employment:

$$\frac{\partial L}{\partial k} + \frac{\partial L}{\partial w}\frac{\partial w}{\partial k} = 0, \tag{2.2}$$

$$\frac{\partial L}{\partial A} + \frac{\partial L}{\partial w}\frac{\partial w}{\partial A} = 0. \tag{2.3}$$

2.2.1 The employment equation

The empirical employment equation includes the structural variables influencing both job creation and job destruction in the models with search frictions and labour-augmenting exogenous technological progress, as described in the previous chapter under the assumption that job creation costs are exogenous and unobservable. These variables are the level of marginal product, the wage rate, the interest rate and the expected rates of growth of the marginal product and the wage rate. The marginal product is proxied by its arguments, including the level of TFP and the level of the capital-labour ratio. The expected rates of growth of marginal product and the wage rate are proxied by the rate of TFP growth.

Since job creation and job destruction depend on the same variables, making it impossible to identify them separately, we estimate a single employment equation and make what inferences are possible about job creation and job destruction from it.

In our employment equation the dependent variable is the ratio of employment to population of working age and the independent variables are the level and rate of change of TFP, the level of the capital stock normalized to the working age population, the real cost of labour and the real interest rate. The capital stock and the real wage rate are treated as endogenous. In the short run we allow the capital stock and TFP to have different effects on employment (e.g. because the costs of adjustment in capital are different from the technology implementation lags) but in the long run their effects are restricted by (2.2)-(2.3). The different adjustment lags in job creation and job destruction also imply differential short-run and long-run effects. Recall that TFP growth increases job destruction, by reducing the useful life of a job, but may increase or decrease job creation. Supposing that job destruction reacts faster than job creation to shocks, as usually found in the data,[3] we should expect the impact effect of productivity growth on employment to be negative, and

[3]The standard reference is Davis, Haltiwanger and Schuh (1996). In some European countries, however, job creation sometimes reacts faster than job destruction because of firing restrictions. See Boeri (1996) and Garibaldi (1998).

either remain negative or turn positive in the medium to long run, when job creation has had time to adjust.

From a theoretical perspective there has not been much formal work on the out-of-steady-state behavior of job creation and job destruction. Some recent simulation results by Postel-Vinay (2002), however, lend further support to our empirical specifications. His main claim is that the short-run effects of changes in growth rates are likely to differ and be "perverse" vis-a-vis the steady-state effects.

2.2.2 The wage equation

In models with search frictions the wage setting decisions are formalized as the result of a bargaining process (typically bilateral Nash bargaining) between firms and workers. In particular, firms and workers set wages in order to share the rent from job matches. Such a rent has to compensate both firms and workers for the costs incurred in the search process including foregone wages and profits. The real wage then depends on an internal component representing intrinsic job productivity and on an external component representing workers' outside option.[4] The variables influencing the external component are the expected returns from search and the unemployment income. In this framework the way unemployment rate enters the wage equation is through the bargaining power each party has. Given the number of vacancies, a higher unemployment rate implies that rate at which vacant jobs arrive

[4] While in the case of disembodied technological progress both the internal and the external component grow at the same rate as the aggregate productivity, in case of (partially) embodied technological progress the internal component grows at a lower pace. If technological progress is fully embodied as in Aghion and Howitt (1994), productivity in existing job remains fixed at the level of job creation time.

to unemployed worker is lower than the rate at which unemployed workers arrive at vacant jobs. As a consequence the workers' bargaining power is lower, implying lower wage rate.

Following this approach, we then estimate an error-correction equation for wage determination and impose the restriction that real wages in the steady state grow at the rate of TFP growth. In the empirical specification, the unemployment income is represented by two parameters of the unemployment insurance system, the ratio of compensation to mean wages and the duration of entitlement. The marginal product of labour and the expected returns from search are represented by the level and rate of growth of the capital-labour ratio and TFP, where now, in contrast to their effects on employment, both levels and rates of growth should have a positive impact on wages. The capital stock is divided by the labour force (rather than employment) to avoid spurious correlations due to cyclical noise in the employment series.[5] In the steady state the unemployment rate is constant, so steady-state results are not influenced by this change.[6] We also include the first difference in the inflation rate as an additional cyclical variable to pick up temporary deviations from the steady-state path due to information imperfections or long-term contracts.

[5]The use of capital to labour force ratio as an indicator for trend productivity is very common in the empirical specification of the wage equation. See Layard et al. (1991) for a cross-country comparison of the estimates of the wage equation.

[6]Notice that this empirical specification of the wage equation is quite general and its predictions may be consistent with other wage setting mecchanisms. For example, competitive models or efficiency wage models have broadly similar implications. See Bean (1994) for a review of the different wage setting mechanisms and their implications.

2.2.3 The investment equation

The specification of the investment equation is consistent with a standard neoclassical approach. A profit maximizing firm demands capital stock at the point where the marginal productivity of capital is equal to the user cost of capital.

Following Blanchard (1998), we then specify the investment equation as a function of factor prices, namely the cost of capital and the real wage (in efficiency units). In the long run the equation converges to a value of the capital stock proportional to TFP and the factor of proportionality depends on the cost of capital and the cost of labour. For the cost of capital we use the real interest rate but we also include a variable for government debt, on the assumption that more government involvement in capital markets makes it more difficult for private business to acquire funds (Phelps, 1994).[7]

2.2.4 The system

In accordance with the discussion above and the theoretical considerations in the previous chapter, the empirical specification for the employment equation takes the following log form :

$$\begin{aligned} \ln(L/P)_{it} &= \alpha_0 + \alpha_1 \ln(L/P)_{it-1} + \alpha_2 \ln(L/P)_{it-2} + \alpha_3 \ln w_{it-1} + \alpha_4 \ln(K7P)_{it} + \\ &\quad \alpha_5 \ln A_{it} + \alpha_6 d \ln A_{it} + \alpha_7 d \ln A_{it-1} + \alpha_8 r_{it} + c_i^n + \lambda_t^n + \epsilon_{it}^n \qquad (2.4) \end{aligned}$$

[7] The estimated growth effects are unaffected by the inclusion of the government debt variable in the investment equation.

where $(L/P)_{it}$ is the ratio of employment to population of working age in country i and in year t, (K/P) is the ratio of the capital stock to the population of working age, A is measured technological progress, w is the real wage rate, and r the expected (ex ante) real interest rate. c_i and λ_t capture country-specific effects and time effects respectively.

The wage equation takes the following form

$$\begin{aligned} d\ln w_{it} &= \beta_0 + \beta_1 d\ln w_{it-1} + \beta_2 d\ln(K/LF)_{it} + \beta_3 d\ln A_{it} + \beta_4 \ln w_{it-1} \\ &+ \beta_5 \ln(K/LF)_{it-1} + \beta_6 \ln A_{it-1} + \beta_7 \ln u_{it} + \beta_8 (BD_{it} * \ln u_{it}) + \beta_9 union_{it} \\ &+ \beta_{10} dtax + \beta_{11} rer_{it} + \beta_{12} d^2 \ln p_{it} + c_i^w + \lambda_t^w + \epsilon_{it}^w \end{aligned} \quad (2.5)$$

where u is the unemployment rate, BD stands for benefit duration, $dtax$ for change in the tax wedge, rer is the benefit replacement ratio, $union$ for union density, LF for labour force and p is the price level. The interaction between benefit duration and log of unemployment captures the fact that the effect of unemployment on wages depends on the degree of unemployment protections. In particular, we expect that longer benefit duration lowers the moderating influence of unemployment on wages.

Finally, the log specification of the capital accumulation equation is

$$\begin{aligned} d\ln K_{it} &= \gamma_0 + \gamma_1 d\ln K_{it-1} + \gamma_2 d\ln K_{it-2} + \gamma_3 r_{it} + \gamma_4 \ln w_{it} + \gamma_5 \ln A_{it} + \gamma_6 d\ln A_{it} \\ &+ \gamma_7 d\ln A_{it-1} + \gamma_8 \ln(K/P)_{it-1} + \gamma_9 (D/K)_{it} + c_i^k + \lambda_t^k + \epsilon_{it}^k \end{aligned} \quad (2.6)$$

where D is the level of Government debt.

2.3 Data and estimation

2.3.1 Data: Measuring TFP

The data are annual for the period 1965-1997 for the countries of the European Union, the United States and Japan.[8] We measure TFP growth by making use of a conventional growth accounting framework. The aggregate production function is Cobb-Douglas with labour augmenting technological progress:

$$Y = K^{\alpha}(AL)^{1-\alpha} \tag{2.7}$$

where Y, K and L are aggregate output, capital and employment and A denotes technological progress. Converting (2.7) to logs, and denoting by d the change in a variable between two consecutive periods, we obtain

$$(1-\overline{\alpha})d\ln A = d\ln Y - \overline{\alpha}d\ln K - (1-\overline{\alpha})d\ln L. \tag{2.8}$$

where $\overline{\alpha}$ is the average of α between two periods. As in conventional growth accounting exercises we replace Y, K, L by the measured level of GDP, capital stock and employment. One problem in measuring TFP is that the share of labour in value added is too volatile. Some authors suggest to smooth the observed labour

[8] See Appendix 2.6.3 for the definitions and the sources of the data used in the empirical analysis. The countries of the European Union in the sample are: Austria, Belgium, Denmark, Finland, France, Germany, Ireland, Italy, the Netherlands, Norway, Portugal, Sweden and the United Kingdom. Greece is excluded from the analysis because some of the institutional variables are missing, and Spain because the fast rise in the unemployment in the 1980s and the introduction of temporary contracts in 1984 make it an outlier for reasons unrelated to productivity growth. The statistical properties of the regressions deteriorate when Spain is included although the main messages of the results are unaffected.

shares using the properties of the translog production function (see Harrigan, 1997; Griffith et al., 2000).

Assuming a translog production function and the standard market clearing conditions, the labour share can be expressed as a function of the capital-labour ratio and a country-specific constant:

$$share_{it} = const_i + \beta \left(\frac{K}{L}\right)_{it} + \varepsilon_{it}$$

with i denoting countries and t years in the sample.

Employment is measured by persons employed, which is our measure of employment in the main regressions, and total hours worked. When TFP growth is adjusted for hours worked, the contribution of TFP growth is larger because of the fall in mean hours (especially in European countries) over the sample period.

Table 2.1 reports summary results (results for individual European countries are reported separately in Appendix 2.6.1) for the whole period and for three sub-periods 1965-1973, 1974-1989 and 1990-1997. Note that when we adjust for hours worked the number of countries included in the panel is reduced given the unavailability of the series "hours" for some of the EU countries.[9]

The results in Table 2.1 highlight the stylized fact of growth accounting in the comparison between Europe and the United States. In Europe employment growth has contributed a mere 6.6 per cent to GDP growth (which becomes negative when

[9] The series hours is only available for Austria, Finland, France Germany, Ireland, Italy, Norway, Sweden, the United Kingdom, the United States and Japan.

Table 2.1: Growth accounting for the European Union, United States and Japan, 1965-1997

	GDP growth (%)		Percentage contribution from					
			capital		labour		TFP	
	persons	hours	persons	hours	persons	hours	persons	hours
				1965-1997				
European Union	3.1	3.0	39.6	37.7	6.6	-3.2	53.8	65.6
United States	2.8	-	37.1	-	43.3	42.6	19.6	20.3
Japan	4.7	-	52.9	-	13.9	11.6	33.2	35.5
				1965-1973				
European Union	4.8	4.3	42.6	42.1	4.7	-9.8	52.6	67.7
United States	3.7	-	37.4	-	38.6	33.5	24.0	29.1
Japan	9.0	-	47.0	-	9.6	9.2	43.4	43.8
				1974-1989				
European Union	2.5	2.6	38.8	38.0	14.9	-12.5	46.3	74.6
United States	2.5	-	37.3	-	52.8	56.2	9.9	6.5
Japan	3.6	-	54.1	-	16.7	12.2	29.2	33.7
				1990-1997				
European Union	2.2	2.3	34.2	28.1	16.5	18.3	49.3	53.6
United States	2.4	-	36.0	-	32.2	33.5	31.8	30.6
Japan	2.1	-	64.3	-	25.1	17.8	10.6	17.9

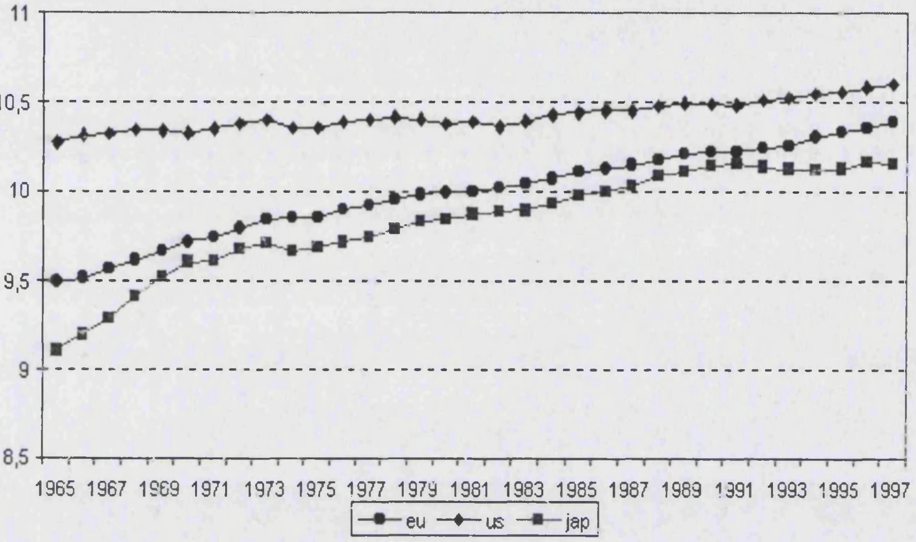
Notes: The European Union figures are simple averages calculated over the sample.

employment is measured by hours of work for the countries where data are available) whereas in the United States the contribution of employment is over 40 percent. In Japan, the contribution of employment is lower but still positive. The difference between the contribution of employment in the United States and Europe is reflected in the contribution of TFP growth. In Japan, however, capital accumulation is also a more important contribution to growth.

Looking at the evolution of our variables over the sub-periods, it appears that the contribution of employment (persons) increases over time in Europe and in Japan, while it slightly decreases in the United States. The increase in the employment contribution in Europe is mostly due to a deficit in capital accumulation, with capital growth rate failing to recover at the pre-oil shock level. Growth in Japan is mainly driven by labour and capital, with the contribution of TFP sharply declining over time. Conversely, the contribution of TFP increases moderately in the United States and remains roughly constant in Europe.

Figure 2.1 plots the computed TFP (persons) for the United States, the average for the countries of the European Union and Japan. The main stylized fact of productivity is fast growth in the 1960s, especially in Japan which was still undergoing reconstruction following the war, followed by a slowdown in the second half of the 1970s and a recovery in the 1990s, especially in the United States. There is a clear evidence of catching up with the United States in both Europe and Japan, with the exception of the 1990s, when Japanese productivity growth fell behind. Another notable feature of the computed series is that no strong cyclical pattern is evident,

Figure 2.1: TFP in the United States, European Union and Japan, 1965-1997



giving us more confidence that the estimates pick up the long-run effects.

Limitations of growth accounting

There are several issues that can affect the interpretation of the Solow residual as a measure of technological change. Generally speaking, since TFP growth is calculated as a residual, measurement errors in any of the observable biased during the boom since the increase in output will be entirely attributed to technological progress, the actual utilization of factors being not shown in the input data. As a consequence, computed TFP growth turns to have a cyclical pattern, leading to serious problems when growth accounting is used to calculate changes of TFP over the business cycle (Wilson, 1995; Fay and Medoff, 1985). The cyclicality of TFP growth may be a major issue in the interpretation of the results in the empirical session since the estimated coefficients on TFP and TFP growth may be dominated by cyclical effects. We tried to address this issue in a number of ways. We checked the robustness of the empirical results to different measures of TFP and TFP growth, which account for both capital utilization and hours worked.[10] The results of the basic specification turned to be remarkably robust to these adjustments.

The second issue is related to the nature of the total factor productivity growth itself. The methodology outlined above assumes that all technical progress is of the disembodied variety. But if the contribution of embodied technical progress is large, the Solow residual can give an upward biased estimate of the contribution of technological progress to growth. In order to account for embodied technical progress (in capital) and of improved human capital (in labour) some researchers have constructed augmented labour and capital series. In the case of labour, adjustments can be done by disaggregating labour inputs into many categories based on education, experience, gender and so on and weighing each category in accordance with its average wage rate. Griffith et al. (2000), for example, control for differences in

[10]The idea is that firms costlessly adjust hours worked when adjusting employment is costly (Ball and Moffitt, 2002).

the quality of inputs by expressing the aggregate labour input as a translog index of two types of workers, production workers and non-production workers, and using as weights the shares of each type of workers in the wage bill. Another approach is including a separate variable for human capital in the production function (see, for example, Mankiw at al., 1992).

Jorgenson and Griliches (1967) have demonstrated that the Solow residual is reduced substantially if improvements in the quality of capital stock are accounted by using vintage capital models. Such models allow for technical progress to be reflected in the age of capital, with new capital stock being more productive.

The failure to take this quality changes into consideration tends to understate the contribution of inputs and to overstate the fraction of GDP growth due to the residual. However, improvements in the quality of labour (such as skills) and in the quality of capital stock are poorly measured (Topel, 1999; OECD, 2001) and when some adjustments can be done, comparable measures across countries are difficult to obtain. As a consequence, if we interpret TFP growth as a broad index of overall productivity, an approach based on changes in physical quantities of inputs can still give a good proxy of the evolution of economic growth over time and the relative importance of its determinants.

2.3.2 Econometric issues

The structural model is estimated by three-stage least squares. In each equation we include fixed effects for each country, and one time dummy for each year in the sample. We also include country-specific dummies for German unification.[11] The inclusion of lagged dependent variables can lead to finite sample biases with the within-group estimator. The results in Nickell (1981), however, show that the magnitude of the bias diminishes in the length of the time series in the panel. Since the sample runs for 31 years, the size of this bias is likely to be small. The asymptotic unbiasedness of the coefficients crucially depends on the absence of serial correlation in the errors. This will be investigated by using a serial correlation test described by Baltagi (1995).[12] Finally, with lags of the dependent variable included, when coefficients differ across countries, pooling across groups can give inconsistent estimates (Pesaran and Smith, 1995). We test for differences in the coefficients across the sample by using a poolability test described by Baltagi (1995).[13]

2.4 Estimation results

2.4.1 System estimation

The results of the estimation for the pooled sample are reported in column (1) of Tables 2.2-2.4. The long-run restrictions (2.1)-(2.3) are imposed and not rejected at the 5% level, with $\chi^2(4) = 9.60$. The time dummies remove the common employment trends and cycles in the countries of the sample and they are entered to avoid spu-

[11]The dummies for German unification are obtained by interacting the fixed effect for Germany with the time dummies for the post-unification years, 1991-95.

[12]The test is an LM statitistic which tests for an $AR(1)$ and/or an $MA(1)$ structure in the residuals in a fixed-effects model. It is asymptotically distributed as $N(0,1)$ under the null. See Baltagi (1995).

[13]The poolability test is a generalized Chow test extended to the case of N linear regressions, which tests for the common slopes of the regressors. The test statistic is asymptotically distributed as $\chi(q)$ under the null. See Baltagi (1995, 48-54).

Table 2.2: Employment equation

$\ln(L/P)_{it}$ Independent Variables	All countries (1)	EU countries (2)	US-Japan diff. (3)
$\ln(L/P)_{it-1}$	1.180	1.164	-0.087
	(27.12)	(26.16)	(-0.52)
$\ln(L/P)_{it-2}$	-0.263	-0.270	0.095
	(-6.03)	(-6.44)	(0.58)
$\ln w_{it-1}$	-0.057	-0.078	0.026
	(-4.47)	(-6.40)	(0.51)
$\ln(K/P)^*_{it}$	0.027	0.021	0.017
	(4.35)	(3.00)	(0.79)
$\ln A_{it}$	0.030	0.057	-0.002
	(4.26)	(5.37)	(-2.25)
$d\ln A_{it}$	-0.084	-0.166	0.310
	(-3.69)	(-4.67)	(2.49)
$d\ln A_{it-1}$	0.160	0.270	-0.164
	(7.63)	(8.23)	(-1.45)
r_{it}	-0.074	-0.075	0.062
	(-2.70)	(-2.76)	(0.93)
Year dummies	*yes*	*yes*	-
Fixed effects	*yes*	*yes*	-
Serial Correlation	0.57	-0.26	-
p-value	0.28	0.39	
Heteroskedasticity	16.38	16.38	-
p-value	0.29	0.29	-
Obs.	462	462	-
Fixed effects	15	15	-
Years	1964-1995	1964-1995	-

Notes for Tables 2.2-2.4. The estimation method is three stage least squares. Numbers in brackets below the coefficients are t-statistics. $(L/P)_{it}$ is the ratio of employment to population of working age in country i in year t, (K/P) is the ratio of the capital stock to the population of working age, A is measured TFP progress, w is the real wage rate, and r the real interest rate. Serial Correlation is an LM test (Baltagi 1995) distributed N(0,1) under the null (H_0 : no autocorrelation). Heteroskedasticity is a groupwise LM test, distributed $\chi^2(N-1)$ under the null (given $v_{it} = c_i + \lambda_t + \epsilon_{it}$, $H_0 : \epsilon_{it}$ is homoskedastic). **Instrumented variables:* the instruments used are all the exogenous variables in the three regressions and lags of the endogenous.

Table 2.3: Wage equation

$d\ln w_{it}$ Independent Variables	All countries (1)	EU countries (2)	US-Japan diff. (3)
$d\ln w_{it-1}$	0.058	0.053	0.049
	(1.46)	(1.34)	(1.47)
$d\ln(K/LF)^*_{it}$	0.503	0.270	0.783
	(4.24)	(1.98)	(1.98)
$d\ln A_{it}$	0.241	0.310	0.004
	(5.89)	(6.15)	(6.15)
$\ln w_{it-1}$	-0.177	-0.162	-0.052
	(-6.65)	(-5.89)	(5.88)
$\ln(K/LF)^*_{it-1}$	0.083	0.043	0.036
	(4.84)	(5.88)	(0.37)
$\ln A_{it-1}$	0.094	0.119	-0.088
	(5.45)	(5.17)	(-1.88)
$\ln u_{it}$	-0.010	-0.012	0.012
	(-2.31)	(-2.29)	(1.40)
$BD_{it} * \ln u_{it}$	0.006	0.006	-0.001
	(2.88)	(5.64)	(-0.65)
$union_{it}$	0.043	0.028	0.081
	(2.10)	(2.10)	(0.48)
$dtax_{it}$	-0.055	-0.066	0.098
	(-0.84)	(-0.97)	(0.48)
rer_{it}	-0.020	-0.018	-0.074
	(-1.30)	(-1.50)	(-0.57)
$d^2\ln p_{it}$	-0.203	-0.208	0.113
	(-3.55)	(-3.54)	(0.78)
Year dummies	*yes*	*yes*	-
Fixed effects	*yes*	*yes*	-
Serial Correlation	1.21	1.02	-
p-value	0.11	0.15	-
Heteroskedasticity	16.40	16.39	-
p-value	0.29	0.29	
Obs.	462	462	-
Fixed effects	15	15	-
Years	1964-1995	1964-1995	-

Notes. See notes to Table 2.2. All variables have been defined except: *LF* is the labor force, *u* the unemployment rate, *BD* the maximum duration of benefit entitlement, *union* the fraction of workers belonging to a union (union density), *rer* the benefit replacement ratio, *tax* the tax wedge and *p* the price level.

Table 2.4: Investment equation

$d\ln K_{it}$ Independent Variables	All countries (1)	EU countries (2)	US-Japan diff. (3)
$d\ln K_{it-1}$	0.963	0.910	0.211
	(21.72)	(19.95)	(0.98)
$d\ln K_{it-2}$	-0.141	-0.097	-0.177
	(-3.20)	(-2.06)	(-0.87)
r_{it}	-0.036	-0.026	-0.002
	(-2.70)	(-2.02)	(-0.06)
$\ln w^*_{it}$	-0.012	-0.021	0.019
	(-1.83)	(-3.53)	(0.79)
$\ln A_{it}$	0.021	0.041	-0.032
	(5.12)	(6.89)	(-2.20)
$d\ln A_{it}$	0.064	0.076	0.273
	(5.88)	(4.51)	(4.18)
$d\ln A_{it-1}$	0.026	0.048	-0.104
	(2.37)	(2.79)	(-1.05)
$\ln(K/P)_{it-1}$	-0.009	-0.020	0.013
	(-2.29)	(-4.43)	(0.89)
$d\ln(D/K)_{it}$	-0.005	-0.008	-0.006
	(-2.08)	(-3.24)	(-0.55)
Year dummies	*yes*	*yes*	-
Fixed effects	*yes*	*yes*	-
Serial Correlation	0.38	0.12	-
p-value	0.35	0.45	-
Heteroskedasticity	18.46	20.77	
p-value	0.19	0.11	
Obs.	462	462	-
Fixed effects	15	15	-
Years	1964-1995	1964-1995	-

Notes. See notes to Table 2.2. All variables have been defined except for D, which is the level of government debt.

rious correlations due to those co-movements. Therefore, the estimated coefficients rely on the differences across countries in the evolution of each independent variable and how these differences impact on employment in each country.

The estimated coefficients on the lagged dependent variables imply long lags, which we illustrate with simulations in section 3.4.3. In the employment equation, the dependent variable is the employment rate, defined as the employment to the working age population ratio. Consistently, capital stock is normalized to working age population as well. The terms of the employment equation can be rearranged to yield

$$\begin{aligned} \ln(L/P)_t &= 1.21\ln(L/P)_{t-1} - 0.27\ln(L/P)_{t-2} - 0.059\ln w_{t-1} - 0.076 r_t \\ &\quad +0.027\ln k_t + 0.031\ln A_t - 0.086 d\ln A_t + 0.16 d\ln A_{t-1}, \end{aligned} \tag{2.9}$$

where k_t is the ratio of capital to employment. The lag in the employment equation is long, implying large differences between impact and steady-state effects. The wage elasticity is -0.059 on impact but rises to -1.02 in the steady state. The interest semi-elasticity is even higher, rising to -1.31 in the steady state. There are significant influences from the rate of growth of TFP on employment, which are negative in the first year but turn positive in the second.[14]

The wage equation is an error-correction equation with a long estimated adjust-

[14] We also experiment by including cyclical measures as independent variables, to make sure that the estimeted coefficients on TFP are not dominated by cyclical effects. We use the cyclical component of the GDP and the deviation of "hours" from the trend as proxies of the business cycle. The latter appears to be a better proxy for the business cycle in relation to labour market dynamics (Nickell, 1996). We decide to omit it from our final specification because of the lack of information on "hours worked" for some of the countries in the sample.

ment lag. The key variables of the model are statistically significant and with the predicted sign. The capital stock and TFP affect the wage rate with positive coefficient, in both levels and rates of change. Unemployment has a restraining influence on wages, as predicted by the model, but its influence is reduced in countries that have long durations of benefit entitlement. This is consistent with the view often expressed in policy analyses, that long entitlement to benefit encourages the build up of long-duration unemployment, and reduces the economic role of unemployment in restraining wage demands.[15] This is the only parameter of the unemployment compensation system that we found statistically significant. We did not find that taxes increase wage costs but found that unionization does.

The capital stock in the wage equation is divided by the labour force instead of the level of employment to avoid introducing cyclical noise but of course since $\ln L - \ln LF = \ln(1-u) \approx -u$, the estimated equation is approximately equivalent to an equation that has the ratio of capital to employment and three lags of the unemployment rate as independent variables. The steady-state semi-elasticity of the wage rate with respect to the unemployment rate for a country whose unemployed lose half their entitlement after one year's unemployment is estimated to be -0.04.

As with the wage equation, the capital equation is an error-correction equation which is also characterized by a long adjustment lag. The interest rate, wage rate and growth in government debt reduce private investment.

[15] See, for example, Layard et al. (1991).

Heterogeneity in the coefficients

We consider the possibility of heterogeneity in the coefficients across countries by comparing the results from the basic specification of the system with a specification that allows the coefficients to vary across countries. In the heterogeneous coefficients estimation we interact each regressor with the country fixed effects. The null hypothesis of common slopes is tested by comparing the sum of squared residuals of the constrained model with that of the unconstrained model (Pesaran and Smith, 1995). The test statistics for the three equations are $\chi^2_L(126) = 25.89$, $\chi^2_w(180) = 176.69$ and $\chi^2_k(126) = 41.36$ respectively. So the null of common slopes is not rejected, confirming the qualitative findings of the more parsimonious model.

We also allow for different coefficients for the EU countries and the non EU countries, namely the United States and Japan. Columns (2) and (3) in Tables 2.2-2.4 report the coefficients for the EU countries as a whole and the differences respect to the United States and Japan. The most interesting feature of the estimated differences between the two sets of countries is in the coefficients of unemployment rate and capital growth in the wage equation. It appears that unemployment rate plays a significant role in explaining wage setting decisions in the EU countries while the coefficient for the United States and Japan is zero, though the difference in the coefficient between Europe and the other two countries does not appear to be significant . On the other hand, real wages seem to be more responsive to changes in productivity in the non-European countries, with productivity gains arising from faster capital accumulation having a much stronger impact on short run wage dynamics.

However, the interactions on the coefficients in each equation turn to be jointly not significant ($\chi^2_L(9) = 0.72$ and $\chi^2_W(12) = 0.39$ and $\chi^2_K(9) = 0.39$). Therefore the pooled model remains our preferred specification.

Robustness checks

Since the emphasis of the analysis is on the effect of TFP growth on unemployment, we check the robustness of the results to different measures of TFP and TFP growth. In Tables 2.5-2.7 we present three kind of corrections, namely TFP estimated using the regression approach (column (1)) , TFP adjusted for capital utilization (column (2)) and hours worked (column (3)).[16]

The basic model is remarkably robust to all these adjustments. TFP growth is significant in all the three equations and the sign and magnitude of coefficients remains almost unchanged. In the employment equation the coefficient on the current and lagged TFP growth adjusted for capital utilization is considerably larger than in the basic specification. However, the net effect of TFP growth on employment is not significantly affected. When we adjust TFP for hours worked the number of countries included in the panel is reduced given the unavailability of the series "hours" for some of the EU countries. All the results of the previous specification apply to this smaller sample.

[16] See Appendix 2.6.2 for a description on how we obtain the different measures of TFP.

Table 2.5: Employment equation- Robustness checks

Dependent variable	$\ln(L/P)_{it}$		
Adjustments to TFP	*Regression Approach*	*Capital Utilization*	*Hours*
Independent Variables	(1)	(2)	(3)
$\ln(L/P)_{it-1}$	1.173	1.204	1.307
	(26.58)	(28.17)	(26.39)
$\ln(L/P)_{it-2}$	-0.265	-0.287	-0.396
	(-6.48)	(-7.04)	(-8.51)
$\ln w_{it-1}$	-0.056	-0.061	-0.083
	(-4.68)	(-5.11)	(-5.04)
$\ln(K/P)^{*}_{it}$	0.033	0.030	0.025
	(4.35)	(4.52)	(3.12)
$\ln A_{it}$	0.023	0.031	0.058
	(4.26)	(4.53)	(4.56)
$d \ln A_{it}$	-0.031	-0.249	-0.027
	(-1.51)	(-9.05)	(-0.66)
$d \ln A_{it-1}$	0.141	0.342	0.227
	(7.47)	(8.94)	(5.86)
r_{it}	-0.075	-0.045	-0.108
	(-2.75)	(-1.73)	(-3.00)
Year dummies	*yes*	*yes*	*yes*
Fixed effects	*yes*	*yes*	*yes*
Serial Correlation	-0.07	-0.049	0.53
p-value	0.47	0.48	0.30
Heteroskedasticity	16.39	16.37	10.45
p-value	0.29	0.29	0.29
Obs.	462	462	315
Fixed effects	15	15	11
Years	1964-1995	1964-1995	1964-1995

Notes. See Appendix 2.6.2 for a description on how the different measures of TFP are calculated.

Table 2.6: Wage equation - Robustness checks

Dependent variable	$d\ln w_{it}$		
Adjustments to TFP	*Regression Approach*	*Capital Utilization*	*Hours*
Independent variables	(1)	(2)	(3)
$d\ln w_{it-1}$	0.054	0.061	0.004
	(1.40)	(1.56)	(0.09)
$d\ln(K/LF)^{*}_{it}$	0.427	0.465	0.457
	(4.24)	(4.24)	(4.24)
$d\ln A_{it}$	0.207	0.265	0.344
	(5.89)	(5.89)	(5.89)
$\ln w_{it-1}$	-0.175	-0.195	-0.188
	(-6.47)	(-6.65)	(-6.65)
$\ln(K/LF)^{*}_{it-1}$	0.104	0.095	0.056
	(5.81)	(5.47)	(3.03)
$\ln A_{it-1}$	0.071	0.100	0.132
	(5.82)	(6.18)	(4.93)
$\ln u_{it}$	-0.010	-0.010	-0.008
	(-2.37)	(-2.18)	(-1.75)
$BD_{it} * \ln u_{it}$	0.007	0.007	0.006
	(3.12)	(3.15)	(5.54)
$union_{it}$	0.037	0.036	0.007
	(1.83)	(1.77)	(0.27)
$dtax_{it}$	-0.045	-0.047	-0.064
	(-0.71)	(-0.72)	(-0.78)
rer_{it}	-0.021	-0.022	-0.011
	(-1.48)	(1.53)	(0.81)
$d^2\ln p_{it}$	-0.205	-0.192	-0.017
	(-3.64)	(-3.35)	(-0.22)
Year dummies	*yes*	*yes*	*yes*
Fixed effects	*yes*	*yes*	*yes*
Serial Correlation	1.06	1.19	0.66
p-value	0.14	0.11	0.25
Heteroskedasticity	16.39	16.39	10.34
p-value	0.29	0.29	0.29
Obs.	462	462	315
Fixed effects	15	15	11
Years	1964-1995	1964-1995	1964-1995

Notes. See Appendix 2.6.2 for a description on how the different measures of TFP are calculated.

Table 2.7: Investment equation - Robustness checks

Independent variable	$d\ln K_{it}$		
Adjustments to TFP	*Regression Approach*	*Capital Utilization*	*Hours*
Independent variables	(1)	(2)	(3)
$d\ln K_{it-1}$	0.936	0.958	0.908
	(20.44)	(20.94)	(17.11)
$d\ln K_{it-2}$	-0.124	-0.167	-0.115
	(-2.74)	(-3.75)	(-2.12)
r_{it}	-0.027	-0.026	-0.055
	(-2.11)	(-1.84)	(-2.79)
$\ln w^*_{it}$	-0.012	-0.017	-0.025
	(-2.13)	(-2.53)	(-2.91)
$\ln A_{it}$	0.018	0.024	0.038
	(5.37)	(5.10)	(4.99)
$d\ln A_{it}$	0.053	0.028	0.033
	(5.19)	(1.83)	(1.50)
$d\ln A_{it-1}$	0.030	0.030	0.071
	(2.88)	(2.03)	(3.17)
$\ln(K/P)_{it-1}$	-0.006	-0.007	-0.013
	(-1.49)	(-1.79)	(-2.36)
$d\ln(D/K)_{it}$	-0.007	-0.008	-0.008
	(-2.61)	(-2.89)	(-2.59)
Year dummies	*yes*	*yes*	*yes*
Fixed effects	*yes*	*yes*	*yes*
Serial Correlation	0.23	0.52	0.65
p-value	0.41	0.30	0.26
Heteroskedasticity	18.34	13.50	16.61
p-value	0.19	0.49	0.12
Obs.	462	462	315
Fixed effects	15	15	11
Years	1964-1995	1964-1995	1964-1995

Notes. See Appendix 2.6.2 for a description on how the different measures of TFP are calculated.

2.4.2 Simulations

We report the results of two simulations to illustrate the properties of the estimated model. In the first, we impose a zero-growth steady state, for expository purposes, and allow the level of TFP to increase by 5 percent, once and for all. We trace the response of the three endogenous variables to this change. In the second simulation we trace the response of the endogenous variables to a once-for-all change in the rate of growth of TFP but instead of assuming an arbitrary change in the rate of growth, we simulate a productivity slowdown that corresponds roughly to the slowdown observed after 1973.

In the third and main simulation we use the empirical model to predict how much of the observed change in the unemployment rate can be attributed to TFP growth, by holding all other exogenous variables constant and allowing TFP to take its observed values.

We make use of our estimates and the identity linking employment with unemployment, $L_t + U_t \equiv LF_t$, where LF_t is the exogenous labour force in period t. The calculations are done by breaking up the growth terms in the regressions into the first difference of the logs and collecting terms, to yield the equations:

$$\begin{aligned}\ln L_t &= 1.212 \ln L_{t-1} - 0.270 \ln L_{t-2} - 0.059 \ln w_{t-1} + 0.027 \ln k_t \\ &\quad -0.055 \ln A_t + 0.251 \ln A_{t-1} - 0.164 \ln A_{t-2} + C_1 \qquad (2.10)\end{aligned}$$

$$\begin{aligned}\ln w_t &= 0.881 \ln w_{t-1} - 0.058 \ln w_{t-2} + 0.503 \ln k_t - 0.420 \ln k_{t-1} \\ &+0.241 \ln A_t - 0.147 \ln A_{t-1} - 0.010 \ln u_t + 0.503 \ln(1-u_t) \\ &-0.420 \ln(1-u_{t-1}) + 0.006(\ln u_t * BD_t) + C_2 \end{aligned} \tag{2.11}$$

$$\begin{aligned}\ln K_t &= 1.954 \ln K_{t-1} - 1.105 \ln K_{t-2} + 0.141 \ln K_{t-3} - 0.012 \ln w_t \\ &+0.085 \ln A_t - 0.038 \ln A_{t-1} - 0.026 \ln A_{t-2} + C_3 \end{aligned} \tag{2.12}$$

Two things need explanation. The C_i are "constants," by which we mean all variables not varied in the simulations. The terms containing $\ln(1-u_t)$ in the wage equation are present because the ratio of the capital stock to the labour force in the estimated equations was replaced by the ratio of the capital stock to employment. Finally, consistency between equation (2.12) and the other two equations is achieved by making use of the definition $k_t = (K/L)_t$.

Figure 2.2 panels (a) and (b) show the results of the first simulation. We set TFP at its sample mean and calibrate the constants C_i $(i = 1, 2, 3)$ such that all the endogenous variables are in a steady state at their sample means. We then let (in year 4 in the figures) $\ln A$ increase by 0.05 once and trace the paths followed by the three endogenous variables in response to this change.

The increase in TFP brings a slow response from wages and the ratio of capital to employment, both of which eventually rise by the full 5 percent. But it takes real wages 5 years to increase by 4 percent and the capital-labour ratio about 11 years

Figure 2.2: Simulation of a once-for-all 5% increase in TFP

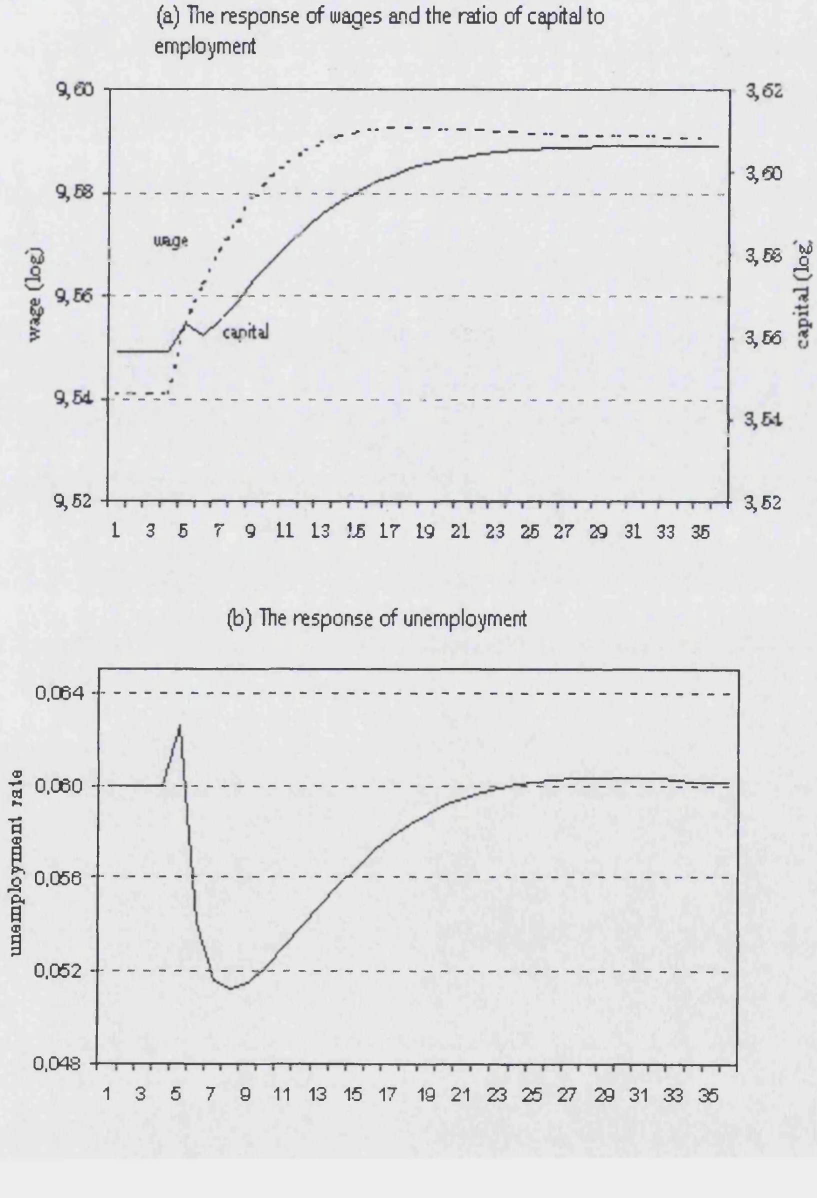


Table 2.8: Actual and predicted unemployment rate, productivity slowdown

Period	mean TFP growth (%)		mean rate of unemployment (%)		predicted rate of unemployment (%)	
	US	EU	US	EU	US	EU
1960-73	1.90	3.95	4.96	2.26	-	-
1974-92	0.80	1.79	6.82	6.60	6.60	5.10

to increase by 4 percent. Although adjustment is not monotonic, the fluctuations are not quantitatively significant.[17] Unemployment rises by 0.26 percent one year after the shock, but the rise is reversed in year 2. Unemployment then falls quickly, and two years later it reaches its lowest point of 1 percentage point below its initial value of 6 percent. The simulation shows that TFP changes bring about sizeable temporary unemployment effects, induced by the slow response of wages and the capital stock to TFP, but also by internal employment dynamics attributed to lagged dependent variables in the above regressions.

Table 2.8 shows the average TFP growth rate prior to 1973 and the average rate up to 1992, before growth picked up again. In the second simulation we give TFP growth its pre-1973 mean value in year 1 of the simulation (year 4 in figures 4 and 5) and let TFP grow according to the mean rates in Table 2.8 until the end of the sample. We then calibrate the constants C_i ($i = 1, 2, 3$) such that all the endogenous variables are in a steady state in the 4 years preceding the shock, with the capital-labour ratio and wage rate growing at the same rate as TFP and the unemployment rate constant at the rate shown in Table 2.8.

[17] Adjustment in the aggregate capital stock is monotonic. But because the change in employment reverses after one year, change in the ratio of capital to employment also reverses one year after the shock.

Figure 2.3: Growth rates of TFP, wages and the capital to employment ratio following the 1973 slowdown

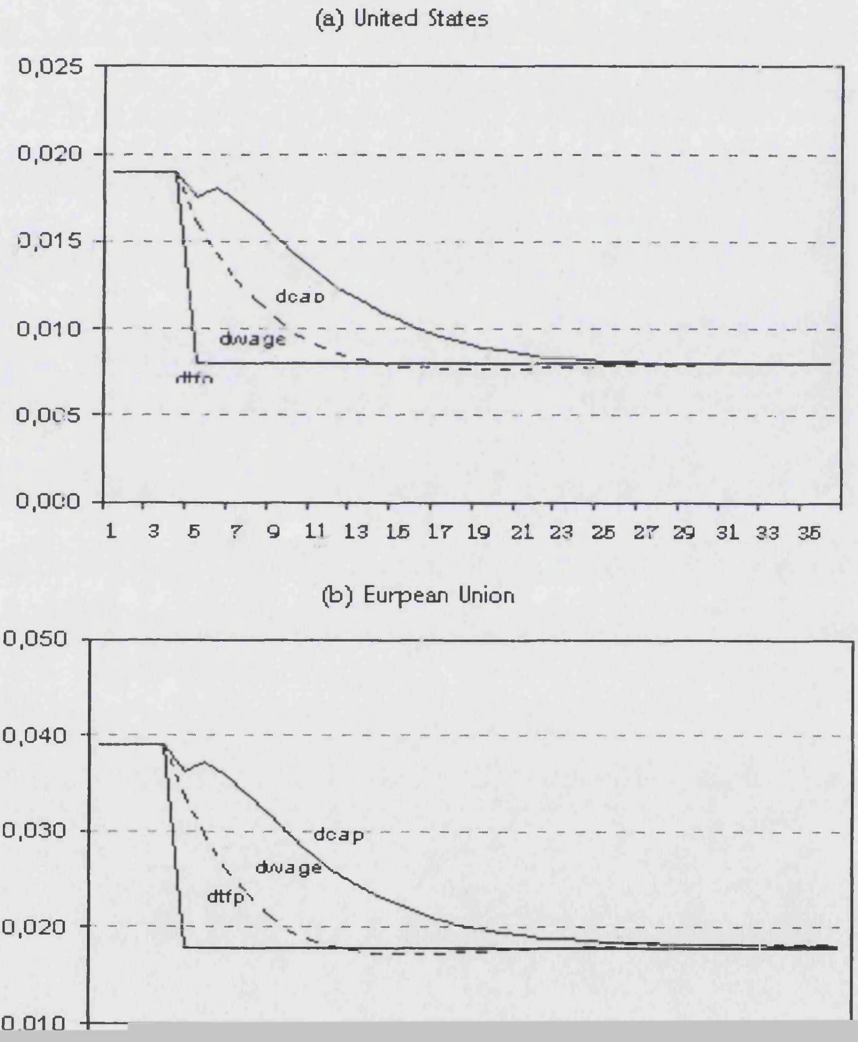


Figure 2.4: Predicted unemployment response to the 1973 productivity slowdown

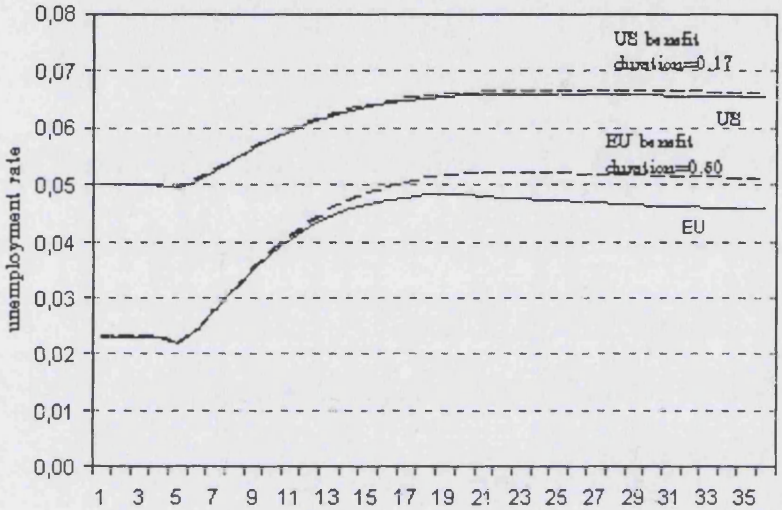


Figure 2.3 shows the response of wages and capital growth to the TFP shock and Figure 2.4 shows the response of the unemployment rate. There is a marked difference in the simulated series for the United States and Europe, due largely to the different TFP shock. TFP growth fell by more in Europe than in the United States and this accounts for a predicted rise in unemployment in Europe between 1973 and 1990 of 2.84 percentage points but in the United States of only of 1.64 percentage points. Another reason for the differential response is the fact that the entitlement to unemployment benefit is longer in Europe than in the United States. As unemployment increases, the disincentive effect of the unemployment insurance system is stronger, leading to less wage moderation and so to higher unemployment in the countries with the longer durations. The effect on unemployment of the productivity slowdown is more than half a percentage point larger in Europe when

the impact of benefit duration is accounted for (dashed line).

The response of wage growth and capital accumulation to the productivity slowdown in Figure 2.3 follows a similar pattern to the response of the level of wages and capital shown in Figure 2.2. The adjustment lags are of a similar magnitude, with wages responding faster than the capital stock. Of course, in Figure 2.3 the response is in growth rates and because the TFP shock is treated as permanent, wage growth and the capital-labour ratio change permanently. The change in unemployment is also permanent. Despite the complicated lags estimated in the regressions, once-for-all changes in productivity growth do not cause cyclical responses from any of the endogenous variables. Also, despite the smaller slowdown in the United States, the model gets closer to attributing the full rise in US unemployment after 1973 to the slowdown, in contrast to Europe, where our prediction falls short by about 1.5 percentage points (Table 2.8).

The predictive power of the model is shown in Figure 2.5 panels (a) and (b). The figure shows the unemployment rate obtained from the model when we allow TFP growth to take its actual values but keep constant all the other exogenous variables. Overall, the two figures indicate that the empirical model explains a significant portion of unemployment in the two economies, though with some differences. TFP growth explains well the trend changes in unemployment in the United States. The rise up to the mid 1980s and subsequent decline are picked up by the model. But in the European Union, TFP growth explains a lower fraction of the overall change in the unemployment rate, and although the model picks up some of the rise up to

Figure 2.5: Predicted unemployment rate when TFP takes actual values and other exogenous variables held constant compared with the actual unemployment rate

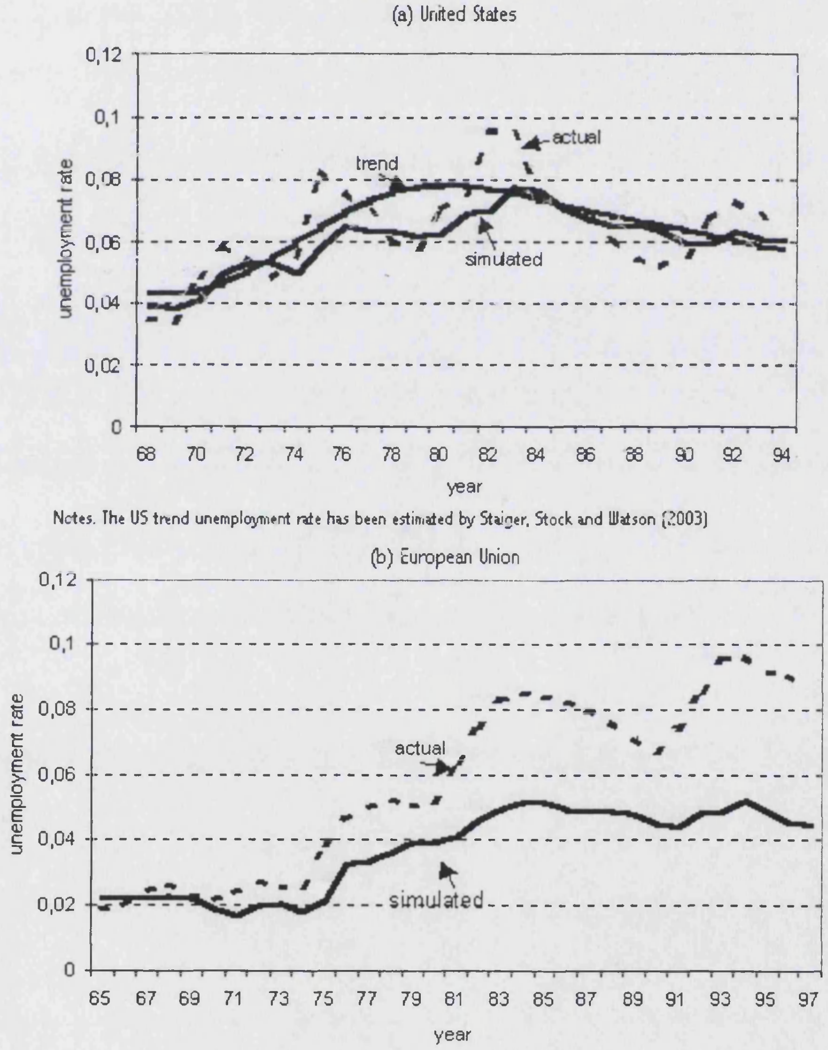


Table 2.9: Actual and predicted unemployment rate

Period	US unemployment (%)		EU unemployment (%)	
	actual	predicted	actual	predicted
1970-73	4.96	-	2.26	-
1973-79	6.40	5.80	4.13	3.17
1980-89	7.17	7.39	7.53	4.95
1990-97	6.03	6.57	8.59	4.91

the mid 1980s, it fails to account for the changes in the 1990s.

Table 2.9 reports the average level of actual and predicted unemployment for three sub-periods. In 1970-73 we restrict unemployment in the model to be at the level of the observed average. In the United States, the slowdown in TFP growth after 1973 explains about 60 percent of the rise in unemployment in the 1970s but the explanatory power picks up and by the end of the sample the model overpredicts slightly the change in mean unemployment. In Europe the slowdown of TFP growth explains more than three quarters of the increase in unemployment in the 1970s but it does not fully explain the further rise in unemployment that occurred in the 1980s and it actually predicts a small decline in mean unemployment in the 1990s, when unemployment went up by a full percentage point.

2.4.3 Measuring the fraction of disembodied technological progress

In Chapter 1, we showed that TFP growth increases job destruction but it may increase or decrease job creation at given unemployment rate, depending on the value taken by some key parameters. When technological progress is not fully embodied, the overall effect of technological progress on unemployment crucially depends on the costs of implementing the new technology in the existing jobs (Mortensen and Pissarides, 1998) or more generally, it depends on the fraction λ of technological progress that can be adopted by existing jobs (Pissarides and Vallanti, 2003). Given our estimate of a strong positive effect of TFP growth on employment, in this section we investigate whether the estimate imposes any limits on the values taken by the parameter λ in the model of Pissarides and Vallanti (2003). As the overall effect of growth on employment is positive, our estimates imply that λ should be high, but how high?

In Pissarides and Vallanti (2003), the steady-state solutions for the three unknowns, T, θ and u, are given by the following equations[18]

$$T = \frac{\ln\phi - \ln\omega}{(1-\lambda)g}. \tag{2.13}$$

$$(1-\beta)(y(\lambda g)\phi - y(g)\omega) = \frac{c\theta}{m(\theta)}. \tag{2.14}$$

$$u = \frac{n+s}{\left(1 - e^{-(n+s)T}\right) m(\theta) + n + s}. \tag{2.15}$$

Using these steady state solutions we first calculate the smallest value of λ which is consistent with the positive effect of TFP growth on employment found in the data. We then use the results from this first calibration to find the value of λ implied by our point estimates.

[18]See section 1.2.2 in chapter 1, for a discussion of the steady state conditions in the theoretical model.

Differentiation of (2.15) with respect to the rate of growth of TFP yields

$$\frac{\partial u}{\partial g}\frac{g}{u} = -\frac{\partial T}{\partial g} g[um(\theta) - (1-u)(n+s)] - (1-u)\eta\frac{\partial \theta}{\partial g}\frac{g}{\theta}. \tag{2.16}$$

From equations (2.13) and (2.14) we derive, by direct substitution and differentiation

$$\frac{\partial T}{\partial g} g = -T - \frac{1}{1-\lambda}\frac{\partial \theta}{\partial g}\frac{1}{\theta}. \tag{2.17}$$

Substitution of $\partial T/\partial g$ from (2.17) into (2.16) yields

$$\begin{aligned}\frac{\partial u}{\partial g}\frac{g}{u} &= T[um(\theta) - (1-u)(n+s)] \\ &\quad - \left[(1-u)\eta - \frac{um(\theta) - (1-u)(n+s)}{g(1-\lambda)}\right]\frac{\partial \theta}{\partial g}\frac{g}{\theta}\end{aligned} \tag{2.18}$$

By (2.15) , $um(\theta) - (1-u)(n+s) > 0$, so if the growth rate reduces unemployment, the second term in (2.18) must be negative. The term in the square brackets has in general an ambiguous sign, but reasonable parameter values give an overwhelmingly positive value (see below). The intuitive conclusion follows that if productivity growth reduces unemployment it is because it increases job creation at given unemployment rate; i.e., that consistency between the theoretical model and estimates requires, at the very least, $\partial\theta/\partial g > 0$. The smallest value of λ consistent with a positive $\partial\theta/\partial g$ is a lower bound on the values of λ consistent with our estimates and can be computed for reasonable parameter values.

In order to obtain the effect of TFP growth on job creation, for a given unemployment rate, we differentiate equation 2.14 with respect to g to obtain:

$$\left(\frac{c\beta y(g)}{1-\beta}+\frac{c(1-\eta)}{m(\theta)}\right)\frac{\partial\theta}{\partial g}=(1-\beta)\left(\lambda y'(\lambda g)\phi-y'(g)\omega\right) \tag{2.19}$$

From (2.19) , $\partial\theta/\partial g > 0$ requires

$$\lambda y'(\lambda g)\phi - y'(g)\omega > 0. \tag{2.20}$$

We obtain the range of λ that satisfies (2.20) when the other unknowns are at their steady-state values. Let λ^* be the lowest value of λ that satisfies (2.20). We obtain solutions to the following system of steady-state equations

$$\lambda^* y'(\lambda^* g)\phi - y'(g)\omega = 0. \tag{2.21}$$

$$y(\lambda^* g) = \frac{1-e^{-(r+s-\lambda^* g)T}}{r+s-\lambda^* g} \tag{2.22}$$

$$y(a) = \frac{1-e^{-(r+s-g)T}}{r+s-g} \tag{2.23}$$

$$T = \frac{\ln\phi - \ln\omega}{(1-\lambda^*)g} \tag{2.24}$$

$$\omega = b + \frac{\beta}{1-\beta}c\theta \tag{2.25}$$

$$(1-\beta)(y(\lambda^* g)\phi - y(g)\omega) = \frac{c\theta}{m(\theta)}. \tag{2.26}$$

The unknowns are $\lambda^*, y(\lambda^* g), y(g), T, \omega$, and θ. The matching flow is assumed to be

Table 2.10: Baseline parameter values

r	0.04	β	0.50
b	0.30ϕ	η	0.50
c	0.10ϕ	g	0.02

constant-elasticity

$$m(\theta) = m_0\theta^{\eta}. \tag{2.27}$$

The parameters were either given standard values or derived by calibrating the steady-state equation for unemployment and average job duration. The baseline parameter values appear in Table 2.10. The real rate of interest is 4 per cent per annum, the value of unemployment income is fixed at the sample mean for the United States and the hiring cost is taken from Hamermesh (1993), who estimates it on average to be one month's wages. The average recruitment cost in the model is $c\theta/m(\theta)$, which depends on the unknown θ. Wages in this economy are about 92 per cent of the marginal product of labour, giving the values 0.3ϕ for b and 0.1ϕ for c. The value of ϕ needs not be specified. The values for β and η are the ones commonly used in calibrations of search equilibrium models and the value for TFP growth is its sample mean.[19]

The value for the parameter s is obtained by calibrating the expected duration of jobs. According to the OECD (1999), the mean duration of jobs in the United States is 4.2 years (in the UK it is 5 years and in continental Europe 7.3 years). In

[19] We calibrate the model to US values because they are the ones that are least contaminated by policy on employment protection and other things that are not in the model. However, calibrating to European values gives almost identical results.

the model, the mean duration of jobs is given by $(1 - \exp(-sT))/s$, so we treat s as an unknown and introduce the equation

$$\frac{1 - e^{-sT}}{s} = 4.2. \tag{2.28}$$

Finally, the parameter m_0 is calibrated from the steady-state equation for unemployment. In our sample the mean unemployment rate in the United States is 6 per cent. We treat m_0 as another unknown and introduce the equation

$$\frac{n + s}{\left(1 - e^{-(n+s)T}\right) m_0 \theta^{0.5} + n + s} = 0.06. \tag{2.29}$$

The rate of growth of the labour force n is assumed to be 0.02.

The solutions for all unknowns are given in Table 2.11. The critical value for λ turns out to be 0.926. Thus, to get a positive effect from productivity growth on job creation, productivity in existing jobs has to grow on average at a rate more than 90 per cent the rate of growth of new and more advanced jobs. But at this high value of λ existing jobs fall behind by a very small margin, which at reasonable growth rates and job turnover rates, implies that job terminations through obsolescence are virtually nonexistent in the steady state. Given a calibrated T almost equal to 60, by the time productivity growth makes a job obsolete, the job is certain to have ended for other reasons.[20]

[20] Of course, this does not preclude creative destruction from being a powerful influence on employment in sectors adjusting to new technologies at fast pace, or even at the level of the economy as a whole out of the steady state.

Table 2.11: Model solutions

λ^*	0.926	θ	6.16	$y(\lambda^* g)$	3.85
T	59.6	ω	0.92ϕ	$y(g)$	3.87
s	0.24	m_0	1.63		

The other solution values are reasonable. Note that θ is the ratio of recruitment effort to search effort. Although it is usually interpreted as the ratio of vacancies to unemployment (in which case the number 6.16 would be unreasonable) we did not give it this interpretation. We used the steady-state unemployment rate to infer it. It implies that on average the duration of unemployment in the United States is 3 months, which is reasonable. It also implies that the average recruitment cost per employee is 0.145ϕ, or about 1.8 months' wages. This is a little higher than Hamermesh's estimate, but changing the parameter c in the computations by a factor of 2 changes the recruitment cost but has no influence on the solutions for λ^* or T and s.[21]

In order to obtain the value of λ implied by our point estimates, we use the derived values for all the unknowns in Table 2.11 to obtain, from (2.19),

$$\frac{\partial \theta}{\partial a}\frac{g}{\theta} = 1.949\lambda - 1.806. \tag{2.30}$$

[21]The computed value for λ^* turns out to be robust virtually to all reasonable parameter variations. Increasing b to 0.4 increases λ^* to 0.937. Increasing g to 0.03 (both the higher value for b and the higher value for g are the means for the countries of the European Union) also increases it to 0.936. Forcing the mean duration of jobs in the absence of obsolescence to be 10 years (i.e., treating s as a parameter and setting it equal to 0.1) increases λ^* to 0.931. The reason for this robust behavior is clear from equation (2.21). Because reasonable values of g are small, the present discounted value terms $y(\lambda g)$ and $y(g)$ are approximately equal to each other. The solution for λ^* is then approximately equal to the ratio of the reservation wage to marginal product. But the only reason for a deviation between the reservation wage and marginal product in the steady-state of this economy is the existence of frictions, and the frictions implied by the data are not big enough to make reservation wages much less than marginal product.

Equation (2.18) then gives a simple expression, because at values of λ as high as the computed λ^* the term $um(\theta) - (1-u)(n+s)$ is 0, so

$$\begin{aligned} \frac{\partial u}{\partial g}\frac{g}{u} &= -0.47\frac{\partial \theta}{\partial g}\frac{g}{\theta} \\ &= 0.849 - 0.916\lambda. \end{aligned} \tag{2.31}$$

The steady-state estimates in Table 2.8 suggest that for each one percentage point change in the productivity growth rate unemployment changes in the opposite direction by 1.49 points.[22] Therefore, the elasticity of u with respect to g at the mean values reported in Table 2.8 is -0.35 (it is higher, -0.50, at $u = 0.06$ and $g = 0.02$). But this value is sufficiently high to give a point estimate of λ above 1, the upper limit of its feasible range. So job destruction because of embodied technological progress does not appear to contribute at all to the steady-state unemployment dynamics.

2.5 Conclusions

In this chapter we showed that although equilibrium models of employment imply that the effects of faster TFP growth can be either positive or negative, empirically the effects appear to be strongly positive. We used the estimates to obtain a prediction of the extent to which exogenous TFP growth can account for the observed

[22] Because of the way the estimates were obtained, it is more accurate to talk of the change in unemployment caused by a one percentage point change in the growth rate, rather than in term of elasticities. The estimate of 1.49 is for the United States. For the European Union the estimate is 1.31. The result for the European Union is in line with that in Fitoussi et al. (2000).

changes in the rate of unemployment (or employment). The empirical model does a good job in attributing the rise in unemployment in the United States after 1973 and its subsequent decline to the productivity slowdown and subsequent recovery. It is also fairly successful at tracking other dynamics in the US unemployment rate. The slowdown in productivity growth in Europe was bigger than the US slowdown, and the model attributes a substantial rise in the European unemployment to it. But it is generally less successful in attributing the dynamics of European unemployment to productivity changes.

We used the results from the empirical model to derive an estimate for the fraction of productivity growth that is embodied in new jobs, the factor behind the Schumpeterian "creative destruction". Our estimates imply that an upper bound to this fraction is 7 percent, but the point estimate gives a value below zero. This implies that creative destruction is not a factor in the steady state of the countries in the sample, although the fact that the point estimate is below zero could also mean that there are additional forces at work contributing to a positive relation between productivity growth and employment. Such forces could be related to the supply-side forces identified by Phelps (1994), Hoon and Phelps (1997) and Ball and Moffitt (2002), which also imply long lags in the effect of growth on employment. More work is needed in linking the demand-side factors estimated here and the supply-side factors estimated elsewhere.

2.6 Appendix

2.6.1 Growth accounting

Table 2.12: Growth accounting for the European countries, 1965-1997

	GDP growth	Percentage contribution from				
		capital	labour		TFP	
			persons	hours	persons	hours
Austria $\alpha_k = 0.38$	3.1	48.5	9.4	-2.8	42.1	54.4
Belgium $\alpha_k = 0.37$	2.7	39.6	1.8	-	58.6	-
Denmark $\alpha_k = 0.36$	2.5	36.9	15.7	-	47.4	-
Finland $\alpha_k = 0.34$	3.0	30.7	0.4	-12.5	68.9	81.9
France $\alpha_k = 0.37$	2.8	44.4	7.8	-6.7	47.7	62.2
Germany $\alpha_k = 0.38$	2.7	38.9	1.6	1.1	59.5	60.0
Ireland $\alpha_k = 0.33$	4.7	33.4	10.9	6.0	55.7	60.5
Italy $\alpha_k = 0.35$	3.0	31.4	0.5	-10.4	68.1	79.0
Netherlands $\alpha_k = 0.37$	3.0	34.8	29.5	-	35.7	-
Norway $\alpha_k = 0.43$	3.6	38.6	19.0	2.0	42.4	59.4
Portugal $\alpha_k = 0.38$	4.0	41.8	14.8	-	43.3	-
Sweden $\alpha_k = 0.33$	2.1	32.7	6.8	-4.4	60.5	71.7
U.K. $\alpha_k = 0.36$	2.2	43.7	5.9	-10.0	50.4	66.3

2.6.2 Total factor productivity measures

Adjusting TFP growth for hours worked

Our basic measurement of labour input is number of workers employed in a given country i at a give time t. We can adjust this by taking the average hours actually worked per worker. Hours worked is available from ISDB (OECD) for a limited number of EU countries, the US and Japan. Adjusting for hours worked, the aggregate measure of TFP growth will be:

$$(1-\overline{\alpha})\Delta \ln A^h = \Delta \ln Y - \overline{\alpha}\Delta \ln K - (1-\overline{\alpha})(\Delta \ln N + \Delta \ln H)$$

where H is the annual hours worked per person in employment.

Adjusting TFP growth for capital accumulation

The basic measure of TFP and TFP growth rate does not take into account the fact that countries can experience different cycles and during slowdown in the economic activity the capital stock may not be fully utilized. We adjust for this by calculating the GDP trend as the fitted values obtained by regressing the observed GDP on a quintic trend and adjusting capital stock as follows:

$$K^{adj} = K_{it}\left[1 + \left(\frac{Y_{it} - Y_{it}^{tr}}{Y_{it}^{tr}}\right)\right]$$

where Y^{tr} is the trend GDP.

TFP measurement by using the estimation approach

The aim of using the econometric approach (Fajnzylber and Lederman, 1999) is to estimate the share of capital in output directly from the production function rather than rely on its calculation based on macro data. Imposing constant return to scale, we calculate the TFP growth rate as the residuals obtained from the following regression:

$$\begin{aligned}\Delta \ln\left(\frac{Y}{L}\right)_{it} &= \alpha_o + \alpha_1 \Delta \ln\left(\frac{K}{L}\right)_{it} + \xi_{it} \\ where\ \xi_{it} &= c_i + \lambda_t + \varepsilon_{it}\end{aligned}$$

Thus, assuming labour augmenting technological progress, the TFP growth rate is calculated as follows:

$$\widehat{\Delta TFP}_{it} = \frac{\widehat{\alpha}_o + \widehat{\xi}_{it}}{1-\widehat{\alpha}_1} = \frac{1}{1-\widehat{\alpha}_1}\left[\Delta \ln\left(\frac{Y}{L}\right)_{it} - \widehat{\alpha}_1 \Delta \ln\left(\frac{K}{L}\right)_{it}\right]$$

2.6.3 Data appendix

Sample composition

The countries in the sample are:

Austria	Germany	Norway
Belgium	Ireland	Portugal
Denmark	Italy	Sweden
Finland	Japan	United Kingdom
France	Netherlands	United States

Data definitions and sources

L Total employment (*source*: OECD National Accounts).

P Working age population (*source*: OECD National Accounts).

LF Labor force (*source*: OECD National Accounts).

H Average annual hours worked per person in employment (*source*: OECD International Sectoral Data Base).

w Real labour cost: $w = \left(\dfrac{WSSE}{def_{GDP}}\right)/(L - L_{self})$, where WSSE is the compensation of employees at current price and national currencies (*source*: OECD Economic Outlook), def_{GDP} is the GDP deflator, base year 1990 (*source*: OECD National Accounts), L is total employment and L_{self} is the total number of self- employed (*source*: OECD National Accounts).

K Real capital stock. The calculation of the capital stock is made according to the Perpetual Inventory Method: $K = (1-\delta)K_{-1} + \left(\dfrac{we^n}{def_{INV}}\right)_{-1}$, where we^n is the gross fixed capital formation at current prices and national currencies (*source*: OECD National Accounts) and def_{INV} is the gross fixed capital formation price index, base year 1990 (*source*: OECD National Accounts) and the depreciation rate, δ, is assumed constant and equal to 8 percent, which is consistent with OECD estimates (Machin and Van Reenen, 1998). Initial capital stock is calculated as: $K_0 = \dfrac{we_0}{g+\delta}$, where g is the average annual growth of investment expenditure and we_0 is investment expenditure in the first year for which data on investment expenditure are available.

A Total factor productivity (TFP). This is computed using the following formula: $d\ln A = \dfrac{1}{1-\overline{\alpha}}[d\ln Y - \overline{\alpha} d\ln K - (1-\overline{\alpha})d\ln L]$, where Y is gross domestic output at constant price and national currencies (*source*: OECD National Accounts), K is capital stock as defined above, L is total employment as defined above, $(1-\overline{\alpha})$ is a smoothed share of labour following the procedure described in Harrigan (1997). Labor share is defined as $(1-\alpha) = \frac{wL}{Y}$. In order to make our measure of total factor productivity comparable across countries, we convert both Y and K to US dollars using the GDP and gross fixed capital formation Purchasing Power Parities (1990) respectively (*source*: OECD National Accounts).

r Real long term interest rate deflated by the 3-year expected inflation rate: $r = i - E(d\ln p_{+1})$, where i is the long term nominal interest rate (*source*: OECD Economic Outlook). $E(d\ln p_{+1})$ are fitted values from the regression $d\ln p = \gamma_1 d\ln p_{-1} + \gamma_2 d\ln p_{-2} + \gamma_3 d\ln p_{-3} + \nu$, where $d\ln p$ is the inflation rate based on the consumer price index p (*source*: OECD National Accounts) and the coefficients on the right side are restricted to sum to one, indicating inflation neutrality in the long run (see Cristini, 1999).

u Unemployment rate: $u = 1 - \frac{L}{LF}$, where L is the total employment and LF is the total labour force (see above for definition and data sources).

union Net union density, defined as the percentage of employees who are union members (*source:* Nickell et al. 2001).

tax Tax wedge, calculated as the sum of the employment tax rate, the direct tax rate and the indirect tax rate (*source:* Nickell et al. 2001).

rer Benefit replacement ratio, defined as the ratio of unemployment benefits to wages for a number of representative types (*source:* Nickell et al. 2001, constructed from OECD data sources).

BD Benefit duration, defined as a weighted average of benefits received during the second, third, fourth and fifth year of unemployment divided by the benefits in the first year of unemployment (*source:* Nickell et al. 2001, constructed form OECD data sources).

p Consumer price index, base year 1990 (OECD, Main Economic Indicators).

D Gross government debt (*source*: OECD Economic Outlook and for UK IMF International Financial Statistics). For missing values before 1970, debt is calculated using the formula: $D - D_{-1} = DF$, where DF is the government deficit (*source*: IMF International Financial Statistics).

Part II

International Capital Flows and Labour Market Volatility

Chapter 3

Capital Mobility and Unemployment Dynamics

3.1 Introduction

This chapter focuses on the labour market effects of international capital mobility. Specifically, our aim is to assess whether and to what extent the remarkable increase in capital mobility experienced by the OECD countries in the last two decades has contributed to unemployment dynamics.

The benefits of capital mobility are well known: the removal of barriers to factors mobility increases efficiency and, by lowering the cost of financial transactions, improves saving and investment both from a quantitative and qualitative point of view. In the long run, higher capital mobility enhances capital accumulation and economic growth. However, in a world in which labour is less mobile than capital, perfect capital mobility will also amplify the impact of country-specific productivity shocks on domestic employment.

The reason why this happens is easy to understand if one considers how an economy adjusts to a temporary reduction in productivity. In an economy without capital mobility, a temporary decrease in productivity leads to a reduction in the rate of return to capital and then to a temporary fall in capital accumulation and labour demand. Low barriers to capital mobility allow investors to diversify country-specific productivity shocks across countries. When a domestic negative shock hits the economy, capital flows abroad where the rates of return are relatively higher. This further shrinks the labour demand and deepens the recession. Conversely, if the shock is positive, the inflow of foreign capital accelerates the increase in the labour demand. These forces result in bigger and sharper fluctuations in labour demand and real wages than would be observed in a closed economy, while the mean unemployment rate is not substantially affected. From this perspective, the main implication of higher international capital mobility is a reduction of the risk associated to capital income and an increase of the risk of labour income. Therefore, in absence of perfect insurance markets, higher capital mobility may have a significant negative impact on the welfare of individuals investing in human capital.

In this chapter we test the link between capital mobility and unemployment dynamics by using a panel of 20 OECD countries for the past 30 years. In particular, following Azariadis and Pissarides (2003), we are interested in exploring two possible roles played by capital mobility - first its effect on the persistence of unemployment and second its impact on unemployment responsiveness to idiosyncratic productivity shocks. In our analysis we find evidence for both mechanisms: larger penetration of international capital significantly amplifies the impact of idiosyncratic shocks on domestic unemployment, reduces the duration of the response to the shocks and increases unemployment volatility.

The reminder of the chapter is organized as follows. In section 3.2, we present the theoretical motivations of our study. Section 3.3 defines the key measures and concepts of unemployment volatility and capital mobility that we use in the empirical analysis along with a preliminary analysis of the data. In section 3.4 we present the empirical results and simulate the effects of changes in capital mobility on unemployment volatility. Section 3.5 concludes.

3.2 Theoretical motivations and empirical evidence

The importance of international capital mobility has been extensively examined in the traditional trade theory. However, still little attention has been devoted to the macroeconomic effects of capital market integration. Indeed, increased capital mobility can produce undesirable effects in economies whose domestic capital becomes more responsive to productivity or price shocks.[1]

A direct implication of increased international capital mobility is an increase in investment volatility as the substitution between domestic and foreign investment becomes larger. Using a simple neoclassical model, Razin and Rose (1994) show that a reduction in barriers to capital mobility enhances investment opportunities and

[1]There is a large theoretical and empirical literature which releates changes in the business cycle volatility to changes in the degree of capital mobility. On the theoretical side, the effects of increased capital market integration on macroeconomic volatility are in fact not clear, and depend on the nature of the underlying shocks. For a discussion of this literature, see the survey of Buch (2002). The analsysis of the effects of capital market integration on business cycle volatility goes beyond the scope of this paper. From now on, we will focus our discussion on the implications of increased capital mobility for labour market volatility.

therefore the volatility of investment. These effects are larger when the underlying shocks are idiosyncratic and permanent. A non structural empirical analysis is also performed to test the link between openness and volatility suggested by the theory, finding little support to the theoretical conclusions.[2]

Regarding the effects of increasing international capital mobility on the labour market, Rodrik (1997) is one of the first who emphasizes the link between openness and labour market instability in a world where labour is intrinsically less mobile than capital. The main implication of this asymmetry is that workers have to face greater instability in earnings and hours worked in response to country specific shocks when international mobility of capital increases. Using a simple static model of open economy, he shows that the elasticity of demand of domestic labour increases with the degree of "openness" of the economy.[3] The intuition is easy to understand. The demand of any factor used in the production process becomes more sensitive to changes in its own price when other production factors (as for example capital) respond quicker and to a larger extent to economic changes.[4] When an idiosyncratic shock hits the economy (such as an exogenous shock to labour demand caused by an unexpected change in labour productivity) a flatter demand curve will result in larger changes in both employment and wages.[5]

[2] One of the main limitations of this kind of studies is the difficulty of design appropriate measures for the degree of capital mobility. The most frequently used indicators indicate the existence of barriers to capital mobility but they do not measure the intensity of such barriers. As a consequence the data (mainly cross sections) are not powerful enough to deliver any clear-cut implication.

[3] The degree of "openness" of the economy is captured by the increasing cost incurred by firms as capital moves across the national borders.

[4] As Rodrik pointed out, this can be seen as a direct consequence of the Le Chatelier- Samuelson principle.

[5] The distribution of volatility between wages and employment depends on the slope of the labour supply curve.

Azariadis and Pissarides (2003) analyse the impact of capital mobility on unemployment dynamics using a labour search framework.[6] Their one-sector equilibrium life-cycle model combines two important characteristics: (1) non-Walrasian labour markets with search frictions, and (2) asymmetry between international mobility of capital and labour, with capital being perfectly mobile across countries and labour perfectly immobile. In this framework, unemployment arises in equilibrium because of the presence of frictions in the matching process between vacancies (opened by firms at a constant unit cost) and available workers. Temporary international differences in total factor productivity determine the allocation of capital across national borders and, through capital adjustments, affect the domestic employment (and unemployment) rate. They show that in an open economy unemployment fluctuations caused by idiosyncratic TFP shocks are wider though less persistent than in a closed economy. The intuition is the following. In a closed economy adjustments of capital stock (and consequently of employment) after a productivity shock occur gradually and are driven by changes in domestic savings. In an economy with capital mobility, accumulation and decumulation of capital stock do not occur entirely through changes in domestic savings. Capital is imported from abroad when a positive TFP shock hits the domestic economy and is exported abroad in the case of negative shock. As a consequence, the adjustment of employment is faster (instantaneous under extreme assumptions) in an open economy than in a closed economy. Under

[6] The model is a open-economy version of models previously used to study the implications of search theory in explaining certain phenomena of the business cycle that the standard neoclassical framework cannot explain in a satisfactory way. See among the others Mertz (1995), Andolfatto (1996) and den Haan et al. (1997).

quite general assumptions, the main implications for the unemployment dynamics are that: (1) international capital mobility amplifies the impact on domestic unemployment of idiosyncratic TFP shocks; (2) it shortens the duration of the effect; (3) it rises the volatility of unemployment. Numerical calibrations of the model show that the variance of the unemployment rate with perfect capital mobility is almost three time larger than in economy without capital mobility. These results appear to be consistent with observation that the variability of unemployment has increased in the last decades in almost all the OECD countries in parallel with the liberalization of international capital markets.

An increased labour market instability in the United States over the last three decades as been documented in a number of studies. Gottschalk and Moffitt (1994) show a substantial increase in earnings dispersion in the US manufacturing sector between the 70s and 80s, half of which has been related to the increase in the variance of "transitory" movements in earnings.[7] The fact that the change in *short-term* earning volatility appears to persist along any dimensions one can cut the data (e.g. skill groups, sectors, establishments) may suggest the presence of a common factor (such has globalization, but also institutional changes) which have led to greater wage instability across and within different groups. Recent evidence in Farber (1996, 2003) also shows an increase in job insecurity between the 80s and 90s in the United States. Focusing on the incidence of job loss over the periods 1982-1996 and 1996-2001, Farber finds an increase in job loss rates over time after accounting for the

[7]The increase of the variance of "transitory" or *short-term* changes in earnings captures an increase of the fluctuations of worker's earning from year to year.

state of the labour market.[8]

As Rodrik pointed out, though neither Farber nor Gottschalk and Moffitt relate the declining job security to the increased integration of international markets, these facts appear to be consistent with an economy in which greater openness interacted with fluctuations in labour demand has led to greater instability in wages and employment.

Regarding the effects of "globalisation" on labour demand, as predicted by Rodrik (1997) and Azariadis and Pissarides (2003), a number of papers analyse the link between international market integration and labour demand elasticity.[9] Using data for the US manufacturing sector from 1961 to 1991, Slaughter (2001) finds that production-labour demand becomes more elastic over time in the overall manufacturing sector and in 5 of the 8 manufacturing industries considered. However, when the estimated (time variant) labour demand elasticity is regressed on a number of indicators of the degree of trade liberation, the effect of trade liberalization turns out to be not robust to the inclusion of time controls, suggesting the presence of a large unexplained residuals in changes of labour demand elasticities over time. Following a similar approach, Faini et al. (1999)[10] find some evidence of a positive effect of

[8] In the early 90s (during a weak labour market) job loss rates have been found to be higher than those recorded during the recession in the early 80s. Job loss also increased substantially in the 1999-2001 period in concomitance with the beginning of the recession.

[9] The indicators of international market integration used in the analysis include both measures of trade and capital openness. In fact the effect of international trade on the elasticity of labour demand is analogous to that of international capital mobility. The reason is that firms and consumers can substitute foreign workers for domestic workers by either investing abroad or by importing goods produced abroad (Rodrik, 1997). As explained before, higher labour demand elasticity triggers more volatile responses of wages and employment to any exogenous shocks to labour demand.

[10] This paper follows the approach used in a preliminary version of Slaughter's study published in the NBER working paper series in 1997.

globalisation on labour demand elasticity for the manufacturing sectors in Italy over the period 1985-1995. Finally, Bruno et al. (2003) develop a general framework to test the impact of globalisation on labour demand elasticities that generalises the previous empirical contributions. First a labour demand equation is obtained from the solution of a firm's cost minimization problem and a trade variable is included in this specification. The labour demand is then estimated using an industry panel for a number of OECD countries over the period 1970-1996. The hypothesis that high international integration affects labour demand elasticity receives strong support for France and the UK only.

A different approach is followed in two recent papers by Krishna et al. (2001) and Fajnzylber and Maloney (2001), which investigate the link between openness and labour demand elasticities in countries experiencing dramatic changes in trade regimes.[11] Both papers find little support to the conjecture of more-elastic labour demand in response to trade liberalization.

3.3 Employment dynamics and capital mobility: a preliminary analysis

As we have seen in the previous section, the theory predicts that economies with larger international capital flows have higher volatility of investment (Razin and

[11] Krishna et al. (2001) analyse the impact of trade liberalization in Turkey where significant import liberalization measures were announced in December 1983 and implemented soon after. The 1984 import liberalization program significantly reduced both tariff and non-tariff barriers. Fajnzylber and Maloney (2001) use dynamic panel techniques to estimate labor demand relations for manufacturing establishments in Chile, Colombia, and Mexico across their periods of reforms.

Rose, 1994) and unemployment (Azariadis and Pissarides, 2003). In this section we consider some preliminary evidence of the relationship between capital mobility and unemployment (and investment) volatility by looking at the correlation between different measures of international capital flows and our variables of interest. The analysis is based on annual data for 20 OECD countries over the period 1970-2001[12].

We consider three measures of the penetration of foreign capital in the OECD countries, namely the FDI inflows (FDI_in), the absolute value of FDI inflows net of FDI outflows (FDI_net), and the sum of FDI inflows and outflows as a proxy of the overall FDI activity (FDI_sum). The FDI flows are normalized by dividing them by domestic investment. The data on FDI flows are available from the International Financial Statistics of the IMF for almost all the OECD countries for the period under investigation.[13] Measures of capital mobility based on FDI intensity have the advantage that data on FDI are readily available on a comparable basis for a large number of countries. However, some limitations remain due to existing divergences in the compilation methodologies, definitions and classifications.[14]

Following a standard approach in the real business cycle literature, we calculate the investment and unemployment rates volatility as the standard deviation of the cyclical component of the time series under investigation. We detrended the data using the Hodrick-Prescott filter, setting the smoothing parameter λ equal to 100

[12] A full list of the countries included in the analysis and the definition of variables used is given in Appendix 3.6.4.

[13] The IMF publishes annual data on FDI inflows (direct investment in the reporting economy) and FDI outflows (direct investment abroad) in the Balance of Payments Statistics Yearbook, which are also available in the International Financial Statistics.

[14] For a discussion on the international comparability of FDI statistcs, see the excellent survey by Falzoni (2000).

Table 3.1: Capital mobility and volatility of unemployment and investment rate

	FDIin	FDIout	FDIsum	FDInet	sd_un	sd_inv
			1970-2001			
sample mean (1)	0.084	0.092	0.177	0.059	0.011	0.072
			1970-1985			
sample mean (2)	0.033	0.032	0.064	0.029	0.009	0.070
			1986-2001			
sample mean (3)	0.125	0.138	0.265	0.082	0.013	0.075
sample mean ratio (3)/(2)	**6.721**	**8.450**	**5.642**	**3.936**	**1.667**	**1.139**

as suggested for annual data (Hodrick and Prescott, 1997). Raw data on unemployment and investment are available from the OECD National Account Statistics and Economic Outlook.

Table 3.1 reports the sample average volatility of unemployment and investment rates and the average of the previously defined measures of FDI flows for the whole period (1970-2001) and for two sub-periods, before and after 1985. The striking feature of the data is the remarkable increase in international capital mobility after the mid 1980s. The sharp increase in FDI inflows affected almost all the countries in the sample[15] and, in accordance with the prediction of the theory, this coincides with an increase in the volatility of unemployment and investment. On average the standard deviation of the unemployment rate is almost 70 percent higher in the period 1986-2001 than in the previous period while the rise in the investment rate standard deviation is about 15 percentage points.

A preliminary assessment of the cross country correlation between unemployment and investment volatility and our measures of capital mobility is provided in Table

[15] Tables 1A-3A in appendix 3.6.1 report FDI statistics, unemployment and investment volatility for individual OECD countries.

Table 3.2: Spearman correlation between unemployment/investment volatility and capital mobility

	FDIin	FDIsum	FDInet
		1970-2001	
sd_un	0.54**	0.51**	0.52**
sd_inv	0.27*	0.42*	0.46**
		1970-1985	
sd_un	0.20	0.25	0.38*
sd_inv	0.34	0.03	0.32
		1986-2001	
sd_un	0.59**	0.61**	0.69**
sd_inv	0.37*	0.43**	0.44**

Notes. **5 percent significance *10 percent significance

3.2, where the Spearman correlation coefficients are reported for the whole period and for the two sub-periods separately[16]. The results show that both unemployment volatility and investment volatility are strongly positively correlated with all the measures of capital mobility considered. The rank correlation is not significant in the period 1970-1985, but it turns to be strongly significant in the most recent period.

Finally, Figures 3.1 and 3.2 plot each measure of capital mobility against the volatility of unemployment rate and investment rate respectively. There is a strong evidence that countries characterized by a higher degree of openness to international capital flows have higher unemployment and investment volatility. This relationship holds irrespective of the measure for capital mobility used. Again the positive correlation is more significant for the years after 1985, when international capital flows into and out of the OECD countries recorded a substantial increase.

In what follows we present more systematic evidence of the effects of capital

[16]Spearman rank correlation coefficients are reported rather then simple correlation coefficients since the former are less sensitive to the presence of outliers than the latter.

Figure 3.1: Unemployment volatility and capital mobility

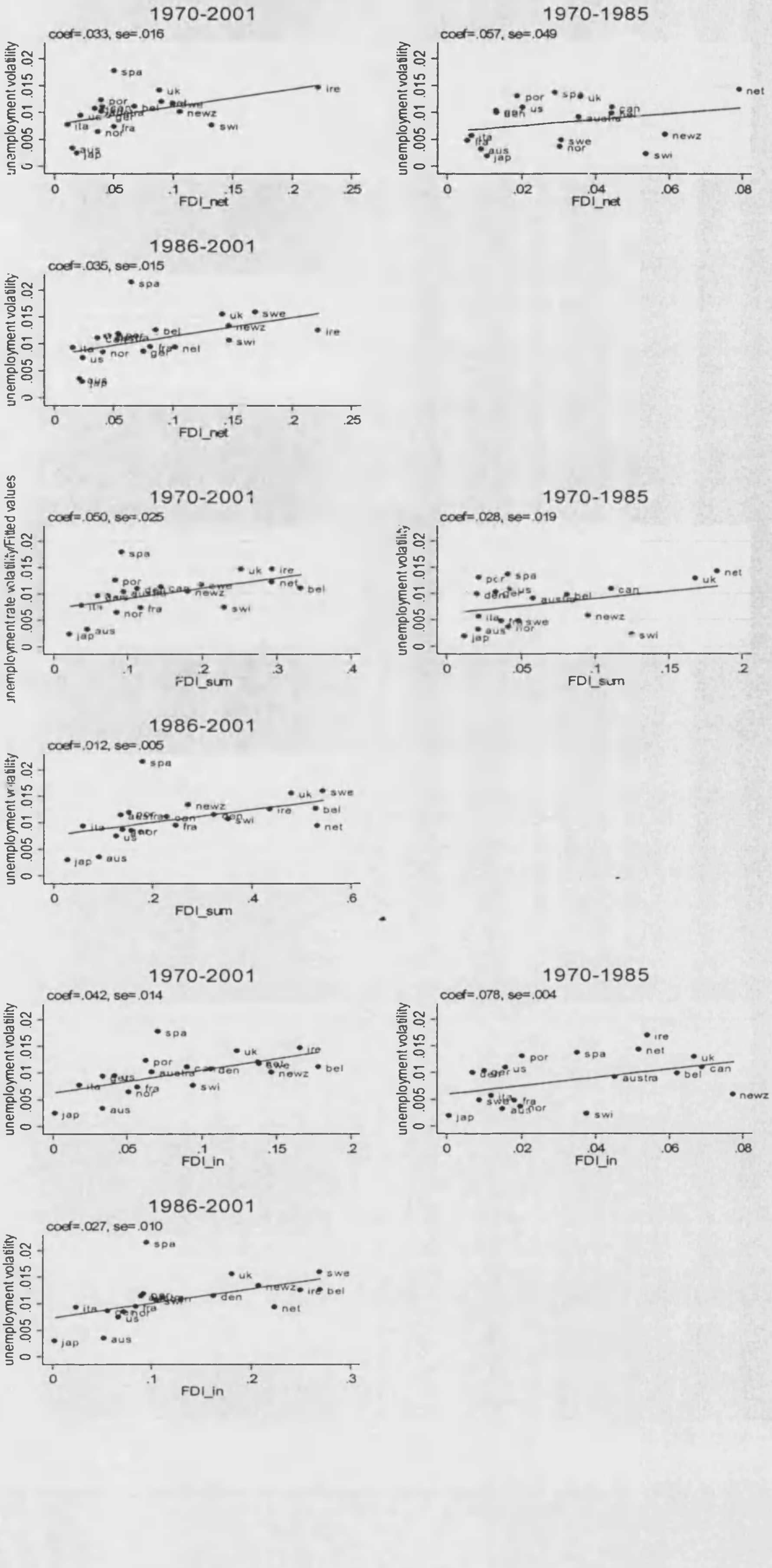
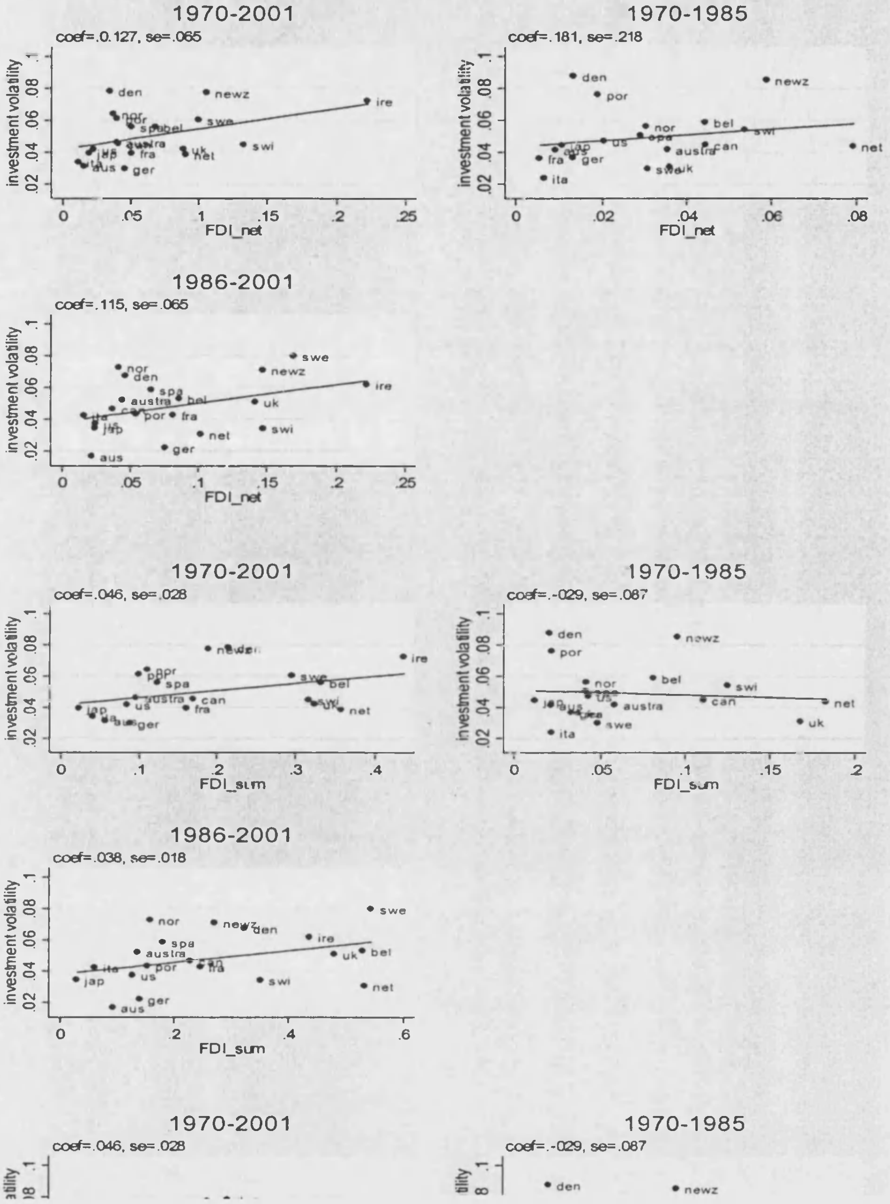


Figure 3.2: Investment volatility and capital mobility



mobility on unemployment dynamics.

3.4 Empirical analysis

3.4.1 Empirical specification

In this section we present econometric evidence of the effects of capital mobility on unemployment persistence and on the adjustment dynamics of unemployment in response to TFP shocks as predicted by Azariadis and Pissarides (2003).

The baseline framework is a reduced form dynamic equation for unemployment where we include controls for labour market institutions and the (ex ante) real interest rate, which may affect the equilibrium rate of unemployment. We also include a TFP shock, a price shock and an import shock which may affect the short run dynamics of unemployment[17]. Among the institutional variables we consider two indicators of the duration and generosity of unemployment insurance systems (benefit duration and benefit replacement ratio), the tax wedge between the real (monetary) labour cost faced by the firms and the consumption wage received by the employees and union density[18]. Fixed effects for each country, a country specific trend and time dummies for each year in the sample are also included.

[17] See Layard *et al.*, 1991 and Nickell *et al.* (2001) for the derivation of the reduced form for the unemployment equation.

[18] Data on labour market institutions are taken from Nickell and Nunziata Labour Market Institutions database. The information is available till 1995. Updated series for the years after 1995 are obtained from the OECD. Net union density series is updated using the new data in Visser (2000) and national sources. All the other data are derived from the OECD National Account Statistics and Economic Outlook. See appendix 3.6.4 for a detailed description of the variables and data sources.

The baseline unemployment equation is as follows:

$$\begin{aligned} u_{it} = & \sum_{j=1}^{p} \theta_j u_{it-j} + \sum_{j=0}^{q} \gamma_j tfp\_sh_{it-j} + \alpha_1' \mathbf{inst}_{it} + \alpha_2 rint_{it} \\ & + \alpha_3 pr\_sh_{it} + \alpha_4 imp\_sh_{it} + c_{it} t + \lambda_t + c_i + \varepsilon_{it} \end{aligned} \tag{3.1}$$

where $i = 1,..,20$, $t = 1,...,31$, tfp_sh is the TFP shock, **inst** denotes the set of institutional variables included in the regression, $rint$ is the (ex ante) real interest rate, pr_sh is an inflationary shock and imp_sh is an import price shock as defined in Nickell *et al.* (2001). c_i and λ_t capture country-specific effects and time effects respectively and c_{it} reflects those country-specific factors which may have an impact on the change of unemployment. Finally, ε_{it} captures all the other shocks to the unemployment rate, and it is assumed to be serially uncorrelated.

The inclusion of lagged dependent variables can lead to finite sample biases with the within-group estimator. The results in Nickell (1981), however, show that the magnitude of the bias diminishes in the length of the time series in the panel. Since the sample runs for 31 years, the size of this bias is likely to be small. The asymptotic unbiasedness of the coefficients crucially depends on the absence of serial correlation in the errors. This will be investigated by using a serial correlation test described by Baltagi (1995)[19].

As a measure of persistence we use the sum of the coefficients on the lags of unemployment, that is $\rho = \sum_{j=1}^{p} \theta_j$. For $\rho \in [-1, 1]$ the cumulative effect of a shock on

[19]The test is an LM statitistic which tests for an $AR(1)$ and/or an $MA(1)$ structure in the residuals in a fixed-effects model. It is asymptotically distributed as $N(0, 1)$ under the null. See Baltagi (1995).

unemployment is given by $1/(1-\rho)$. A larger ρ is then associated with shocks having a larger cumulative effect on unemployment over time, implying larger persistence (Pivetta and Reis, 2001).

Following Nickell et al. (2001), the TFP shock (tfp_sh in the equation) has been measured as the deviation of the Solow residual from its Hodrick-Prescott filtered trend. The existence of a negative relationship between the variable shock and the unemployment rate implies that the sum of the coefficients on the current and lagged variable shock should be negative. We choose both p and q equal to 2 and 1 respectively, in order to satisfy standard dynamic properties of the model. In particular, the two lags of the dependent variable have been chosen in order to obtain serially uncorrelated residuals.

As suggested in the above discussion we are interested in exploring two possible roles played by capital mobility - first its effect on unemployment persistence and second its impact on the responsiveness of unemployment to an idiosyncratic TFP shock. We thus interact our measures of capital mobility with the lags of unemployment to capture the effect on persistence, and with the TFP shock (both current and lagged) to capture the effect on the responsiveness to a productivity shock. We also enter the measures of capital mobility in levels to control for any possible effect of capital mobility on the level of unemployment rate. The equation we estimate takes then the following form:

$$u_{it} = \sum_{j=1}^{p}(\theta_j + \theta'_j FDI_{mit-1})u_{it-j} + \sum_{j=0}^{q}(\gamma_j + \gamma'_j FDI_{mit-1})tfp\_sh_{it-j} \quad (3.2)$$
$$\beta FDI_{mit-1} + \alpha' \mathbf{z}_{it} + c_{it}t + \lambda_t + c_i + \varepsilon_{it}$$

where $m = IN, SUM, NET$, and z_{it}[20] denotes a set of other controls as in equation 3.1. We use lagged rather than current values of FDI flows in order to avoid endogeneity arising from potential correlation between the error term and current FDI flows caused, for example, by unexpected aggregate shocks on employment[21].

The measure of persistence now becomes $\rho = \sum_{j=1}^{p}(\theta_j + \theta'_j \overline{FDI}_m)$. If we expect that capital mobility reduces unemployment persistence, the null hypothesis we want to test is $H_0 : \sum_{j=1}^{p}\theta'_j \geqq 0$ versus $H_1 : \sum_{j=1}^{p}\theta'_j < 0$. If the null is rejected, we can conclude that higher capital mobility leads to a lower persistence of unemployment.

Similarly, capital mobility increases the responsiveness of unemployment to a TFP shock if the sum of the coefficients on the variable shock interacted with our proxies for capital mobility is significantly lower than zero. Formally, $H_0 : \sum_{j=0}^{q}\gamma'_j \geqq 0$ versus $H_1 : \sum_{j=0}^{q}\gamma'_j < 0$[22].

[20] $\mathbf{z}_{it} = (union_{it},\ bd_{it},\ brr_{it},\ tw_{it},\ rint_{it},\ pr\_sh_{it},\ imp\_sh_{it})$

[21] We obtain very similar results when the current value of FDI flows rather than the lagged one is used in the regressions.

[22] Given that the coefficient on the interaction term is always negative on both the current and lagged shock (and then the sum of the two coefficients turns to be always significantly less then zero), to save space the t-statistic and p-value of the null hypotesis $H_0 : \sum_{j=0}^{q}\gamma'_j \geqslant 0$ are not reported in the tables with the empirical results.

3.4.2 Empirical results

We begin in Table 3.3 by showing estimates of the coefficients of a baseline model with no interactions with TFP shocks. The estimates are reported for the whole sample and for the small countries only, in order to check whether there are significant differences in the impact of capital mobility related to the size of the countries considered.[23]

In columns (1), (2) and (3) the lags of unemployment are interacted with the net FDI inflows, the sum of FDI inflows and outflows and FDI inflows respectively. Capital mobility reduces the coefficient on the first lag of unemployment and increases the coefficient on the second lag. The net effect on persistence (the sum of the two coefficients) is negative and significant as revealed by the t-test reported at the bottom of the table.[24] This result is robust to two of the three measures for capital mobility considered, namely *FDIsum* and *FDIin,* and it holds for both the whole sample and the small countries sample. When we consider the net FDI inflows, the coefficients on the interactions have still the expected sign, their sum is negative and marginally significant, though they are not individually nor jointly significant. There is no evidence of any effects of capital mobility on the level of unemployment. All the other controls behave as predicted by the theory with union density, benefit duration and tax wedge having a positive a significant impact on unemployment. Real interest rate is well signed and significant as well. As expected,

[23]The small countries sample is obtained by excluding all the G7 countries with the exception of Canada.

[24]The t-statistic and p-value of the null hypotesis $H_0 : \sum_{j=1}^{p} \theta'_j \geqslant 0$ are reported on the lower panel of Table 3.3.

Table 3.3: Capital mobility and unemployment persistence (whole period)

u_{it}	Whole Countries			Small Countries		
Independent Variables	(1)	(2)	(3)	(1')	(2')	(3')
u_{it-1}	1.337	1.356	1.328	1.326	1.347	1.329
	(23.89)	(27.00)	(25.26)	(19.69)	(23.26)	(21.80)
u_{it-2}	-0.535	-0.555	-0.527	-0.538	-0.560	-0.543
	(9.97)	(11.43)	(10.61)	(8.33)	(10.26)	(9.63)
$u_{it-1} * FDIm_{it-1}$	-0.506	-0.354	-0.248	-0.432	-0.345	-0.397
	(0.94)	(3.51)	(0.87)	(0.68)	(3.80)	(1.34)
$u_{it-2} * FDIm_{it-1}$	0.325	0.288	0.091	0.224	0.283	0.217
	(0.64)	(2.85)	(0.37)	(0.37)	(2.77)	(0.84)
$FDInet_{it-1}$	0.006			0.010		
	(0.58)			(0.92)		
$FDIsum_{it-1}$		-0.000			-0.000	
		(0.08)			(0.11)	
$FDIin_{it-1}$			0.011			0.10
			(1.63)			(1.37)
$FDIout_{it-1}$			-0.002			-0.002
			(1.33)			(1.33)
$union_{it}$	0.040	0.042	0.041	0.041	0.044	0.041
	(3.12)	(3.39)	(3.31)	(2.86)	(3.13)	(3.31)
bd_{it}	0.007	0.008	0.007	0.009	0.009	0.007
	(1.55)	(1.67)	(1.56)	(1.73)	(1.71)	(1.56)
brr_{it}	0.001	0.000	0.003	-0.006	-0.007	-0.003
	(0.09)	(0.03)	(0.30)	(0.44)	(0.54)	(0.21)
tw_{it}	0.024	0.024	0.026	0.044	0.043	0.046
	(1.73)	(1.70)	(1.84)	(2.65)	(2.55)	(2.68)
$rint_{it}$	0.040	0.038	0.039	0.049	0.051	-0.051
	(1.97)	(1.94)	(1.96)	(2.10)	(2.19)	(2.14)
pr_sh_{it}	-0.003	-0.006	-0.000	-0.002	-0.004	0.002
	(0.24)	(0.47)	(0.30)	(0.11)	(0.25)	(0.10)
imp_sh_{it}	-0.005	0.004	0.015	0.005	0.013	0.023
	(0.20)	(0.16)	(0.53)	(0.15)	(0.44)	(0.76)
tfp_sh_{it}	-0.048	-0.051	-0.050	-0.035	-0.038	-0.038
	(2.90)	(3.06)	(3.03)	(1.97)	(2.10)	(2.14)
tfp_sh_{it-1}	-0.090	-0.088	-0.092	-0.084	-0.081	-0.085
	(5.84)	(5.61)	(5.98)	(5.00)	(4.77)	(5.13)
Serial Corr (p-value)	0.43	0.46	0.31	0.29	0.31	0.16
Obs.	531	531	531	361	361	361
Fixed effects	20	20	20	14	14	14
F-tests (p-values):						
$H_0 : \theta_1 = 0, \theta_2 = 0$	0.31	0.00	0.09	0.32	0.00	0.06
$H_0 : \theta_1 + \theta_2 \geqq 0$	0.07	0.04	0.05	0.07	0.06	0.03

Notes. Robust t-statistics in parenthesis. Serial Correlation is an LM test distributed N(0,1) under the null (H0: no autocorrelation). In columns (1), (2) and (3) the lags of the unemployment rate are interacted with FDInet, FDIsum and FDIin respectively.

both the current and lagged TFP shocks have a negative and significant effect on the unemployment rate.

Next we investigate the role that capital mobility plays in increasing the responsiveness of unemployment to a temporary TFP shock. Thus we interact the current and lagged *tfp_sh* with the proxies of capital mobility. The interaction term is expected to be negative: the higher the economy's level of capital mobility, the greater the impact of a TFP shock on the unemployment rate. From Table 3.4, the interaction terms with both the current and lagged shock are indeed negative, though not always statistically significant at conventional levels. The negative effect of capital mobility on the persistence of unemployment remains negative and significant.

From a preliminary exploration of our data (paragraph 3.3) we noticed that the bivariate relationship between capital mobility and unemployment volatility appears to have been significant only since the mid eighties, when capital flows became more important in the OECD countries. Prior to the mid 1980s capital flows were much smaller and they were not measured as accurately as in the more recent period, so it is possible that the earlier measures are dominated by measurement errors, or that barriers to international capital mobility render our empirical model inappropriate.

We therefore ask whether the effect of capital mobility on both persistence and responsiveness of unemployment to TFP shocks is stronger for the years after 1985. Table 3.5 presents these results. We interact both the lags of the unemployment rate and the current and lagged TFP shocks with a period dummy taking value 1 for years after 1985 and 0 otherwise. We also interact both the lags of unemployment

Table 3.4: Capital mobility, unemployment persistence and responsiveness (whole period)

u_{it}	Whole Countries			Small Countries		
Independent Variables	(1)	(2)	(3)	(1')	(2')	(3')
u_{it-1}	1.340	1.366	1.343	1.330	1.359	1.344
	(23.79)	(25.61)	(24.33)	(19.52)	(22.35)	(21.04)
u_{it-2}	-0.541	-0.563	-0.539	-0.544	-0.570	-0.554
	(9.97)	(10.99)	(10.42)	(8.32)	(9.99)	(9.45)
$u_{it-1} * FDIm_{it-1}$	-0.541	-0.421	-0.418	-0.485	-0.421	-0.541
	(1.03)	(3.16)	(1.23)	(0.76)	(3.09)	(1.50)
$u_{it-2} * FDIm_{it-1}$	0.345	0.334	0.224	0.261	0.339	0.035
	(0.70)	(2.63)	(0.79)	(0.42)	(2.46)	(1.10)
$FDInet_{it-1}$	0.005			0.010		
	(0.58)			(0.92)		
$FDIsum_{it-1}$		0.000			-0.000	
		(0.05)			(0.09)	
$FDIin_{it-1}$			0.012			0.010
			(1.74)			(1.31)
$FDIout_{it-1}$			-0.004			-0.003
			(1.04)			(1.37)
$union_{it}$	0.038	0.042	0.042	0.038	0.043	0.043
	(2.96)	(3.31)	(3.33)	(2.68)	(3.03)	(3.04)
bd_{it}	0.007	0.008	0.008	0.010	0.010	0.011
	(1.59)	(1.74)	(1.64)	(1.77)	(1.80)	(1.91)
brr_{it}	0.002	-0.001	0.003	-0.005	-0.008	-0.002
	(0.15)	(0.08)	(0.31)	(0.37)	(0.61)	(0.17)
tw_{it}	0.023	0.023	0.024	0.043	0.041	0.044
	(1.68)	(1.61)	(1.73)	(2.61)	(2.41)	(2.52)
$rint_{it}$	0.038	0.036	0.038	0.046	0.048	0.049
	(1.87)	(1.84)	(1.86)	(1.97)	(2.09)	(2.07)
pr_sh_{it}	-0.004	-0.007	-0.000	-0.002	-0.005	0.002
	(0.28)	(0.54)	(0.03)	(0.15)	(0.32)	(0.15)
imp_sh_{it}	-0.003	0.012	0.000	0.007	0.009	0.022
	(0.12)	(0.01)	(0.45)	(0.23)	(0.30)	(0.71)
tfp_sh_{it}	-0.057	-0.058	-0.061	-0.044	-0.048	-0.050
	(3.05)	(3.24)	(3.35)	(2.16)	(2.37)	(2.46)
tfp_sh_{it-1}	-0.097	-0.096	-0.100	-0.091	-0.091	-0.096
	(5.63)	(5.37)	(5.81)	(4.68)	(4.75)	(5.17)
$tfp\_sh_{it} * FDI_{mit-1}$	-0.166	-0.068	-0.181	-0.150	-0.079	-0.174
	(1.55)	(1.69)	(1.99)	(1.14)	(1.84)	(1.78)
$tfp\_sh_{it-1} * FDI_{mit-1}$	-0.170	-0.075	-0.128	-0.149	-0.093	-0.157
	(1.13)	(1.17)	(1.35)	(0.88)	(1.40)	(1.62)
Serial Corr (p-value)	0.43	0.48	0.26	0.28	0.37	0.17
Obs.	531	531	531	361	361	361
Fixed effects	20	20	20	14	14	14
F-tests (p-values):						
$H_0 : \theta'_1 = 0, \theta'_2 = 0$	0.23	0.00	0.06	0.25	0.00	0.06
$H_0 : \theta'_1 + \theta'_2 \geq 0$	0.05	0.01	0.03	0.05	0.02	0.03
$H_0 : \gamma'_1 = 0, \gamma'_2 = 0$	0.23	0.22	0.12	0.46	0.16	0.14

Notes. Robust t-statistics in parenthesis. Serial Correlation is an LM test distributed N(0,1) under the null (H0: no autocorrelation). In columns (1), (2) and (3) the lags of the unemployment rate are interacted with FDInet, FDIsum and FDIin respectively.

and current and lagged TFP shock with the period dummy and the proxies for capital mobility. The coefficients of the first set of interactions will capture the effects of any factors at play that may influence the persistence and responsiveness of unemployment to TFP shock between the two periods rather than capital mobility. The coefficients of the second set of interactions will capture the additional effect of capital mobility after 1985.[25]

The results are consistent with those for the whole period and the coefficients are significant at conventional levels. In particular, capital mobility is found to significantly reduce the persistence of unemployment after 1985, the sum of the FDI interaction terms being negatively signed and statistically significant at 10% level and 5% level in all the specifications considered. The fact that some coefficients are jointly but not always individually significant and their sum is significantly negative suggests the presence of some degree of collinearity. Nevertheless, this still indicates a significant negative effect of capital mobility on unemployment persistence.

Turning to the effect of capital mobility on the responsiveness of unemployment to TFP shocks, the coefficients on the capital mobility interactions are negative, quantitatively important and statistically significant irrespectively of the proxy of

[25]The specification followed is:

$$\begin{aligned} u_{it} &= \sum_{j=1}^{p}(\theta_j + \theta_j'' d85 + \theta_j' d85 * FDI_{mt-1})u_{it-j} \\ &+\sum_{j=0}^{q}(\gamma_j + \gamma_j'' d85 + \gamma_j' d85 * FDI_{mit-1})tfp\_sh_{it-j} \\ &+\alpha' \mathbf{z}_{it} + \beta FDI_{mit-1} + \alpha' \mathbf{z}_{it} + c_{it}t + \lambda_t + c_i + \varepsilon_{it} \end{aligned}$$

where $d85 = 0$ if $year \in [1970; 1985]$, and $d85 = 1$ otherwise.

Table 3.5: Capital mobility, unemployment persistence and responsiveness after 1985

u_{it}	Whole Countries			Small Countries		
Independent Variables	(1)	(2)	(3)	(1')	(2')	(3')
u_{it-1}	1.273	1.293	1.285	1.257	1.282	1.272
	(21.55)	(22.16)	(22.01)	(17.88)	(18.45)	(18.28)
u_{it-2}	-0.453	-0.469	-0.462	-0.438	-0.457	-0.455
	(7.92)	(8.32)	(8.29)	(6.37)	(6.88)	(6.83)
$u_{it-1} * d85$	0.054	0.054	0.049	0.038	0.031	0.032
	(1.36)	(1.31)	(1.19)	(0.96)	(0.79)	(0.79)
$u_{it-2} * d85$	-0.097	-0.095	-0.089	-0.090	-0.082	-0.080
	(2.61)	(2.47)	(2.39)	(2.55)	(2.35)	(2.30)
$u_{it-1} * d85 * FD\text{Im}_{it-1}$	-0.685	-0.420	-0.455	-0.611	-0.374	-0.480
	(1.34)	(3.16)	(1.36)	(0.99)	(2.57)	(1.37)
$u_{it-2} * *d85 * FD\text{Im}_{it-1}$	0.451	0.318	0.233	0.343	0.272	0.240
	(0.94)	(2.53)	(0.85)	(0.57)	(1.90)	(0.82)
tfp_sh_{it}	-0.038	-0.042	-0.042	-0.011	-0.015	-0.017
	(1.60)	(1.74)	(1.73)	(0.44)	(0.56)	(0.63)
tfp_sh_{it-1}	-0.085	-0.085	-0.087	-0.068	-0.068	-0.071
	(4.21)	(4.16)	(4.20)	(3.20)	(3.13)	(3.23)
$tfp\_sh_{it} * d85$	-0.022	-0.023	-0.022	-0.048	-0.050	-0.046
	(0.65)	(0.72)	(0.68)	(1.29)	(1.38)	(1.21)
$tfp\_sh_{it-1} * d85$	-0.038	-0.039	-0.032	-0.071	-0.074	-0.068
	(1.12)	(1.16)	(0.95)	(1.89)	(2.05)	(1.91)
$tfp\_sh_{it} * d85 * FDI_{mit-1}$	-0.221	-0.109	-0.19	-0.230	-0.123	-0.200
	(2.10)	(2.71)	(2.11)	(1.76)	(2.83)	(2.13)
$tfp\_sh_{it-1} * d85 * FDI_{mit-1}$	-0.377	-0.176	-0.212	-0.439	-0.222	-0.301
	(2.31)	(2.57)	(2.14)	(2.32)	(2.97)	(2.77)
other controls			*see appendix Table 4A*			
Serial Corr (p-value)						
Obs.	531	531	531	361	361	361
Fixed effects	20	20	20	14	14	14
F-tests (p-value):						
$H_0 : \theta_1' = 0, \theta_2' = 0$	0.09	0.00	0.08	0.10	0.01	0.07
$H_0 : \theta_1' + \theta_2' \geqq 0$	0.02	0.00	0.01	0.02	0.00	0.01
$H_0 : \gamma_1' = 0, \gamma_2' = 0$	0.02	0.01	0.04	0.04	0.00	0.01

Notes. Robust t-statistics in parenthesis. Serial Correlation is an LM test distributed N(0,1) under the null (H0: no autocorrelation). In columns (1), (2) and (3) the lags of the unemployment rate are interacted with FDInet, FDIsum and FDIin respectively. See Appendix 6.2 for the complete table with the coefficients and t-statistics for the other controls.

capital mobility used. This result shows that, after controlling for all the factors driving unemployment, international capital flows have a positive effect on the responsiveness of unemployment. Consistently with what we found in the preliminary analysis reported in paragraph 3.3, this effect appears to be stronger after 1985 when the FDI activity is more quantitatively relevant.

To conclude, the evidence in Table 3.5 suggests that countries characterized by larger penetration of international capital are more responsive to idiosyncratic TFP shocks and consequently experience amplified fluctuations in employment.

3.4.3 Simulation: unemployment response to temporary productivity shocks

In this part of the analysis we illustrate the importance of capital mobility for the dynamics of unemployment. By using the results from the last set of regressions (Table 3.5), we simulate the responsiveness of unemployment to a (negative) one-standard deviation TFP shock. We trace the response of unemployment to the TFP shock in a baseline economy with no capital mobility (closed economy) and we then compare this baseline case with an economy experiencing positive international capital flows (open economy). The exercise is repeated for all the three proxies of capital mobility. In order to quantify the effect of capital mobility on unemployment persistence and responsiveness in the open economy, we use the sample average of the three capital mobility indicators in the period 1985-2001, that is $\overline{FDInet} = 0.082$, $\overline{FDIsum} = 0.265$ and $\overline{FDIin} = 0.125$.

We then make use of the following equations in the simulations:

$$\begin{aligned} u_t &= (1.33 - 0.68 * \overline{FDInet})u_{t-1} - (0.55 - 0.45 * \overline{FDInet})u_{t-2} \\ &\quad -(0.06 + 0.22 * \overline{FDInet})shock_t - (0.12 + 0.38 * \overline{FDInet})shock_{t-1} \\ &\quad +Const_1 \end{aligned} \tag{3.3}$$

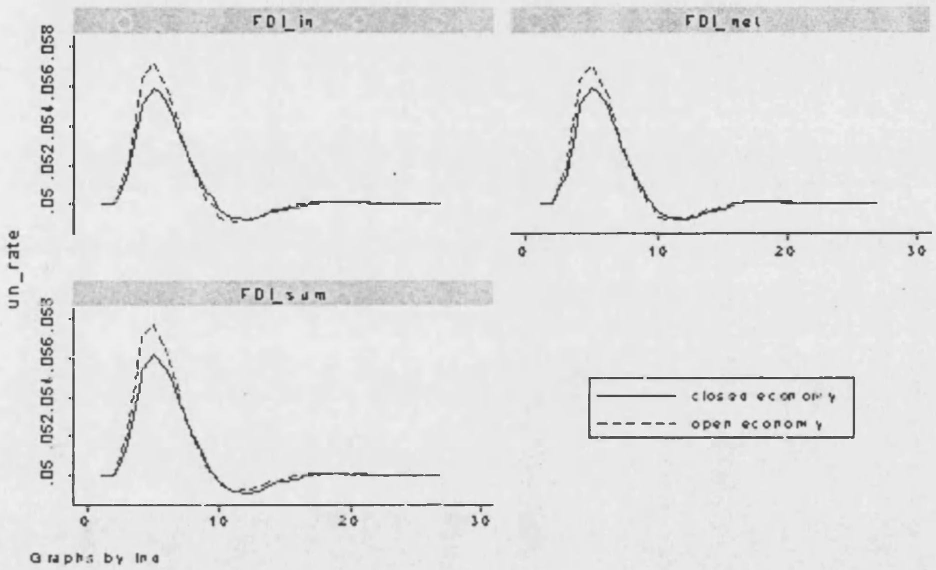
$$\begin{aligned} u_t &= (1.35 - 0.42 * \overline{FDIsum})u_{t-1} - (0.56 - 0.32 * \overline{FDIsum})u_{t-2} \\ &\quad -(0.07 + 0.11 * \overline{FDIsum})shock_t - (0.12 + 0.18 * \overline{FDIsum})shock_{t-1} \\ &\quad +Const_2 \end{aligned} \tag{3.4}$$

$$\begin{aligned} u_t &= (1.33 - 0.45 * \overline{FDIin})u_{t-1} - (0.55 - 0.23 * \overline{FDIin})u_{t-2} \\ &\quad -(0.06 + 0.19 * \overline{FDIin})shock_t - (0.12 + 0.21 * \overline{FDIin})shock_{t-1} \\ &\quad +Const_3 \end{aligned} \tag{3.5}$$

where $Const_i$ are "constants," by which we mean all variables not varied in the simulations.

Figure 3.3 shows the adjustment dynamics of the unemployment rate after one-standard deviation temporary TFP shock when capital mobility affects both the persistence and responsiveness of unemployment to a TFP shock. The initial response of unemployment to the shock is larger in presence of international capital mobility, the increase of the unemployment rate being on average 0.15 percentage

Figure 3.3: Response of unemployment to a TFP shock



points lower in absence of capital mobility. However, the adjustment to the pre-shock level of unemployment is faster in the economy with capital mobility because of the lower degree of persistence.

Figure 3.4 and Figure 3.5 show the adjustment of the unemployment rate to a one-standard deviation temporary TFP shock after separating the two effects of capital mobility on persistence and responsiveness respectively. It emerges that international capital movements significantly amplify the impact on unemployment of temporary shocks (Figure 3.4) though the duration of the response is shorter (Figure 3.5).

Table 3.6 shows the volatility of the unemployment rate for the period 1986-2001 generated in the previous simulation where the volatility of unemployment in the

Figure 3.4: Response of unemployment to a TFP shock - Effect on responsiveness

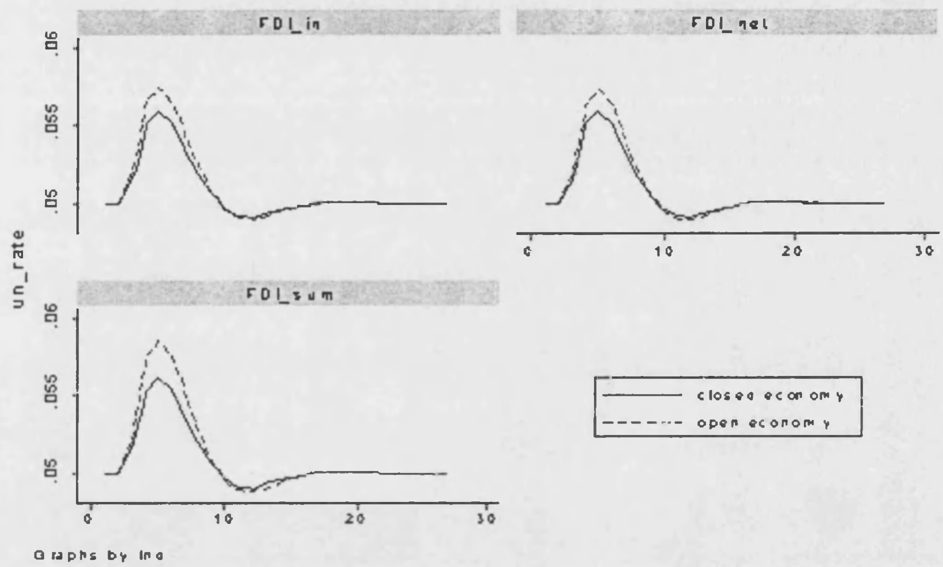


Figure 3.5: Response of unemployment to a TFP shock - Effect on persistence

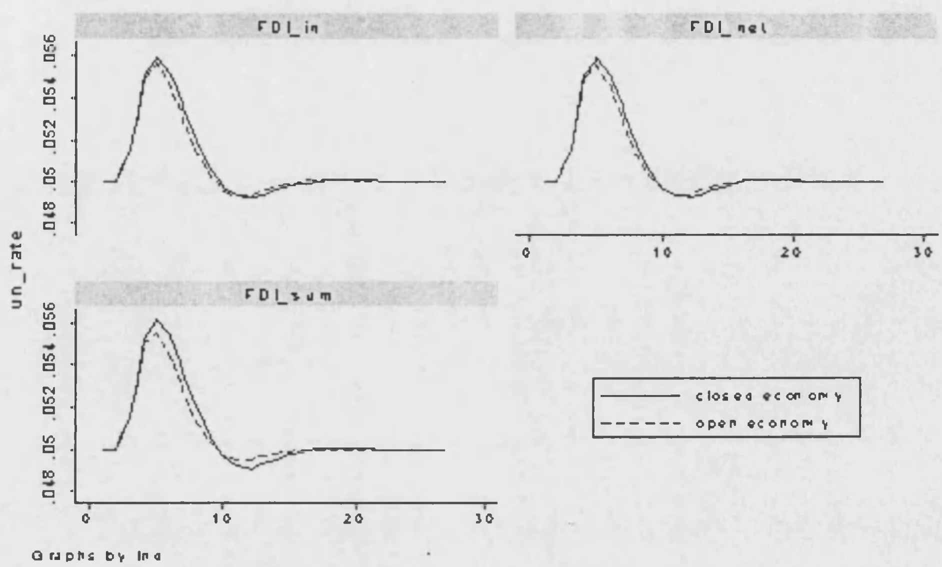


Table 3.6: Simulated unemployment volatility: 1986-2001

		simulated volatility (1986-2001)	
	$\overline{FDI}_m$	closed economy	open economy
Sim:			
FDInet	0.08	1	1.171
FDIsum	0.26	1	1.198
FDIin	0.12	1	1.169

economy without capital mobility (closed economy) is normalized to 1. The results indicate that the simulated standard deviation of the unemployment rate in the open economy is on average 18 percent higher than in the economy with no capital mobility.

Finally, in a second simulation we use our empirical model to illustrate the impact of the observed increase in capital mobility on unemployment volatility. We repeat the previous exercise for two levels of capital mobility, before and after 1985. The results are reported in Table 3.7, where the simulated volatility of unemployment for the period 1970-1985 is normalized to 1. Columns 1 and 2 show the simulated volatility of unemployment after 1985 if FDI remained to pre-85 levels and if FDI is allowed to increase by the observed amount respectively. The table shows that the estimated contribution[26] of the increase in capital mobility to unemployment volatility (Column 3) varies from 12 percent when net FDI inflows are used to almost 16 percent when the other two measures are considered[27]. Overall, these

[26] The contribution of capital mobility (Column 3) is calculated as the ratio of the percentage (simulated) variation of volatility induced by the increase in capital mobility to the total percentage (simulated) increase in volatility between the two periods. For example for the measure *FDInet*, the increase in volatility induced by higher international capital flows is 9.2 percent and the total increase in volatility between the two periods is 77 percent. Therefore, the estimated contribution of capital mobility to the increase of unemployment volatility is 12 percent.

[27] Table 5A in Appendix 3.6.3 reports the contribution of capital mobility to unemployment volatilty for individual OECD countries.

Table 3.7: Capital mobility contribution to variation in unemployment volatility before and after 1985

	unemployment volatility: 1986-2001 simulated		
	pre-1985 FDI level (1)	after-1985 FDI level (2)	cap. mob. contr. (sim) (3)
Sim:			
FDInet	1.62	1.77	**0.120**
FDIin	1.62	1.83	**0.156**
FDIsum	1.53	1.70	**0.158**

Notes. The simulated unemployment volatilities for the period 1970-1985 have been normalized to one. The contribution of capital mobility (Column 3) is calculated as the ratio of the percentage (simulated) variation of volatility induced by the increase in capital mobility to the total percentage (simulated) increase in volatility between the two periods.

estimates suggest that the increase in international capital flows observed in many OECD countries in the second half of 80s can generate sizeable increases in the volatility of unemployment.

3.5 Conclusions

In this chapter we presented empirical evidence for the OECD countries to show that increased international capital mobility has contributed to higher variance in the unemployment rate. Our findings confirm that unemployment in countries characterized by larger penetration of international capital is more responsive to idiosyncratic shocks and consequently these countries experience amplified fluctuations in employment. The time it takes for equilibrium to be restored, however, is shorter with international capital mobility.

We used our empirical model to simulate the response of the unemployment rate to a one-standard error temporary TFP shock. The results suggest that for the period 1986-2001 the simulated unemployment volatility in the economy with positive international capital mobility is on average 18 percent higher than in the economy with no capital mobility.

We then used the model's estimates to illustrate the extent to which capital mobility can account for the higher unemployment volatility occurred in many OECD countries since mid 80s. The model predicts that an increase of international capital flows of the same magnitude of that observed in the data after 1985 accounts for 12-16 percent of the (simulated) increase of unemployment volatility. This suggests a significant role played by international flows of capital in explaining the rise in unemployment fluctuations.

3.6 Appendix

3.6.1 Summary statistics

Table 1A: FDI flows, unemployment and investment volatility: 1970-2001

	FDIin	FDIout	FDIsum	FDInet	sd_un	sd_inv
Australia	0.067	0.029	0.097	0.04	0.010	0.046
Austria	0.034	0.023	0.057	0.016	0.003	0.031
Belgium[28]	0.178	0.154	0.332	0.068	0.011	0.056
Canada	0.09	0.080	0.171	0.041	0.011	0.045
Denmark	0.106	0.109	0.215	0.035	0.011	0.078
Finland	0.064	0.138	0.202	0.078	0.022	0.082
France	0.058	0.104	0.162	0.051	0.007	0.039
Germany	0.034	0.055	0.089	0.046	0.009	0.029
Ireland	0.166	0.107	0.437	0.222	0.015	0.072
Italy	0.018	0.023	0.041	0.011	0.008	0.033
Japan	0.002	0.021	0.023	0.019	0.002	0.039
Netherlands	0.138	0.220	0.358	0.091	0.012	0.038
New Zealand	0.147	0.043	0.190	0.106	0.010	0.077
Norway	0.051	0.059	0.111	0.037	0.006	0.064
Portugal	0.063	0.037	0.100	0.040	0.012	0.061
Spain	0.071	0.053	0.124	0.051	0.018	0.056
Sweden	0.139	0.157	0.296	0.100	0.012	0.060
Switzerland	0.095	0.223	0.317	0.133	0.008	0.045
United Kingdom	0.124	0.200	0.324	0.089	0.014	0.042
United States	0.042	0.043	0.085	0.023	0.009	0.042

[28] Average FDI flows for Belgium are calculated excluding the are calculated excluding the years 1999 and 2000. Data from the OECD (2003) show that the increase in FDI activity was largely driven by few M&A transactions foe which were paid exceptional high prices. This not truly reflect the increase in capital mobility.

Table 2A: FDI inflows, unemployment and investment volatility: 1970-1985

	FDIin	FDIout	FDIsum	FDInet	sd_un	sd_inv
Australia	0.046	0.013	0.059	0.036	0.009	0.041
Austria	0.015	0.006	0.021	0.009	0.003	0.041
Belgium	0.062	0.019	0.081	0.045	0.010	0.058
Canada	0.069	0.042	0.111	0.045	0.011	0.044
Denmark	0.007	0.013	0.020	0.0413	0.010	0.087
Finland	0.005	0.012	0.017	0.008	0.010	0.048
France	0.018	0.019	0.037	0.006	0.005	0.036
Germany	0.010	0.023	0.033	0.013	0.010	0.036
Ireland	0.054	-	-	-	0.016	0.082
Italy	0.012	0.010	0.022	0.007	0.005	0.023
Japan	0.001	0.012	0.012	0.011	0.017	0.044
Netherlands	0.052	0.131	0.183	0.079	0.014	0.044
New Zealand	0.077	0.018	0.096	0.059	0.006	0.085
Norway	0.020	0.022	0.042	0.030	0.003	0.056
Portugal	0.020	0.001	0.022	0.019	0.012	0.076
Spain	0.035	0.006	0.041	0.029	0.013	0.050
Sweden	0.009	0.040	0.048	0.031	0.005	0.029
Switzerland	0.038	0.088	0.126	0.054	0.021	0.054
United Kingdom	0.067	0.102	0.168	0.036	0.013	0.030
United States	0.016	0.027	0.043	0.020	0.011	0.047

Table 3A: FDI inflows, unemployment and investment volatility: 1986-2001

	FDIin	FDIout	FDIsum	FDInet	sd_un	sd_inv
Australia	0.090	0.047	0.137	0.045	0.011	0.052
Austria	0.053	0.041	0.093	0.022	0.003	0.017
Belgium	0.270	0.260	0.529	0.086	0.013	0.053
Canada	0.112	0.118	0.230	0.037	0.011	0.046
Denmark	0.162	0.162	0.324	0.047	0.012	0.067
Finland	0.105	0.225	0.329	0.126	0.030	0.107
France	0.085	0.163	0.248	0.082	0.009	0.042
Germany	0.056	0.085	0.141	0.076	0.009	0.022
Ireland	0.250	0.107	0.437	0.222	0.012	0.062
Italy	0.024	0.036	0.061	0.016	0.009	0.042
Japan	0.002	0.026	0.029	0.024	0.003	0.034
Netherlands	0.224	0.308	0.532	0.102	0.009	0.030
New Zealand	0.208	0.064	0.272	0.147	0.013	0.071
Norway	0.073	0.085	0.158	0.042	0.008	0.072
Portugal	0.093	0.061	0.154	0.054	0.012	0.043
Spain	0.095	0.085	0.181	0.066	0.021	0.058
Sweden	0.269	0.275	0.544	0.170	0.016	0.079
Switzerland	0.105	0.248	0.353	0.148	0.011	0.034
United Kingdom	0.181	0.299	0.480	0.142	0.015	0.051
United States	0.068	0.060	0.127	0.025	0.007	0.037

3.6.2 Regression tables

Table 4A: Capital mobility, unemployment persistence and responsiveness before and after 1985

u_{it}	Whole Countries			Small Countries		
Independent Variables	(1)	(2)	(3)	(1')	(2')	(3')
u_{it-1}	1.273	1.293	1.285	1.257	1.282	1.272
	(21.55)	(22.16)	(22.01)	(17.88)	(18.45)	(18.28)
u_{it-2}	-0.453	-0.469	-0.462	-0.438	-0.457	-0.455
	(7.92)	(8.32)	(8.29)	(6.37)	(6.88)	(6.83)
$u_{it-1} * d85$	0.054	0.054	0.049	0.038	0.031	0.032
	(1.36)	(1.31)	(1.19)	(0.96)	(0.79)	(0.72)
$u_{it-2} * d85$	-0.097	-0.095	-0.089	-0.090	-0.082	-0.080
	(2.61)	(2.47)	(2.39)	(2.55)	(2.35)	(2.30)
$u_{it-1} * d85 * FD\mathrm{Im}_{it-1}$	-0.685	-0.420	-0.455	-0.611	-0.374	-0.480
	(1.34)	(3.16)	(1.36)	(0.99)	(2.57)	(1.37)
$u_{it-2} * *d85 * FD\mathrm{Im}_{it-1}$	0.451	0.318	0.233	0.343	0 272	0.240
	(0.94)	(2.53)	(0.85)	(0.57)	(1.90)	(0.82)
$FDInet_{it-1}$	0.016			0.008		
	(0.65)			(0.31)		
$FDInet_{it-1} * d85$	-0.010			0.001		
	(0.41)			(0.05)		
$FDIsum_{it-1}$		0.005			-0.005	
		(0 28)			(0.30)	
$FDIsum_{it-1} * d85$		-0.004			0.005	
		(0.24)			(0.31)	
$FDIin_{it-1}$			-0.003			-0.025
			(0.09)			(0.79)
$FDIin_{it-1} * d85$			-0.011			-0.014
			(0.55)			(0.68)
$FDIout_{it-1}$			0.015			0.037
			(0.049)			(1.16)
$FDIout_{it-1} * d85$			0.009			0.012
			(0.41)			(0.58)
$union_{it}$	0.039	0.042	0.042	0.042	0.042	0.045
	(3.04)	(3.39)	(3.33)	(2.93)	(3.33)	(3.16)
bd_{it}	0.007	0.008	0.008	0.010	0.008	0.011
	(1.69)	(1.81)	(1.76)	(1.91)	(1.76)	(2.03)
brr_{it}	0.003	0.000	0.005	0.000	0.005	0.002
	(0.28)	(0.01)	(0.41)	(0.01)	(0.41)	(0.12)
tw_{it}	0.025	0.023	0.026	0.045	0.026	0.049
	(1.77)	(1.64)	(1.80)	(2.64)	(1.80)	(2.91)
$rint_{it}$	0.036	0.035	0.037	0.042	0.037	0.047
	(1.81)	(1.81)	(1.87)	(1.86)	(1.87)	(2.08)
(continued)						

Table 4A (continued)						
pr_sh_{it}	-0.007	-0.008	-0.001	-0.005	-0.006	-0.002
	(0.50)	(0.64)	(0.06)	(0.33)	(0.42)	(0.14)
$imppr\_sh_{it}$	-0.005	0.002	0.015	0.007	0.013	0.028
	(0.20)	(0.08)	(0.57)	(0.26)	(0.46)	(0.97)
tfp_sh_{it}	-0.038	-0.042	-0.042	-0.011	-0.015	-0.017
	(1.60)	(1.74)	(1.73)	(0.44)	(0.56)	(0.63)
tfp_sh_{it-1}	-0.085	-0.085	-0.087	-0.068	-0.068	-0.071
	(4.21)	(4.16)	(4.20)	(3.20)	(3.13)	(3.23)
$tfp\_sh_{it} * d85$	-0.022	-0.023	-0.022	-0.048	-0.050	-0.046
	(0.65)	(0.72)	(0.68)	(1.29)	(1.38)	(1.21)
$tfp\_sh_{it-1} * d85$	-0.038	-0.039	-0.032	-0.071	-0.074	-0.068
	(1.12)	(1.16)	(0.95)	(1.89)	(2.05)	(1.91)
$tfp\_sh_{it} * d85 * FDI_{mit-1}$	-0.221	-0.109	-0.190	-0.230	-0.123	-0.200
	(2.10)	(2.71)	(2.11)	(1.76)	(2.83)	(2.13)
$tfp\_sh_{it-1} * d85 * FDI_{mit-1}$	-0.377	-0.176	-0.212	-0.439	-0.222	-0.301
	(2.31)	(2.57)	(2.14)	(2.32)	(2.97)	(2.77)
Serial Corr (p-value)	0.35	0.43	0.26	0.21	0.30	0.14
Obs.	531	531	531	361	361	361
Fixed effects	20	20	20	14	14	14
F-tests (p-value):						
$H_0 : \theta_1' = 0, \theta_2' = 0$	0.09	0.00	0.08	0.10	0.01	0.07
$H_0 : \theta_1' + \theta_2' \geq 0$	0.02	0.00	0.01	0.02	0.00	0.01
$H_0 : \gamma_1' = 0, \gamma_2' = 0$	0.02	0.01	0.04	0.04	0.00	0.01

3.6.3 Simulation tables

Table 5A: Capital mobility contribution to variation in unemployment volatility before and after 1985

		unemployment volatility: 1986-2001 simulated pre-1985 FDI level (1)	after-1985 FDI level (2)	cap. mob. contr. (sim) (3)
	Sim:			
Australia	**FDInet**	1.65	1.68	**0.027**
	FDIsum	1.62	1.72	**0.086**
	FDIin	1.56	1.64	**0.080**
Austria	**FDInet**	1.53	1.60	**0.076**
	FDIsum	1.57	1.66	**0.087**
	FDIin	1.49	1.57	**0.094**
Belgium	**FDInet**	1.67	1.80	**0.097**
	FDIsum	1.65	2.08	**0.241**
	FDIin	1.59	1.94	**0.234**
Canada	**FDInet**	1.67	1.65	**-0.018**
	FDIsum	1.68	1.82	**0.102**
	FDIin	1.60	1.68	**0.074**
Denmark	**FDInet**	1.57	1.68	**0.103**
	FDIsum	1.58	1.91	**0.230**
	FDIin	1.48	1.77	**0.254**
Finland	**FDInet**	1.55	1.91	**0.255**
	FDIsum	1.57	1.91	**0.234**
	FDIin	1.47	1.66	**0.196**
France	**FDInet**	1.53	1.79	**0.215**
	FDIsum	1.59	1.83	**0.182**
	FDIin	1.50	1.63	**0.138**
Germany	**FDInet**	1.57	1.77	**0.165**
	FDIsum	1.59	1.72	**0.114**
	FDIin	1.48	1.57	**0.107**
Ireland	**FDInet**	-	-	-
	FDIsum	-	-	-
	FDIin	1.57	1.91	**0.238**
Italy	**FDInet**	1.55	1.58	**0.033**
	FDIsum	1.57	1.62	**0.051**
	FDIin	1.49	1.51	**0.026**
Japan	**FDInet**	1.56	1.61	**0.053**
	FDIsum	1.56	1.58	**0.022**
	FDIin	1.46	1.47	**0.015**

(continued)

Table 5A (continued)				
	Sim:			
Netherlands	**FDInet**	1.78	1.85	**0.046**
	FDIsum	1.77	2.08	**0.162**
	FDIin	1.57	1.87	**0.220**
New Zealand	**FDInet**	1.72	1.97	**0.150**
	FDIsum	1.66	1.86	**0.140**
	FDIin	1.62	1.85	**0.167**
Norway	**FDInet**	1.63	1.67	**0.037**
	FDIsum	1.60	1.73	**0.111**
	FDIin	1.50	1.61	**0.120**
Portugal	**FDInet**	1.59	1.70	**0.099**
	FDIsum	1.57	1.74	**0.146**
	FDIin	1.50	1.64	**0.146**
Spain	**FDInet**	1.62	1.74	**0.100**
	FDIsum	1.60	1.76	**0.132**
	FDIin	1.53	1.65	**0.121**
Sweden	**FDInet**	1.63	2.03	**0.238**
	FDIsum	1.61	2.10	**0.277**
	FDIin	1.48	1.93	**0.327**
Switzerland	**FDInet**	1.70	1.97	**0.164**
	FDIsum	1.70	1.93	**0.145**
	FDIin	1.54	1.66	**0.118**
UK	**FDInet**	1.64	1.95	**0.199**
	FDIsum	1.75	2.05	**0.163**
	FDIin	1.59	1.80	**0.165**
US	**FDInet**	1.59	1.61	**0.021**
	FDIsum	1.60	1.71	**0.097**
	FDIin	1.49	1.60	**0.123**
Average	**FDInet**	1.62	1.77	**0.108**
	FDIsum	1.62	1.83	**0.143**
	FDIin	1.53	1.70	**0.148**

Notes. Both actual and simulated unemployment volatilities have been normalized to one for the period 1970-1985.

3.6.4 Data appendix

Sample composition

The countries in the sample are:

Australia	Finland	Japan	Spain
Austria	France	Netherlands	Sweden
Belgium	Germany	Norway	Switzerland
Canada	Ireland	New Zealand	United Kingdom
Denmark	Italy	Portugal	United States

Data definitions and sources

u Unemployment rate (*source*: OECD Economic Outlook).

sd_un Unemployment rate volatility. This is calculated as the standard deviation of the cyclical component of the unemployment rate. We detrended the data using the Hodrick-Prescott filter, setting the smoothing parameter λ equal to 100 as suggested for annual data (Hodrick and Prescott, 1997).

sd_inv Investment rate volatility where the investment rate is defined as the ratio of real investment to real GDP (*source*: OECD National Accounts). Volatility is calculated as the standard deviation of the cyclical component of the investment rate. We detrended the data using the Hodrick-Prescott filter, setting the smoothing parameter λ equal to 100 as suggested for annual data (Hodrick and Prescott, 1997).

FDIin Foreign direct investment inflows (*source*: International Financial Statistics, IMF) normalized to nominal domestic investment (*source*: OECD National Accounts).

FDIout Foreign direct investment outflows (*source*: International Financial Statistics, IMF) normalized to nominal domestic investment (*source*: OECD National Accounts).

FDInet Net foreign direct investment flows: $FDInet = |FDIin - FDIout|$.

FDIsum Sum of foreign direct investment inflows and outflows: $FDIsum = FDIin + FDIout$.

$\left(\frac{WSSE}{def_{GDP}}\right)/(L - L_{self})$, where WSSE is the compensa

w Real labour cost: $w = \left(\frac{WSSE}{def_{GDP}}\right)/(L - L_{self})$, where WSSE is the compensation of employees at current price and national currencies (*source*: OECD Economic Outlook), def_{GDP} is the GDP deflator, base year 1990 (*source*: OECD National Accounts), L is total employment and L_{self} is the total number of self- employed (*source*: OECD National Accounts).

K Real capital stock. The calculation of the capital stock is made according to the Perpetual Inventory Method: $K = (1-\delta)K_{-1} + \left(\frac{I^n}{def_{INV}}\right)_{-1}$, where I^n is the gross fixed capital formation at current prices and national currencies (*source*: OECD National Accounts) and def_{INV} is the gross fixed capital formation price index, base year 1990 (*source*: OECD National Accounts) and the depreciation rate, δ, is assumed constant and equal to 8 percent, which is consistent with OECD estimates (Machin and Van Reenen, 1998). Initial capital stock is calculated as: $K_0 = \frac{I_0}{g+\delta}$, where g is the average annual growth of investment expenditure and I_0 is investment expenditure in the first year for which data is available.

tfp_sh TFP shock. This is computed as the deviation of the Solow residual from its (Hodrick-Prescott) trend (Nickell *et al.* 2001). The Solow residual is calculated using the following formula: $dinA = \frac{1}{1-\overline{\alpha}}[d\ln Y - \overline{\alpha} d\ln K - (1-\overline{\alpha})d\ln L]$, where Y is gross domestic output at constant price and national currencies (*source*: OECD National Accounts), K is capital stock as defined above, L is total employment (*source*: OECD Economic Outlook), $(1-\overline{\alpha})$ is a smoothed share of labour following the procedure described in Harrigan (1997). Labor share is defined as $(1-\alpha) = \frac{wL}{Y}$.

p Consumer price index , base year 1990 (OECD, Main Economic Indicators).

pr_sh Price shock. This is computed as the change in inflation: $pr\_sh = \Delta^2 p$

imp_sh Import price shock. This is measured by proportional changes in real import prices weighted by the trade share (Nickell *et al.* 2001): $imp\_sh = \frac{M}{Y_n}\Delta \ln\left(\frac{P_M}{P_Y}\right)$ where M (*source*: OECD Outlook) and Y_n (*source*: OECD National Accounts) are imports and GDP at current prices, P_M (*source*: OECD Outlook) and P_Y (*source*: OECD National Accounts) are the import price deflator and the GDP deflator (*source*: OECD National Accounts) both with 1995 as base year .

rint Real long term interest rate deflated by the 3-year expected inflation rate: $r = i - E(d\ln p_{+1})$, where i is the long term nominal interest rate (*source*: OECD Economic Outlook). $E(d\ln p_{+1})$ are fitted values from the regression $d\ln p = \gamma_1 d\ln p_{-1} + \gamma_2 d\ln p_{-2} + \gamma_3 d\ln p_{-3} + \nu$, where $d\ln p$ is the inflation rate based on the consumer price index p (*source*: OECD National Accounts) and the coefficients on the right side are restricted to sum to one, indicating inflation neutrality in the long run (see Cristini, 1999).

union Net union density, defined as the percentage of employees who are union members (*source:* Nickell et al. 2001). For the years after 1995 the series has been updated using the new data in Visser (2000) and national sources.

tw Tax wedge, calculated as the sum of the employment tax rate, the direct tax rate and the indirect tax rate (*source:* Nickell et al. 2001). Updated series for the years after 1995 are obtained from the OECD. When necessary, we extrapolated the series for the period 1999-2001.

br Benefit replacement ratio, defined as the ratio of unemployment benefits to wages for a number of representative types (*source:* Nickell et al. 2001, constructed from OECD data sources). Updated series for the years after 1995 are obtained from the OECD. When necessary, we extrapolated the series for the period 1999-2001.

bd Benefit duration, defined as a weighted average of benefits received during the second, third, fourth and fifth year of unemployment divided by the benefits in the first year of unemployment (*source:* Nickell et al. 2001, constructed form OECD data source). Updated series for the years after 1995 are obtained from the OECD. When necessary, we extrapolated the series for the period 1999-2001.

Part III

Job Flows in Europe

Chapter 4

Gross Job Flows and Institutions

4.1 Introduction

Recent theoretical and empirical literature has stressed the importance of job reallocation in a world where agents (firms and workers) are heterogeneous and the matching process between vacancies and workers is costly. When a shock hits the economy, the desired allocation of jobs among firms and sectors changes, leading to job destruction on the one hand and the creation of new vacancies on the other. Because of heterogeneity and other labour market frictions, new vacancies and unemployed workers do not match instantaneously, implying spells of unemployment and vacant positions in the economy (Pissarides, 2000).

Gross job flows may be considered a proxy for labour market flexibility to the extent that they provide a measure of the responsiveness of the labour market to changes in economic conditions. In recent years, several studies have estimated job creation and destruction from longitudinal data at plant or firm level. Studies on gross job flows have shown that a high number of jobs are simultaneously created and destroyed in the economy even when the employment growth is close to zero.[1] This provides evidence of the complexity of the dynamics underlying the adjustment process in the labour market and the heterogeneity in the behavior of both workers and firms.

The main limitation of the existing studies on job flows is the lack of internationally comparable job flows statistics (OECD, 1994). A number of problems arise when using establishment/firm level data, which become of particular concern when doing international comparisons. Differences in definitions, sampling intervals, sectoral coverage and sampling frame may lead to misleading interpretations of the cross-country differences in estimated job flows.

We examine time series and cross-sectional patterns of job flows for 13 European countries using a unique homogeneous firm-level dataset that covers the whole spectrum of productive sectors. We provide comparable estimates of job flows of continuing firms, i.e. excluding start-ups and shutdowns, and examine cross-country differences and regularities.

Job flow measures in relation to firm characteristics are reported in order to identify the patterns of job reallocation among different groups of firms within and between the countries studied. We find important regularities across countries, where smaller and younger firms concentrated in services exhibit larger job turnover.

After controlling for firm characteristics, we find persistent cross-country dif-

[1] For a thorough discussion of the results in this literature, see the excellent survey of Davis et al. (1996).

ferences in job flows that can be partially explained by institutional features. As expected, we find a negative effect of policies aiming to protect jobs on the dynamics of job reallocation. Similarly, generous unemployment benefits and institutions that increase co-ordination in the wage bargaining reduce job turnover.

The remainder of the chapter is organised as follows. In section 4.2, we present the theoretical motivations of our study and the most relevant empirical evidence. Section 4.3 describes the data used in the analysis and defines concepts and measures of gross job flows. In section 4.4, we describe gross job flows for different firm characteristics and extend the analysis to the multivariate framework in order to uncover the main driving factors of labour dynamics. Section 4.5 assesses the role of institutional features in explaining persistent cross-country differences in gross job flow patterns. In Section 4.6 a number of robustness checks is carried out and Section 4.7 concludes.

4.2 Theoretical motivations and empirical evidence

4.2.1 Job flows: international comparisons

There is a large literature aiming to explain the magnitude and cyclical behavior of job reallocation and its components. Empirical studies on job flows include Davis and Haltiwanger (1992), Davis et al. (1996) and Haltiwanger and Schuh (1999) for the US manufacturing industry, Blanchflower and Burgess (1996) for the UK, Broersma and Gautier (1997) for the Netherlands, Albaek and Sorensen (1998) for Denmark, Lagarde et al. (1994) for France, Dolado and Gomez (1995) for Spain, Contini et al. (1991) for Italy, Stiglbauer et al. (2002) for Austria, Faggio and Konings (2001) for 5 accession countries and Contini et al. (1995) for countries of the European Union. In addition OECD (1994) and OECD (1996) report results on job flows for 10 OECD countries between the late 1980s and early 1990s.

The main findings of this literature can be summarised as follows:

- A high number of jobs are simultaneously created and destroyed in all countries and sectors regardless of the cycle phase,

- Job creation and destruction are negatively correlated but not perfectly. This implies that, although job creation is clearly pro-cyclical and job destruction is counter-cyclical, the volatility of the two flows over the business cycle may differ;

- Job reallocation is inversely correlated with capital intensity, more jobs being created and destroyed in services than in manufacturing;

- The intensity of job reallocation depends on some firm-specific characteristics, in particular job creation tends to be negatively associated with firms' age and size;

- Job reallocation is a persistent phenomenon. This implies that the observed job flows can not be accounted for by temporary layoff and recall policies.

4.2.2 Job flows and labour market institutions: theory and empirical evidence

Cross-country comparisons of job flows provide the basis for a formal investigation of the link between job turnover and labour market institutions and policies. The focus on gross job flows instead of net employment changes allows testing sharper theoretical predictions of the effects of some institutions. A typical example is employment protection legislation (EPL). Barriers to the layoff of workers are expected to hinder both job creation and destruction, having ambiguous effects on the average level of labour demand (Bertola, 1990).

Pissarides (2000) studies the effects of unemployment benefits, employment taxes and job subsidies in a fairly general search-equilibrium framework. Both unemployment benefits and employment taxes decrease job creation and increase job destruction through an increase in labour costs. Job subsidies reduce the cost of matching inducing higher job creation. But job destruction increases as well because of the increase in market tightness that improves the worker's options in the labour market. In contrast, Leonard and Van Audenrode (1993) argue that subsidies to declining firms must be supported by taxes on growing firms, which overall reduce job creation and destruction and therefore job reallocation.

The role of wage setting institutions on employment dynamics has been emphasised in a number of studies. It has been argued that unions may influence worker exit behavior through keeping wages above the market clearing level and through other "non wage" aspects (Farber, 1986; Freeman, 1980). In both cases the presence of unions contributes to improve the employee-employer relationship, making job separation more costly and consequently reducing job turnover. Salvanes (1997) points out that more co-ordinated wage negotiations combined with wage drift policies might impose an additional restriction to plants when negotiating wages, reducing job creation and therefore gross job flows. However, more co-ordinated wage bargaining systems will result in higher job reallocation if they compress the wage structure (Bertola and Rogerson, 1997).[2]

It has been emphasised in the literature that labour market institutions can have an impact on the employment adjustment along the business cycle. Garibaldi (1998) focuses on the effects of dismissal costs on the cyclical behavior of job creation and destruction. Introducing firing restrictions in a quite standard matching framework with endogenous job destruction, he argues that when costs associated with dismissals are negligible, job destruction is instantaneous while job creation takes time. As a consequence job destruction varies more than job creation and job reallocation should move counter-cyclically. This prediction is supported by the counter-cyclical pattern of job reallocation observed in US manufacturing (Davis and Haltiwanger, 1992). However, when firing is costly and time consuming the asymmetry in the job flows' cyclical behavior disappears or might even be reversed for stringent enough dismissal restrictions. Thus, taking into account the stringency of firing laws in Continental Europe, this could provide a rationale for the a-cyclical

[2] Bertola and Rogerson (1997) show how wage compression induced by either a centralised bargaining system or by the presence of wage floors, may be conducive to higher job turnover through an increase in job creation by the more productive firms and job destruction by the less productive ones.

pattern in job reallocation found in Austria (Stiglbauer et al., 2002) and Germany (Boeri and Cramer, 1992) and pro-cyclical pattern found in France (Lagarde et al., 1994) and Sweden (OECD, 1994).

From an empirical point of view, a preliminary attempt to relate facts with theory within a cross-country framework is due to Garibaldi, Koenings and Pissarides (1997). By pooling summary job turnover measures from previous studies, they present cross-country bivariate relationships with some labour market institutions and policies and find a negative correlation between job reallocation and the strictness of EPL and the duration of unemployment benefits. Similar correlations in OECD (1999) show a very weak negative association between different indicators of the strictness of EPL and job turnover rates.

Regarding wage setting institutions, Lucifora (1998) for Italy and Blanchflower and Burgess (1996) for the UK find a lower rate of job turnover in unionised sectors, while Heyman (2001) finds a positive association between job reallocation and the degree of wage compression on a panel of Swedish manufacturing establishments, supporting Bertola and Rogerson's hypothesis.

To the best of our knowledge, Salvanes (1997) is the only study that presents cross-country multivariate analysis on the effect of labour market institutions on labour market dynamics. Pooling cross-sectional sectoral data from previous studies for seven OECD countries, he assesses the role of EPL, wage bargaining centralisation and industrial subsidies on job flows. He finds that stricter dismissal costs have a negative impact on job creation and destruction rates. Interestingly, the degree of centralisation also has a negative effect on labour market dynamics by reducing job creation. With regards to industrial subsidies, the positive impact on job reallocation reported in this chapter contrasts with the negative effect found by Leonard and Van Audennrode (1993) when comparing the US and Belgium labour markets.

Therefore, despite the growing number of studies on this area, there is still little consensus on the effects of institutions on job flows and no clear pattern emerges by looking at cross-country job flow developments. The difficulties in international comparisons partly reflect the lack of homogeneous data, which may have affected the empirical results presented so far.

4.3 Data and measurement issues

4.3.1 Data sources

Annual firm-level observations over the period 1992-2001 are available from Amadeus produced by Bureau van Dijk (BvD). Amadeus contains comparable firm-level data for European countries and covers all sectors with the exception of the financial sector. BvD local providers collect balance sheet information, sector of operation and number of employees from the national Chambers of Commerce, and uniform formats are applied to the data allowing accurate cross-country comparisons and analysis. Thus, apart from employment data, the dataset includes a wide range of financial information and descriptive information (industry and activity codes, incorporation year, etc.). There are several versions of Amadeus, depending on the number of firms included in the dataset. The version of Amadeus used for our study is the top 1 million companies. In order to be included in Amadeus, a firm must satisfy at least one of the following criteria: operating revenues equal to at least 1.5 (1) million euro, total assets equal to at least 3 (2) million euro, number of employees equal to at least 15 (10) for the UK, Germany, France and Italy (for all the other European countries).

The data has several advantages, which make it especially well suited for international comparisons. First, the data collection method is reasonably homogeneous across countries. This overcomes the problem of previous studies where available country data differed on the sources (administrative vs. survey) and unit of study (firm vs. establishment). Second, information is provided on narrowly defined sectors (2-digit NACE classification) and data on both manufacturing and non-manufacturing sectors are reasonably representative. The availability of services data is an important advantage with respect to previous studies, where cross-country comparisons relied on information obtained from the whole economy in some countries and the manufacturing sector in others.

There are, however, some limitations in the data. First, it is not possible to distinguish between newly created firms and firms that simply enter the sample at a given period t but were already operating in the period before. Similarly, it is not possible to identify firms' closures from firms that exit the sample for other reasons. Therefore, we restrict our analysis to continuing firms, e.g. firms that are in the sample for at least two consecutive periods. Although this is quite standard in the literature, it introduces a downward bias in the estimates of job flows. As differences across countries in job turnover rates implied by entry and exit have been found to be quantitatively relevant (Bartelsman et al., 2003), this may hamper the cross-country comparability of estimated job flows. However, the exclusion of entry and exit should be less of a problem because it is precisely job turnover of continuing firms the component that is more likely to be affected by some of the labour market institutions considered in this chapter (OECD, 1999).

Second, the data are available at the firm rather than the establishment level. Measuring job flows at firm level understates the actual magnitude of total gross flows among plants[3] and may lead to longitudinal linkage problems if ownership and organisational changes (i.e. mergers, acquisitions, etc.) are not accounted for.[4] This may be less of a problem with plant-level data, plant being defined in terms of physical location of production. However, cross-country comparisons of establishment data pose serious difficulties since there is important heterogeneity in the definition of establishment across datasets (OECD, 1994). This is less of a problem with firm data. Similarly, estimates of job creation and job destruction based on year-to-year employment changes will also understate the actual flows since short term jobs (i.e. seasonal jobs) are likely not to be accounted for. As shown by Blanchard and Portugal (2001), the frequency of the data can be quite relevant for cross-country comparisons of job turnover. Finally, the inclusion criteria in Amadeus introduces

[3]Job creation and job destruction resulting from movement between establishments within the same firm offset each other at the firm level. As a result, higher job reallocation rates are expected at the establishment level. Schuh and Triest (2000) estimate for the United States that job flows between firms represent less than 60% of the total job flows between establishments owned by these firms.

[4]See Davis et al. (1996) for a detailed discussion on problems arising from the measurement of employment changes at the establishment/firm level.

a bias against very small firms.

We assess how representative the data is in Section 3.3. Although the results yield clear positive signs, these characteristics of the data should be kept in mind when comparing our results with previous studies.

4.3.2 Measuring job flows

The conventions of Davis et al. (1996) are followed in defining job flows statistics. Denote the level of employment at firm f in period t with n_{ft} and let Δn_{ft} be the change in employment between period t and $t-1$. Let $S+$ be the set of firms in sector S with $\Delta n_{ft} > 0$ and $S-$ be the set of firms in sector S with $\Delta n_{ft} < 0$. We calculate job creation by summing employment changes in $S+$. Correspondingly, job destruction is calculated by summing all the (absolute) changes in $S-$. Rates of job creation and job destruction are obtained by dividing by the size of sector. Firm size at time t is calculated as the average employment between period t and $t-1$, i.e. $x_{ft} = 0.5(n_{ft} + n_{ft-1})$. Accordingly, the sector size is defined as $X_{st} = \sum_{f \in S} x_{ft}$.

Job flow rates can equivalently be expressed as the size-weighted average over firms' growth rates as follows

$JC = \sum g_{ft} \frac{x_{ft}}{X_{st}}$ Job Creation Rate

$JD = \sum |g_{ft}| \frac{x_{ft}}{X_{st}}$ Job Destruction Rate

where $g_{ft} = \frac{\Delta n_{ft}}{x_{ft}}$ is the growth rate of employment in firm f and period t.[5]

[5] The growth measure defined above is monotonically correlated with the conventional measure defined as the change in employment divided by the lagged employment, and the two measures are approximately the same for small growth rates. Moreover, unlike the conventional measure, which ranges from -1 and $+\infty$, this measure of growth rate is symmetric around zero, being bounded in the interval [-2,2], allowing employment expansions and contractions to be treated symmetrically.

The sum of the job creation rate and job destruction rate is the job reallocation rate (JR). It gives the total number of employment positions reallocated in the economy.

The difference between job creation and job destruction is the net employment growth (NET). Finally, minimum worker reallocation ($minWR$) is defined as the maximum between JC and JD and represents the lower bound of the fraction of workers who change jobs or employment status (worker reallocation) in response to firm-level employment changes.

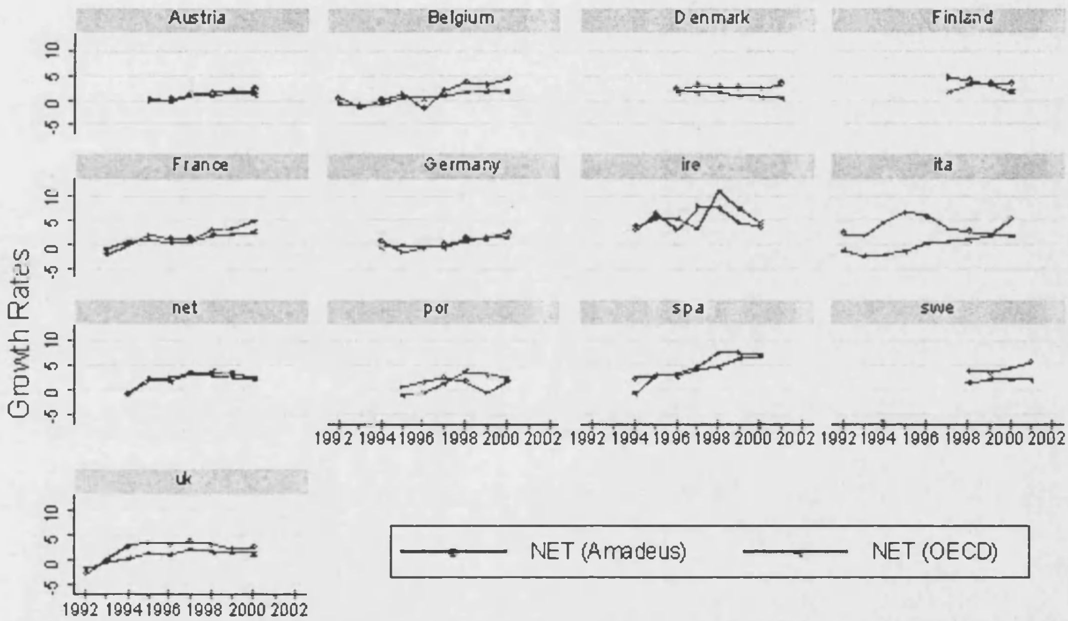
4.3.3 Sample description

In order to judge how representative our dataset is, we present comparisons with respect to official sources. Using information provided by Eurostat and the OECD, we compare the employment coverage and yearly net employment changes in our sample with labour force survey data. Similarly, we assess how representative is the coverage in our sample as regards the distribution of employment by sector and firm size.[6]

Figure 4.1 compares the evolution of employment growth from our sample with the growth in the number of employees measured by OECD statistics. Although there are some minor inconsistencies, the employment figures in our sample follow quite closely the official statistics (the average correlation excluding Italy is 0.8). The most significant exception is Italy, which consistently overstates employment growth. This inconsistency is not related to specific outliers, since tabulations show

[6] The final sample covers the EU countries with the exception of Luxembourg and Greece. Greece and Luxembourg are excluded from the analysis due to lack of institutional data.

Figure 4.1: Growth in the number of employees - Comparing Amadeus with Official Statistics from the OECD



that Italian employment growth in Amadeus is always above the mean values of the rest of the sample for all breakdowns of firm characteristics.[7]

Table 4.1 shows the final sample composition and the sample period for each country after filtering the observations from outliers.[8] The period of observation varies across countries but information is available in most cases at least during 1995-2000. The number of average valid observations per year ranges from almost 90,000 firms in Germany to some 500 firms in Ireland. This implies an annual average employment coverage of 25 per cent when compared to figures in the Labour Force Survey (LFS).

Table 4.2 shows the distribution of firms and employment by sector and country and compares the distribution of sectoral employment in our sample with the distribution calculated using information from the Labour Force Survey (LFS). Although there is a bias towards employment in manufacturing, the sample is well representative of both manufacturing and non-manufacturing sectors. Moreover the sectoral coverage is rather homogeneous across countries and stable over time. Regarding the distribution of firms by size classes, our sample is expected to be biased against small firms due to the eligibility criteria applied in Amadeus.

Table 4.3 compares the distribution of employment by firm size in our sample and OECD (1994) estimates based on the report Enterprises in Europe produced by Eurostat in 1992 and 1994. It shows that, overall, although there is a bias towards

[7] In the text, we report results including Italy. We have repeated the analyses in sections 4 and 5 excluding Italy from the sample (available upon request). The main findings of the paper are largely unaffected by the exclusion of Italy, although results are somewhat more robust when Italy is excluded from the institutional analysis.

[8] Discussion of the data selection and cleaning can be found in Appendix 4.8.

Table 4.1: Final Sample Composition

Panel A: Number of observations per year

	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Aus				4028	7558	9609	11465	12490	11588	
Bel	21160	24047	25797	27407	26851	28655	29855	30440	30506	
Den					10973	13529	14502	15990	17098	6404
Fin						4353	6976	8916	9640	
Fra		23898	27321	38098	51311	55049	61593	71556	74673	
Ger			14898	49416	93081	103647	114387	124816	125967	
Ire			289	454	539	593	661	605	248	
Ita	15273	17883	22352	27200	33273	66222	71254	71278	63836	
Net			23864	26382	28734	15703	5268	4949	2789	
Por				1157	1680	1705	1909	646	476	
Spa			9850	23538	38479	47415	54055	66354	69630	
Swe							33350	36411	38194	9380
Uk	14474	20909	24254	28946	32936	36393	39090	42231	42758	
Tot	50853	86737	148625	226806	325415	382873	444635	486682	487403	15784

Panel B: Average number of observation and sample coverage

	Sample period	Average number of obs. per year	Employment coverage (%)
Aus	1995-2000	9486	18.9
Bel	1992-2000	27185	48.6
Den	1996-2001	13083	29.9
Fin	1997-2000	7471	27.5
Fra	1993-2000	50437	23.4
Ger	1994-2000	89459	36.2
Ire	1994-2000	484	5.9
Ita	1992-2000	43205	23.6
Net	1994-2000	15384	9.8
Por	1995-2000	1262	5.3
Spa	1994-2000	44189	24.2
Swe	1998-2001	29334	33.2
Uk	1992-2000	31332	27.2

Notes. Employment coverage is calculated in relation of total employment in the Labour Force Survey.

Table 4.2: Distribution of firms and employment by sector (NACE ocde, rev.1)

			Sectors								
		Source	01-05	10-14	15-37	40-41	45	50-55	60-64	70-74	75-99
Aus	%empl	Ams	0.002	0.004	0.300	0.014	0.149	0.321	0.066	0.096	0.047
		LFS	0.081	0.004	0.276	0.012	0.108	0.283	0.087	0.087	0.061
	%firms	Ams	0.003	0.007	0.216	0.002	0.182	0.418	0.071	0.081	0.017
Bel	%empl	Ams	0.004	0.004	0.394	0.021	0.083	0.205	0.142	0.125	0.023
		LFS	0.034	0.004	0.294	0.012	0.099	0.271	0.115	0.110	0.061
	%firms	Ams	0.011	0.003	0.228	0.002	0.002	0.122	0.381	0.080	0.141
Den	%empl	Ams	0.011	0.002	0.372	0.002	0.078	0.238	0.115	0.159	0.023
		LFS	0.054	0.000	0.284	0.010	0.101	0.249	0.105	0.126	0.072
	%firms	Ams	0.022	0.002	0.254	0.001	0.137	0.306	0.060	0.189	0.029
Fin	%empl	Ams	0.004	0.004	0.433	0.019	0.066	0.209	0.113	0.123	0.028
		LFS	0.093	0.003	0.287	0.016	0.084	0.207	0.106	0.128	0.076
	%firms	Ams	0.008	0.003	0.281	0.016	0.103	0.329	0.071	0.158	0.031
Fra	%empl	Ams	0.005	0.006	0.408	0.020	0.073	0.204	0.098	0.151	0.036
		LFS	0.062	0.003	0.271	0.031	0.096	0.240	0.094	0.129	0.036
	%firms	Ams	0.010	0.006	0.270	0.002	0.103	0.329	0.071	0.158	0.031
Ger	%empl	Ams	0.038	0.007	0.331	0.012	0.123	0.240	0.076	0.098	0.075
		LFS	0.004	0.007	0.395	0.019	0.068	0.194	0.111	0.153	0.050
	%firms	Ams	0.011	0.005	0.281	0.005	0.136	0.336	0.052	0.140	0.035
Ire	%empl	Ams	0.004	0.009	0.445	-	0.040	0.216	0.149	0.109	0.029
		LFS	0.109	0.005	0.244	0.011	0.118	0.267	0.074	0.101	0.072
	%firms	Ams	0.007	0.021	0.416	-	0.049	0.301	0.072	0.107	0.027
Ita	%empl	Ams	0.006	0.002	0.592	0.013	0.052	0.157	0.084	0.066	0.029
		LFS	0.031	0.008	0.471	0.022	0.119	0.107	0.108	0.071	0.062
	%firms	Ams	0.011	0.004	0.483	0.004	0.063	0.316	0.045	0.054	0.020
Net	%empl	Ams	0.013	0.006	0.310	0.009	0.142	0.244	0.080	0.153	0.042
		LFS	0.050	0.002	0.229	0.009	0.092	0.294	0.091	0.166	0.067
	%firms	Ams	0.022	0.002	0.192	0.001	0.138	0.294	0.064	0.261	0.026
Por	%empl	Ams	0.003	0.006	0.402	0.009	0.140	0.189	0.170	0.063	0.016
		LFS	0.120	0.005	0.293	0.010	0.134	0.252	0.051	0.057	0.080
	%firms	Ams	0.006	0.003	0.382	0.005	0.119	0.391	0.030	0.053	0.011
Spa	%empl	Ams	0.012	0.011	0.364	0.014	0.093	0.248	0.092	0.119	0.047
		LFS	0.095	0.006	0.240	0.008	0.129	0.284	0.075	0.082	0.081
	%firms	Ams	0.015	0.007	0.307	0.004	0.118	0.366	0.053	0.100	0.031
Swe	%empl	Ams	0.007	0.004	0.366	0.013	0.070	0.206	0.109	0.179	0.046
		LFS	0.041	0.004	0.288	0.012	0.084	0.231	0.102	0.161	0.078
	%firms	Ams	0.014	0.003	0.207	0.007	0.095	0.378	0.072	0.185	0.039
Uk	%empl	Ams	0.011	0.009	0.341	0.008	0.045	0.274	0.068	0.157	0.087
		LFS	0.023	0.006	0.258	0.010	0.101	0.280	0.094	0.146	0.081
	%firms	Ams	0.011	0.005	0.287	0.002	0.072	0.252	0.053	0.193	0.124

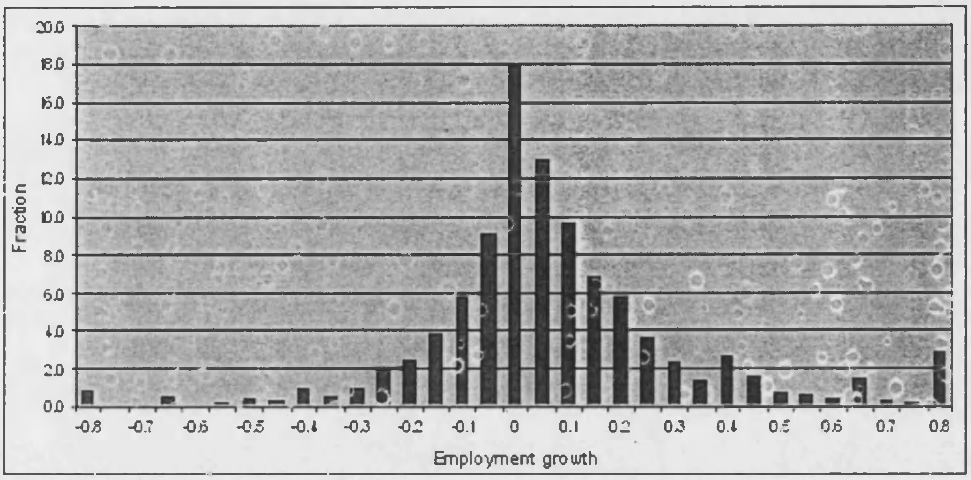
Notes. LFS is the EU Labour Force Survey. Ams is the final sample from Amadeus. 01-05 Agriculture, forestry and fishing; 10-14 Mining and quarrying; 15-37 Manufacturing; 40-41 Energy and water supply; 45 Construction; 50-55 Trade, Restaurants and Hotels; 60-64 Transportation and communication; 70-74 Business services; 75-99 Community, social and personal services.

Table 4.3: Distribution of firms and employment by size

			Firm size (number of employees)		
		Source	Small 1-99	Medium 100-499	Large 500+
Aus	%empl	Ams	0.404	0.279	0.317
		OECD	-	-	-
	%firms	Ams	0.906	0.082	0.013
Bel	%empl	Ams	0.381	0.224	0.395
		OECD	0.460	0.191	0.349
	%firms	Ams	0.939	0.051	0.010
Den	%empl	Ams	0.410	0.247	0.343
		OECD	0.614	0.176	0.210
	%firms	Ams	0.926	0.063	0.011
Fin	%empl	Ams	0.313	0.269	0.418
		OECD	0.443	0.171	0.386
	%firms	Ams	0.897	0.084	0.019
Fra	%empl	Ams	0.301	0.246	0.452
		OECD	0.501	0.162	0.337
	%firms	Ams	0.887	0.094	0.019
Ger	%empl	Ams	0.211	0.215	0.574
		OECD	0.446	0.182	0.372
	%firms	Ams	0.896	0.124	0.027
Ire	%empl	Ams	0.266	0.452	0.282
		OECD	-	-	-
	%firms	Ams	0.683	0.286	0.032
Ita	%empl	Ams	0.345	0.268	0.387
		OECD	0.714	0.099	0.187
	%firms	Ams	0.896	0.091	0.013
Net	%empl	Ams	0.570	0.250	0.180
		OECD	-	-	-
	%firms	Ams	0.945	0.050	0.005
Por	%empl	Ams	0.217	0.343	0.440
		OECD	0.595	0.195	0.210
	%firms	Ams	0.770	0.195	0.035
Spa	%empl	Ams	0.406	0.236	0.358
		OECD	0.654	0.145	0.200
	%firms	Ams	0.935	0.055	0.010
Swe	%empl	Ams	0.391	0.195	0.414
		OECD	-	-	-
	%firms	Ams	0.952	0.039	0.009
Uk	%empl	Ams	0.154	0.254	0.592
		OECD	0.491	0.172	0.338
	%firms	Ams	0.728	0.219	0.053

Notes. The figures in the table are average values over the sample period. Data for the OECD are from the OECD Economic Outlook (based on Enterprises in Europe, 1994).

Figure 4.2: Distribution of continuing firms according to employment growth rates



Note: Distributions of firms by employment growth rate (annual observations) for the panel of European countries in the period 1992-2000. The growth rates are defined as the change in employment divided by the average employment between two consecutive periods. Firms for which employment remains unchanged are not included.

larger firms in our sample, smaller firms are well represented.

4.4 Job turnover and firm characteristics

4.4.1 An overview

In this Section, we present an overview of recent developments in the job flows in the European countries.

Figure 4.2 presents the distribution of the employment growth rates for the whole sample of EU countries over the 1992-2000 period. It shows that the employment change for 30% of the observations falls in the [-5%, 5%] range. This percentage increases to about 50% when the range of growth considered is [-10%, 10%]. It is clear, however, that there is a high dispersion of growth rates. Moreover, this figure also points to a higher concentration of observations in positive growth rates, which reflects the fact that the period of study is overall expansionary.

Table 4.4 reports the aggregate rates of job creation (JC), job destruction (JD), job reallocation (JR), minimum worker reallocation (minWR) and net employment change (NET) in each country, averaged within the sample period. First note the large flows, both regarding job creation and destruction, observable in all countries. Although all of the countries registered a net increase of employment within the period of study, the coexistence of significant job creation and destruction flows is a broadly based finding. Job creation rates ranges between 4.4% in Germany and 8.6% in Spain, and job destruction rates from 3.0% in Finland and 4.4% in the UK. These developments led to an average job reallocation rate of around 10% in the EU, Austria and Germany being the country with the lowest job reallocation (7.9% and 8.1% respectively) and Spain and Italy those with the highest (12.1% and 12.3%). This means that, on average, one tenth of jobs are either created or destroyed per year. The minimum amount of workers that have to move to accommodate the change in job positions or employment status (minimum worker reallocation) varied between 4.6% on average in Austria and 8.6% in Spain.

The rest of Table 4.4 presents summary statistics of flow rates by sector and firm's size, age and capital intensity pooling the information across countries and years. According to the sector,[9] service industries exhibit, on average, larger job

[9] Sectors are defined according to the 1-digit NACE classification (NACE code, rev 1).

Table 4.4: Average job flow rates

	JC	JD	JR	NET	minWR
By country					
Austria	4.6	3.4	7.9	1.2	4.6
Belgium	5.2	3.8	9.0	1.3	5.5
Denmark	6.2	3.3	9.5	2.8	6.2
Finland	7.0	3.0	10.0	4.0	7.0
France	5.1	3.2	8.3	1.8	5.3
Germany	4.4	3.7	8.1	0.7	4.7
Ireland	8.5	3.1	11.6	5.4	8.5
Italy	8.2	4.1	12.3	4.1	8.2
Netherlands	6.5	4.3	10.8	2.2	6.6
Portugal	4.9	3.5	8.4	1.5	5.0
Spain	8.6	3.4	12.1	5.2	8.6
Sweden	8.1	3.6	11.7	4.5	8.1
United Kingdom	6.6	4.4	11.0	2.3	6.9
Euro area	5.6	3.7	9.3	1.9	6.3
Nordic countries	7.3	3.4	10.7	2.9	7.1
By sector					
Agriculture	5.8	4.3	10.1	1.6	6.7
Mining	3.3	5.8	9.1	-2.7	6.2
Manufacturing	4.6	3.9	8.5	0.7	5.3
Energy	2.3	4.1	6.4	-1.3	4.8
Construction	6.8	4.7	11.5	1.7	7.3
Trade, restaurants, hotels	6.8	3.0	9.8	3.4	6.8
Transport and communication	5.0	4.0	9.0	0.7	6.3
Business services	8.3	4.3	12.6	4.4	8.7
Community, social and personal ser.	7.6	3.0	10.6	4.2	7.5
By size					
1-19 employees	10.7	3.5	14.2	6.9	10.7
20-49 employees	7.8	3.8	11.6	3.8	7.9
50-99 employees	7.4	3.8	11.2	3.3	7.4
100-249 employees	7.0	4.0	11.0	2.9	7.1
250-499 employees	5.8	3.4	9.2	2.2	6.0
500-999 employees	5.7	3.6	9.4	2.0	5.9
1000-2499 employees	4.8	3.7	8.5	2.2	5.3
2500 and more employees	3.7	3.8	7.5	-0.4	4.7
By age					
1 year	8.9	3.7	12.6	5.2	9.0
2-5 years	8.4	4.1	12.5	4.3	8.4
6-10 years	7.6	4.0	11.6	2.6	8.0
10+ years	5.2	3.6	8.8	1.6	5.4
By capital intensity					
20% or less	6.5	4.0	10.5	2.5	7.3
20-30%	5.7	3.7	9.4	2.0	6.5
30-40%	5.9	3.2	9.1	2.7	6.4
More than 40%	6.1	3.8	9.9	2.3	6.6

Notes. Average values over the sample period flows. Business services is the sector with the largest job flows in Europe during the period of study, a pattern mainly driven by the strong employment creation in this sector, while manufacturing and energy present the lowest JR rates. As regards size classes, the concept used in the analysis refers to the average size of the firm in two consecutive periods. The average size is used instead of the current size as it is expected to give a better indication of the intended scale of operations. We divide the sample in eight categories: 1-19 employees; 20-49; 50-99; 100-249; 250-499; 500-999; 1,000-2,499; and 2,500 and over. The process of job reallocation is clearly stronger among smaller firms. In fact, there is an inverse relationship between the size of the firm and the intensity of job reallocation. Moreover, this inverted relationship is mainly due to the pattern of job creation, which shows a higher variation among firm size than the pattern of job destruction. Concerning the age of the firm, four groups are considered: 1 year old; 2-5 years; 6-10 years; and more than 10 years. Job flows are significant in all age groups and decrease monotonically with thw age of firms.

Capital intensity is defined as the capital share (measured as value added minus the wage bill) in value added. We distinguish four categories: below 20%; 20-30%; 30-40%; and more than 40%. According to the estimates in Table 4, there seems to be an U-shaped relationship between capital intensity and JR, with firms with either low or high capital intensity exhibiting larger turnover rates.

To better understand firm-level job dynamics, it is also useful to measure how persistent are the decisions of creating or destroying jobs. Job reallocation may not

Table 4.5: Average persistence rates

	Job Creation		Job Destruction	
	One year	Two years	One year	Two years
Austria	0.92	0.86	0.86	0.79
Belgium	0.80	0.71	0.75	0.63
Denmark	0.81	0.72	0.68	0.54
Finland	0.86	0.80	0.70	0.62
France	0.82	0.74	0.70	0.56
Germany	0.91	0.85	0.87	0.77
Ireland	0.87	0.83	0.67	0.53
Italy	0.85	0.78	0.64	0.52
Netherlands	0.80	0.72	0.68	0.56
Portugal	0.81	0.73	0.69	0.57
Spain	0.85	0.78	0.64	0.55
Sweden	0.86	0.79	0.71	0.56
United Kingdom	0.83	0.75	0.71	0.57
Sample mean	0.85	0.77	0.72	0.60
Euro area	0.85	0.78	0.72	0.61
Nordic countries	0.84	0.77	0.70	0.57

Mean comparison test (whole sample)

	Differences between JC and JD persistence rates:
One year	0.13 (13.43)
Two years	0.18 (13.28)

t-values in parenthesis: H0: mean (diff) =0 vs. H1: mean (diff) >0

Notes. Average values over the sample period

be a persistent phenomenon if it is related to temporary layoffs and recalls. On the other hand, to the extent that job flows are persistent, they must be associated with long-term joblessness or worker reallocation across firms. Following Davis et al. (1996), we define the N-period persistence of job creation as the fraction of newly created jobs at time t that survives through the period t+N. Analogously, the N-period persistence of job destruction is defined as the fraction of jobs destroyed at time t that do not reappear through the period t+N.

Table 4.5 summarises the persistence rates of job creation and job destruction over a one and two-year horizon. Between 80% and 92% of newly created jobs and 64% and 87% of recent destroyed jobs persist at least one year in our sample of European countries. After two years the persistence rates in job creation fall up to a minimum of 71% in Belgium and to a maximum of 86% in Austria, while the persistence in destruction rates vary between 52% in Italy and 79% in Austria. These results indicate that firm-level job decisions are highly persistent, while job creation appears as a more persistent phenomenon than job destruction. As indicated at the bottom of the table, the differences between persistence rates of job creation and job destruction both over one and two year periods are statistically significant for the whole sample of countries. However, this can be partly explained by activity developments, as our results refer to a period of overall expansion and persistency rates tend to show a pro-cyclical pattern (Davis et al. 1996).

Some of these results, including the negative relationship between job reallocation and firm size and age and the fact that job creation and job destruction largely reflect persistent changes, are similar to those reported in Davis et al. (1996) for the US. They are not totally comparable, however, as their study refers to the manufacturing sector only and includes, apart form continuing firms, start-ups and shutdowns.

As a final exercise, the job flows for the euro area as a whole are estimated and confronted with those of the UK, whose labour market is considered to be more flexible than that of the euro area on average, and those of the Nordic countries,[10] which lie under a more "corporatist" model.[11] The average job reallocation rate in the UK is 11%, compared with 9.3% in the euro area (see Table 4.4). In addition, even if the net employment growth is slightly higher in the UK than in the euro area, not only job creation is higher in the former compared to the latter but also

[10] Nordic countries include Denmark, Finland and Sweden.

[11] The "corporatist" model implies a broad co-operation between labour market organisations and governments.

Table 4.6: Average job reallocation rates for the euro area, the UK and Nordic countries

	Euro area	UK	Nordic countries
By sector			
Agriculture	11.0	6.4	11.9
Mining	9.0	10.1	8.5
Manufacturing	7.9	10.1	9.1
Energy	5.8	7.8	11.7
Construction	10.9	14.7	12.4
Trade, restaurants, hotels	9.6	10.4	10.4
Transport and communication	8.9	10.1	8.9
Business services	12.4	13.5	15.3
Community, social and personal ser.	9.6	11.7	12.1
By size			
1-19 employees	13.9	17.0	13.5
20-49 employees	10.8	14.2	12.7
50-99 employees	10.5	12.6	12.7
100-249 employees	10.3	12.9	12.2
250-499 employees	8.4	11.6	10.2
500-999 employees	8.7	11.4	9.5
1000-2499 employees	7.8	10.8	8.9
2500 and more employees	7.2	8.8	5.4
By age			
1 year	13.9	15.8	18.3
2-5 years	12.5	13.7	12.1
6-10 years	10.6	13.0	10.4
10+ years	7.7	10.3	9.5
By capital intensity			
20% or less	10.5	11.2	11.0
20-30%	9.3	10.5	10.2
30-40%	9.1	9.7	9.8
More than 40%	10.0	10.3	10.4

Notes. Average values over the sample period job destruction. Job flows in Nordic countries lie between these two. Table 4.6 presents detailed comparisons that confirm the difference in average job reallocation among the three areas. All breakdowns by firm size, age and capital intensity reflect higher flows in the UK than in the euro area. The same pattern emerges by sectors, only with the exception of agriculture. These patterns are confirmed by differences in persistence rates across these three areas, which point to more persistent decisions in the euro area than in the UK and Nordic countries. Whether or not labour market institutions are responsible for these differences is something that will be investigated in section 4.5.

4.4.2 The impact of firm characteristics on job flows

Next, we study the joint impact of the different firm characteristics considered in the descriptive analysis on the dynamics of job flows. Some of the firm characteristics presented above are highly correlated among each other (e.g. firm's age and size), suggesting the need of moving to a multivariate framework in order to disentangle the main determinants of labour market flows. For this purpose, we calculate JC, JD and JR rates for narrow sectors defined as the crossing of 4 age groups, 7 sectors of activity, 4 size groups, 13 countries, 10 years (between 1992 and 2001) and 4 capital intensity groups. Then, we regress the sectoral flows on dummy variables defined for each of these groups and the aggregate employment growth rate in each country-year to control for the business cycle.

We consider two different specifications, depending on whether we include or not capital intensity in the definition of the cells. The reason is that Amadeus has very limited information on value added for firms in Austria, Germany and the Netherlands. Thus, considering capital intensity classes might affect significantly the estimates of these countries. When capital intensity crossings are excluded, the potential number of cells is 13,440, ascending to 53,760 if capital is included in the analysis. In the first case, we have about 7,000 valid observations, and almost 18,000 when capital intensity is considered.[12] Reported standard errors are robust to heteroskedasticity and country clustering.[13]

Table 4.7 summarises the results of the OLS regressions for JR, JC and JD on the class dummies. Columns (A) to (C) do not include capital intensity groups, which are reported in columns (D) to (F). According to the goodness of fit in the regressions, the proposed models do a much better job in explaining the patterns of JR and JC than in explaining JD, suggesting a more important role of idiosyncratic factors in the determination of the latter. The results are in line with the descriptive analysis discussed in the previous section. Thus, there is a negative relationship between JR and JC and the age of the firms, especially when firms are more than 5 years old. According to columns (A) and (B), JR and JC are 4 percentage points lower in firms above 10 years old than in those which have been operating for less than a year.

[12] The main reason for missing observations is the different sample periods available for each country. See Table 1 for a full description of the sample coverage by year and country.

[13] We trimmed out outlier observations following the method of detection of outliers in the multivariate framework developed by Hadi (1992). In order to identify the outliers, we constructed categorical variables by age, size, industrial sector, country and capital intensity (if applicable). This implied the exclusion of 56 (147) cells in the case of JR, 65 (153) in the case of JC and 101 (237) in the case of JD in the sample without (with) capital intensity. The results presented in the paper refer to the regressions without outliers. Results including outliers, available upon request, do not differ importantly with respect to those presented in the text.

Interestingly, there is some indication of a reversed pattern in JD, with older firms significantly destroying more jobs than younger ones. The sectoral dummies confirm a higher job reallocation and creation in construction and service than in industry, while the latter presents higher job destruction. For instance, job reallocation and creation rates in Business services are more than 5 percentage points higher than in industry, while the difference in job destruction is not significant.

Similarly, the negative relationship between the size of the firm and job reallocation is confirmed by the multivariate analysis. Indeed, both job creation and destruction rates are lower the larger the firm is, although differences are higher in job creation than in job destruction. As a result, a firm of more than 1,000 employees presents a job reallocation rate around 7 percentage points lower than a firm with less than 50 workers, which is explained by 6.2 percentage points less in job creation and 1.3 percentage point less in job destruction.

Differences across countries in job flow statistics are statistically significant even after controlling for a wide range of firm characteristics. According to the estimates of JR, only Spain and Italy show a higher rate than the UK, while all the other countries show significantly lower rates. The highest difference compared with the UK is observed in Austria, which has a 5 percentage points lower JR rate.[14]

When ranges of capital intensity are taken into account, all previous results remain broadly unchanged (see Columns D to F in Table 3). In addition, we do not

[14]Interestingly, the UK presented relatively low job flow patterns when compared to many Continental European countries in previous international comparisons (e.g. OECD, 1994; Garibaldi et al., 1997; OECD, 1999). This apparently puzzling result, reversed in our study, might be due to the lack of homogeneous data in previous analyses.

Table 4.7: Firm characteristics and labour market flows. OLS Estimates

Model	(A)	(B)	(C)	(D)	(E)	(F)
Dep var	JR	JC	JD	JR	JC	JD
intercept	16.699	10.858	5.782	15.896	10.942	4.978
	(22.46)	(20.19)	(12.27)	(20.01)	(13.20)	(14.81)
cycle ind	0.001	0.005	-0.003	0.228	0.572	0.286
	(1.47)	(5.13)	(4.68)	(2.52)	(5.25)	(5.87)
Age: 2-5 years	0.431	0.507	0.128	0.076	-0.088	0.240
	(1.17)	(1.64)	(1.16)	(0.30)	(0.41)	(2.17)
6-10 years	-0.518	-1.347	0.204	-1.491	-1.623	0.304
	(5.21)	(4.69)	(2.07)	(8.42)	(8.39)	(3.51)
10+ years	-4.127	-4.041	0.501	-4.254	-4.424	0.697
	(9.91)	(9.28)	(4.87)	(10.34)	(10.48)	(9.48)
Sector: Agriculture	0.265	-0.161	-0.648	0.333	0.234	-0.540
	(0.33)	(0.22)	(3.39)	(0.61)	(0.54)	(2.48)
Construction	2.235	1.549	0.446	3.894	2.714	0.636
	(2.89)	(2.59)	(1.36)	(4.93)	(4.37)	(1.50)
Trade	1.381	1.825	-0.607	1.672	2.095	-0.554
	(3.52)	(4.64)	(4.41)	(6.23)	(6.63)	(4.18)
Transport	2.451	2.933	-0.807	2.434	2.920	-0.710
	(6.51)	(7.32)	(6.32)	(5.08)	(6.90)	(7.52)
Business services	5.484	5.149	0.117	4.891	4.775	-0.191
	(8.59)	(8.82)	(0.99)	(8.99)	(9.71)	(1.73)
Other services	1.800	2.469	-0.924	1.993	2.678	-1.073
	(4.16)	(5.98)	(6.10)	(4.29)	(6.36)	(6.89)
Size: 50-249	-1.476	-1.644	-0.045	-1.791	-1.610	-0.333
	(4.35)	(5.53)	(0.30)	(7.23)	(7.68)	(3.15)
250-999	-4.989	-4.276	-1.224	-4.523	-3.746	-0.994
	(8.78)	(9.69)	(4.80)	(10.25)	(11.62)	(4.46)
1000+	-6.941	-6.232	-1.302	-5.523	-4.822	-1.034
	(12.55)	(15.71)	(5.25)	(13.36)	(11.31)	(4.73)
K-intensity: 20-30%				-0.377	-0.008	-0.452
				(1.90)	(0.03)	(5.55)
30-40%				-0.367	0.085	-0.169
				(1.51)	(0.28)	(6.39)
40% +				0.557	0.364	-0.030
				(3.17)	(1.32)	(0.21)
Country: France	-3.505	-2.169	-1.287	-3.264	-2.295	-0.932
	(38.56)	(31.46)	(18.21)	(32.00)	(36.23)	(13.99)
Sweden	-1.004	-1.411	-0.289	-1.988	-1.964	-0.248
	(3.56)	(6.78)	(3.44)	(8.12)	(10.88)	(2.44)
Italy	0.964	0.370	0.177	1.167	0.368	0.320
	(5.52)	(2.20)	(1.58)	(7.95)	(2.31)	(3.91)
Spain	0.718	0.484	-0.008	0.475	-0.087	0.355
	(3.22)	(1.93)	(0.04)	(2.46)	(0.40)	(2.15)
Portugal	-3.116	-1.382	-1.939	-2.746	-1.999	-1.505
	(12.36)	(5.62)	(13.31)	(8.68)	(6.95)	(12.07)
Netherlands	-1.511	-1.853	-0.147	-4.153	-3.354	-1.636
	(11.22)	(20.58)	(4.80)	(23.90)	(21.62)	(25.41)
Ireland	-1.668	-1.078	-1.347	-2.384	-1.693	-1.551
	(5.92)	(3.77)	(6.64)	(8.53)	(4.19)	(8.49)
Germany	-3.939	-2.474	-1.404	-3.822	-4.311	-0.231
	(15.47)	(11.12)	(9.40)	(13.92)	(15.47)	(2.07)
Finland	-3.588	-2.573	-1.178	-3.389	-2.955	-0.793
	(22.21)	(26.90)	(14.48)	(16.88)	(19.01)	(7.96)
Denmark	-4.728	-3.688	-1.176	-5.817	-4.552	-1.453
	(17.82)	(17.73)	(14.86)	(20.23)	(18.38)	(15.52)
Belgium	-2.297	-1.195	-1.203	-2.731	-2.172	-0.726
	(22.13)	(11.30)	(15.71)	(25.82)	(19.07)	(13.81)
Austria	-5.363	-3.990	-1.825	-5.731	-4.832	-1.003
	(20.33)	(15.74)	(12.07)	(19.78)	(15.43)	(10.66)
Time Dummies	*yes*	*yes*	*yes*	*yes*	*yes*	*yes*
Observations	7943	7931	7887	20755	20760	20658
R-squared	0.32	0.33	0.14	0.22	0.22	0.08

Notes. Base case: Age (1 year); Sector (Manufacturing); Size (1-49); Country (UK); Capital intensity (less than 20 percent). Calculated standard errors are robust to country clustering. t-statistics in parenthesis find a systematic role of capital intensity in the determination of job flows.

Finally, we focus on the effects of the business cycle on job turnover. Previous country estimates suggest clear pro-cyclical patterns of JR in the US (Davis and Haltiwanger, 1999) but either a-cyclical or slightly pro-cyclical movements in European countries. Our estimates suggest a pro-cyclical character of JR in Europe, although the effect is only statistically significant when capital intensity classes are considered.

4.5 Job flows and institutions

The aim of our next set of regressions is to uncover the determinants of country idiosyncratic factors in the patterns of job turnover. According to our previous discussion, we concentrate on several institutional and regulatory aspects of the labour market:

- Tax and benefits systems: including an index of the duration of unemployment benefits and the tax wedge between the real (monetary) labour cost faced by the firms and the consumption wage received by the employees. The latter is normalized by GDP, while the former ranges from 0 (if benefit provision stops after 1 year) to 1 (for a constant benefit after 5 years).

- Wage-setting institutions: including an index of co-ordination in the wage bargaining process which ranges from 1 to 3 according to the increasing degree of co-ordination. Within our sample, this indicator is time-invariant.[15]

[15] Wage-setting co-ordination, unemployment benefits duration, and the tax wedge are taken from

- Restrictions to hiring and firing: we consider an updated version of the time-varying index of EPL reported in Nickell et al. (2001) and a time-invariant index as described by OECD (1999). Both increase with the relative stringency of EPL.

- Sectoral employment subsidies: we include an indicator of the share of sectoral and ad hoc state aid as a percentage of GDP.[16]

Additionally, we include in the regressions the share of workers holding temporary contracts in the total number of employees.[17]

The results presented above suggest that failing to control for differences across countries in the size, age and sectoral distribution of firms might blur cross-country comparisons. Hence, we repeat the cell regressions presented in Columns (A) to (C) of Table 4.7 including the institutional indicators.

First we present pooled OLS regressions where the country dummies are substituted by the institutional variables. A second set of regressions includes country fixed effects. The main advantage of this specification is that it allows controlling for unobserved time-invariant country heterogeneity. However, together with the limitation of not allowing for the inclusion of time-invariant covariates (one of the indicators of EPL and wage-setting co-ordination) the fixed effect specification disregards the cross-country information in the data. The latter might severely affect the efficiency of the estimates of institutional variables given the slow moving na-

an updated series from Nickell et al. (2001). The information is annual till 1998. When necessary, we extrapolated the variables for the period 1999-2001.

[16]Source: NewCronos Database.

[17]Source: Labour Force Survey.

ture of institutions and the short sample period (see Table 1) of our panel. Thus, as Heckman and Pages (2000) point out, the reduced time-series variation in the institutional data may result in imprecise estimates (high standard errors) when country-specific fixed effects are included in the regressions. A final set of regressions treats country unobserved heterogeneity as random. Differently from the fixed effect methodology, the random effect methodology allows to exploit both the cross-country and time-series variation of the data, implying more precise estimates. The advantage of this approach in terms of efficiency comes with the cost of imposing the assumption of orthogonality between the individual effects and the covariates.

The effects of institutions on JR, JC and JD are reported on Table 4.8. As expected, the strictness of EPL has a negative and statistically significant impact on JR. This result is similar for both indicators of EPL and robust to the inclusion of fixed or random effects in the regression, thought not significant at the conventional levels in the pooled OLS specification. It responds to a reduction of both JC and JD in countries with more stringent EPL, although only the coefficients on JC are statistically significant.

The duration of unemployment benefits and the degree of wage-setting co-ordination have similar effects, reducing JR by dampening JC and JD. All these effects are statistically significant across the different specifications, with the exception of the role of benefits on JD when fixed or random effects are present (Columns L and M). Results for wage-setting co-ordination are in line with those of Salvanes (1997), while the reduction of JC in countries with more generous unemployment benefits supports the predictions of matching models discussed by Pissarides (2000).

Regarding the tax wedge, countries with higher tax burdens experience lower JC and JR. According to the estimates in Columns (A) to (D), a 10 percentage points increase of the tax wedge reduces JR by 0.5 percentage point. However, the tax wedge becomes non-significant although correctly signed when fixed effects are included. These results support the predictions of matching models discussed by Pissarides (2000), although we do not find statistically significant effects of the tax wedge on JD.

Employment subsidies have a negative and significant effect on JD, in line with the results in Leonard and Van Audennrode (1993), suggesting that these policies are successful in alleviating job losses. The effect on JC is positive but statistically significant only when country unobserved heterogeneity is taken into account.

Finally, the evidence suggests a non-significant impact of the use of temporary contracts in the determination of job flows.

The evidence presented is relatively robust to different specifications. When country-specific fixed effects are included in the regressions, most of the effects of institutions remain statistically significant at standard confidence levels. Moreover, the fact that our findings are robust to the use of alternative estimators that do not rely exclusively on the time-series variation of institutions is reassuring.

Table 4.8: Labour market institutions and job flows

Model :	(A) OLS[1]	(B) OLS[1]	(C) Random effects[2]	(D) Random effects[2]	(E) Fixed-effects[1]	(F) OLS[1]	(G) OLS[1]	(H) Random effects[2]	(I) Fixed-effects[1]	(J) OLS[1]	(K) OLS[1]	(L) Random effects[2]	(M) Fixed-effects[1]
Dependent Variable:	JR	JR	JR	JR	JR	JC	JC	JC	JC	JD	JD	JD	JD
Intercept	22.844	23.108	23.539	23.116	27.645	15.665	15.816	16.059	14.023	6.737	6.862	5.663	8.651
	(17.06)	(17.37)	(11.30)	(11.31)	(7.31)	(12.53)	(12.68)	(9.37)	(9.38)	(8.37)	(8.62)	(2.05)	(5.07)
Cycle indicator	0.004	0.004	0.002	0.002	0.002	0.007	0.007	0.005	0.006	-0.003	-0.003	-0.003	-0.003
	(5.61)	(4.97)	(2.79)	(2.55)	(1.43)	(7.75)	(7.51)	(9.95)	(8.83)	(4.27)	(4.23)	(12.19)	(4.56)
Union Co-ordination	-0.947	-0.901	-0.713	-0.689		-0.854	-0.829	-1.020		-0.327	-0.302	0.529	
	(2.08)	(2.00)	(1.20)	(1.21)		(2.43)	(2.39)	(2.04)		(1.71)	(1.55)	(0.41)	
Benefit Duration	-5.472	-5.816	-6.005	-5.917	-3.855	-3.780	-3.969	-4.773	-4.865	-1.250	-1.435	-0.628	0.007
	(3.87)	(3.81)	(6.21)	(6.04)	(2.71)	(2.84)	(2.89)	(5.72)	(4.52)	(3.55)	(3.23)	(0.79)	(0.28)
Tax Wedge	-0.054	-0.052	-0.052	-0.053	-0.147	-0.061	-0.060	-0.028	0.011	0.008	0.009	-0.024	-0.166
	(1.84)	(1.84)	(1.77)	(1.86)	(0.73)	(2.51)	(2.52)	(1.02)	(0.40)	(0.56)	(0.72)	(1.24)	(0.28)
Temporary Contracts	-0.005	0.002	-0.004	-0.001	-0.100	-0.020	-0.016	0.006	-0.001	0.019	0.022	0.006	-0.024
	(0.14)	(0.06)	(0.10)	(0.02)	(1.85)	(0.83)	(0.65)	(0.18)	(0.04)	(1.19)	(1.31)	(0.30)	(0.39)
Subsidies	-0.302	0.207	0.652	0.173	1.119	0.733	0.777	1.044	1.397	-0.841	-0.757	-0.556	-0.493
	(0.38)	(0.26)	(1.17)	(0.33)	(1.78)	(0.99)	(1.06)	(2.08)	(3.97)	(4.17)	(4.36)	(2.29)	(1.41)
(EPL) – time variant	-0.493		-1.194		-2.117	-0.307		-0.853	-0.921	-0.122		-0.091	-0.276
	(1.14)		(3.18)		(2.66)	(0.93)		(2.68)	(3.10)	(0.61)		(0.49)	(0.74)
(EPL) – time invariant		-0.678		-0.887			-0.409				-0.224		
		(1.29)		(2.01)			(1.10)				(1.00)		
Observations :	7943	7943	7943	7943	7943	7931	7931	7931	7931	7887	7887	7887	7887
R squared	0.30	0.30	-	-	0.23	0.32	0.32	-	0.30	0.12	0.12	-	0.08

Notes: The regressions include age, sector, year and firm size dummies as defined in Columns A to C of Table 7. Range values: Co-ordination(1-3); Unemployment Benefit Duration(0-1); Tax Wedge(18.61-53.33); Share of Temporary Contracts (4.33-34.99); Employment Subsidies(0.23-1.93); EPL time invariant (0.50-3.70); EPL time variant (0.5-3.88). The indicator for the cycle is the aggregate net employment change.

[1]Calculated standard errors are robust to country clustering.

[2]Maximum likelihood estimation.

4.6 Sensitivity analysis

The purpose of this section is to investigate the robustness of the regression results presented in the previous section.

Table 4.9 presents the results of the institutional regressions when the sample is restricted to those years for which we have reliable institutional data. Since some noise might be introduced in the extrapolation of the data on institutions for the period 1999-2001, we repeat the analysis restricting the sample to only the years when information on labour market institutions is available. The results are qualitatively and quantitatively similar to those previously presented.

Aggregate cross-country studies are often criticised on grounds of lack of robustness with respect to the set of countries included in the analysis. Hence, the last set of regressions performs sensitivity analysis following the approach proposed by Sala-i-Martin (1997) in the context of growth regressions, but focusing on the number of countries included in the regression. Very briefly, we look at the distribution of the estimates of the institutional variables across the full set of regressions that result from dropping any combinations of three countries in the OLS, FE and RE specifications. Taking into account that the full sample of countries is 13, the resulting number of regressions is 1365 for each institutional variable (910 for union co-ordination, since this variable is not included in the fixed effect specifications). For each institutional variable, we take averages of the estimated coefficients and their standard deviations across the different regressions. Under the assumption of normality, these two statistics are sufficient to calculate the cumulative distributive

Table 4.9: Labour market institutions and job flows: 1992-1998

Model :	(A) OLS[1]	(B) OLS[1]	(C) Random effects[2]	(D) Random effects[2]	(E) Fixed-effects[1]	(F) OLS[1]	(G) OLS[1]	(H) Random effects[2]	(I) Fixed-effects[1]	(J) OLS[1]	(K) OLS[1]	(L) Random effects[2]	(M) Fixed-effects[1]
Dependent Variable:	JR	JR	JR	JR	JR	JC	JC	JC	JC	JD	JD	JD	JD
Intercept	22.871	23.603	24.354	23.952	21.002	16.216	16.687	17.265	17.990	6.479	6.767	6.017	7.273
	(17.01)	(18.65)	(11.30)	(11.58)	(7.55)	(11.11)	(11.89)	(10.75)	(3.35)	(8.45)	(8.81)	(6.23)	(2.51)
Cycle indicator	0.004	0.003	0.002	0.002	0.002	0.007	0.006	0.006	0.006	-0.003	-0.003	-0.003	-0.003
	(5.97)	(5.25)	(2.49)	(2.46)	(1.56)	(7.81)	(7.81)	(8.91)	(6.74)	(4.99)	(4.92)	(9.87)	(3.29)
Union Co-ordination	-0.755	-0.668	-0.462	-0.483		-0.745	-0.685	-0.789		-0.251	-0.216	0.058	
	(1.60)	(1.53)	(0.88)	(0.97)		(2.03)	(2.04)	(2.04)		(1.41)	(1.24)	(0.20)	
Benefit Duration	-5.861	-6.802	-6.269	-5.923	-1.765	-3.679	-4.317	-4.229	-2.220	-1.730	-2.112	-1.269	0.089
	(3.89)	(4.38)	(5.18)	(4.87)	(0.92)	(2.57)	(3.08)	(4.41)	(0.84)	(3.32)	(3.34)	(2.39)	(0.05)
Tax Wedge	-0.063	-0.057	-0.083	-0.085	-0.038	-0.079	-0.075	-0.080	0.010	0.013	0.016	-0.001	-0.005
	(1.93)	(1.97)	(2.48)	(2.66)	(0.65)	(2.85)	(2.95)	(3.10)	(0.21)	(0.89)	(1.24)	(0.04)	(0.13)
Temporary Contracts	-0.001	0.007	0.012	0.012	-0.123	-0.015	-0.009	-0.009	-0.085	0.017	0.021	0.028	0.016
	(0.04)	(0.25)	(0.29)	(0.32)	(1.00)	(0.62)	(0.41)	(0.29)	(0.74)	(1.26)	(1.55)	(1.60)	(0.38)
Subsidies	-0.144	0.177	-0.276	-0.684	0.562	0.770	1.005	0.644	1.285	-0.765	-0.627	-0.802	-0.611
	(0.18)	(0.21)	(0.43)	(1.15)	(0.81)	(1.24)	(1.34)	(1.16)	(4.29)	(4.03)	(3.13)	(2.86)	(1.43)
(EPL) – time variant	-0.549		-0.898		-3.083	-0.285		-0.484	-1.539	-0.184		-0.157	-0.426
	(1.41)		(2.13)		(4.01)	(0.74)		(1.46)	(2.05)	(0.95)		(0.89)	(0.82)
(EPL) – time invariant		-0.973		-0.620			-0.574				-0.358		
		(1.94)		(1.42)			(1.40)				(1.53)		
Observations :	5470	5470	5470	5470	5470	5465	5465	5465	5465	5433	5433	5433	5433
R squared	0.30	0.30	-	-	0.31	0.31	0.31	-	0.32	0.14	0.14	-	0.15

Notes: The regressions include age, sector, year and firm size dummies as defined in Columns A to C of Table 7. Range values: Co-ordination(1-3); Unemployment Benefit Duration(0-1); Tax Wedge(18.61-53.33); Share of Temporary Contracts (4.33-34.99); Employment Subsidies(0.23-1.93); EPL time invariant (0.50-3.70); EPL time variant (0.5-3.88). The indicator for the cycle is the aggregate net employment change.

[1]Calculated standard errors are robust to country clustering.

[2]Maximum likelihood estimation.

Table 4.10: Sensitivity analysis: robstness with respect to the set of countries

	(A) Coeff.	(B) SD	(C) CDF_N	(D) CDF_{NN}
Dependent variable: Job reallocation (JR)				
EPL-time variant	-1.286	0.549	0.990	0.953
Union co-ordination	0.915	0.618	0.930	0.905
Benefit duration	-4.924	1.440	0.999	0.974
Tax wedge	-0.046	0.039	0.881	0.837
Temporary contracts	-0.042	0.051	0.796	0.782
Subsidies	0.502	0.703	0.762	0.815
Dependent variable: Job creation (JC)				
EPL-time variant	-0.684	0.384	0.962	0.913
Union co-ordination	-0.967	0.471	0.980	0.952
Benefit duration	-4.490	1.158	0.999	0.996
Tax wedge	-0.032	0.031	0.851	0.824
Temporary contracts	-0.005	0.035	0.561	0.714
Subsidies	0.992	0.579	0.957	0.919
Dependent variable: Job destruction (JD)				
EPL-time variant	-0.156	0.257	0.728	0.756
Union co-ordination	0.291	0.430	0.751	0.872
Benefit duration	-0.387	0.569	0.752	0.830
Tax wedge	-0.011	0.017	0.749	0.818
Temporary contracts	-0.002	0.025	0.526	0.792
Subsidies	-0.584	0.299	0.974	0.919

Note: Pooled results of the RE, FE and OLS regressions presented in Table 4.8 for all the combinations that result from dropping up to three countries from the sample. Total number of regressions: 1365 (910 in the case of union co-ordination). C_N: cumulative distributive function under normality assumption. C_{NN}: cumulative distributive function under non-normality assumption

function (cdf) of the estimates and apply standard confidence levels. However, even if the estimates in every regression follow a t-Student distribution, it might be the case that the distribution of the estimates is not normal. Following Sala-i-Martin (1997), in this case we can still compute their cdf as the average of the individual cumulative distributive functions.

Table 4.10 presents the results of the sensitivity analysis. According to the normality criterion (Column C), the results in Table 4 do not depend on the set of countries included in the analysis in the cases of EPL, wage-setting co-ordination, employment subsidies and the duration of unemployment benefits. These institutions retain their significance at the 95% level in those cases in which they were found significant with the full sample. The significance is somewhat weaker in most cases when non-normality is assumed (Column D), but results remain largely consistent with those of Column C. The most remarkable change with respect to Table 4.8 regards the tax wedge, which becomes non-significantly correlated with JR and JC when the set of countries in the sample varies.

4.7 Conclusions

This chapter presents an analysis of job flows for a panel of 13 European countries in the 1990s using a dataset of continuing firms that covers the whole spectrum of productive sectors and, given homogeneity in the definitions and sectoral coverage, permits cross-country comparisons.

We estimate the joint effect of different firm characteristics on job flow rates. We find that both the size and age of the firm have a negative impact on job reallocation. Similarly, firms located in services typically exhibit stronger patterns of job flows than firms operating in manufacturing.

Even after controlling for a number of firm characteristics we find significant cross-country differences in labour market dynamics. Thus, we investigate the role of institutional aspects of labour markets in the determination of job turnover. Once controlled for sectoral and firm characteristics, we find that the strictness of employment protection legislation has a negative effect on job creation and therefore on job reallocation. Similarly, the extent of wage bargaining co-ordination and the generosity of unemployment benefits reduce both job creation and job destruction. All these results are robust to different specifications and different sets of countries included in the regressions. The role of other institutions such as the tax wedge, the use of temporary contracts and employment subsidies on job dynamics are less clear-cut, suggesting the need of further empirical and theoretical work.

4.8 Appendix

4.8.1 Data cleaning

The following observations are dropped from the initial sample in Amadeus:

- Firms for which only consolidated accounts are available. In order to avoid double counting, only unconsolidated accounts are included in the analysis.
- Observations for which employment growth rate is missing value. In this case, the observations and not the entire firm is dropped from the sample.
- Observations where the growth rate of compensation per employee is less then -50% or more than 50% within two consecutive years. The aim of this filter is to clean for possible outliers. We experimented with different cut-off values always obtaining similar results. Most of the observations dropped are well above or below these figures.

As regards the latter, we believe that the information on wages is useful, combined with that of employment, to detect the presence of outliers in our data. A disadvantage of this filter, is that additional noise might be introduced using the wage information. We checked the consistency of the filter constructing an analogous one using the information on added value. Both the coverage of the dataset and the empirical results are not significantly affected by the use of the alternative filter. The percentage of observations that both the wage and value added filters that we apply indicate to be not outliers is more than 95 percent of all the usable observations.

Chapter 5

Job Flow Dynamics and Firing Restrictions

5.1 Introduction

Following Davis and Haltiwanger's (1990, 1992) seminal papers, a large empirical literature has looked at the stylized facts of job creation and job destruction using firm or establishment level data for different OECD countries. A branch of this literature has focused on the relationship between job turnover and the business cycle. A pro-cyclical movement of job creation and counter-cyclical movement of job destruction is observed in all studies, but the volatility of these two flows along the business cycle differs across countries. Estimates for the US, Canada and the UK show that the increase in job destruction during economic downturns tends to be stronger than the increase in job creation during upturns, resulting in counter-cyclical movements of job reallocation (the sum of job creation and job destruction). By contrast, estimates for continental European countries present a less clear-cut picture, with job reallocation tending to be a-cyclical or slightly pro-cyclical. However, different sources of data and a high degree of heterogeneity across these studies make difficult any cross-country comparisons.

Garibaldi (1998) shows that cross-country differences in employment protection legislation may explain the observed dichotomy in the cyclical behavior of job flows between the Anglo-Saxon and European countries. When costs associated with dismissals are negligible, job creation takes time while job destruction is instantaneous. As a consequence, job destruction varies more than job creation within the cycle and job reallocation moves counter-cyclically. This prediction is in line with the counter-cyclical pattern of job reallocation observed in Anglo-Saxon countries, which are characterized by relatively low dismissals restrictions. However, when firing is costly and time consuming as in Continental Europe, the asymmetry in the job flows' cyclical behavior disappears or might even be reversed for stringent enough dismissal restrictions.

This chapter overcomes previous problems of comparability of job flows statistics by using a unique homogenous firm-level data set that covers the whole spectrum of productive sectors, and provides an empirical assessment of the relationship between the cyclical behavior of job flows and labour market institutions. Thus, the contribution of this chapter is twofold. First, it provides a set of estimates of the cyclicality of job flows for sixteen European countries in the nineties, and examines differences and regularities across sectors. Second, it investigates empirically Garibaldi's main hypothesis and extends the institutional analysis of the behavior of job turnover within the business cycle considering other labour market institutions.

Our findings indicate important differences across sectors in the cyclical behavior of job turnover. Typically, service industries present a pro-cyclical pattern while manufacturing industries always react more slowly to the business cycle. Aggregate job turnover rates exhibit either an a-cyclical or pro-cyclical pattern in European countries, though with important cross-country differences. These differences are partially explained by labour market institutions. The tighter firing restrictions are the less volatile job destruction is, resulting in a higher positive correlation between job reallocation and net employment changes (our measure of the cycle). This finding is robust to a number of specifications and is in line with the theoretical predictions of the matching model described by Garibaldi (1998). When the role of other labour market institutions in explaining job flow dynamics is considered, we find that more generous unemployment benefits, a higher tax wedge and a larger use of temporary employment counter-balance the effects of employment protection, reducing the correlation between job turnover and net employment changes.

The rest of the chapter is organized as follows. Next section briefly reviews the cross-country evidence on the relationship between job flows and the business cycle and presents summary statistics of this relationship for our panel of European countries. Section 5.3 spells out the empirical strategy and Section 5.4 presents the main characteristics of the data. The main results of the chapter are presented in Section 5.5. Section 5.6 draws some concluding remarks.

5.2 Job flows and the business cycle

The prevailing view in the business cycle literature predicts an unambiguous pro-cyclical behavior of job creation and counter-cyclical behavior of job destruction. As a consequence, the effect of the cycle on job reallocation (the sum of job creation and job destruction) remains undetermined. Previous evidence regarding the cyclical patterns of job reallocation is far from conclusive. Davis and Haltiwanger (1992) and Davis et al. (1996) find a negative relationship between job reallocation and the cycle in the US manufacturing sector. The same cyclical pattern in job reallocation has been observed for Canada (Baldwin at al, 1994) and the UK (Konings, 1995). For the countries of Continental Europe the evidence is mixed and in general job reallocation has been found to follow an a-cyclical pattern. In particular, an a-cyclical pattern has been found in Austria (Stiglbauer et al., 2002), Italy (Contini et al., 1995), Spain (Dolado and Gomez, 1995) and Germany (Boeri and Cramer, 1992) and a slightly pro-cyclical pattern has been found in France (Lagarde et al., 1994) and Sweden (OECD, 1994). Hence, as suggested by Garibaldi (1998) the empirical evidence suggests a clear dichotomy in the cyclical behavior of job flows between the Anglo-Saxon countries and Continental Europe.

However, whether the dichotomy in the cyclical behavior of job reallocation should be regarded as a stylized fact is still an open question. This is because the existing empirical studies are usually based on internationally incomparable job flows statistics (OECD, 1994). For example, differences in the sectoral coverage and sampling frame may lead to misleading interpretations of the cross-country

Table 5.1: Correlations between job reallocation and net employment change

	Whole economy	Services	Manufacturing
Austria	0.17	0.18	-0.26
Belgium	0.45*	0.40*	-0.11
Denmark	0.05	0.27	-0.12
Finland	0.48*	0.47*	0.65*
France	0.68*	0.79*	0.22
Germany	0.51*	0.53*	-0.06
Greece	0.75*	0.84*	0.55*
Ireland	0.53*	0.84*	0.33*
Italy	0.26*	0.39*	0.19
Luxemburg	0.41*	-0.15	0.34*
Netherlands	0.32*	0.29*	-0.06
Norway	0.64*	0.82*	0.21
Portugal	0.90*	0.94*	0.58*
Spain	0.70*	0.70*	0.60*
Sweden	0.51*	0.43*	0.65*
Switzerland	0.25*	0.57*	0.04
United Kingdom	0.37*	0.56*	-0.41*

Note:* 5 percent significance. Yearly data for a total of 28 sectors, of which 11 are manufactures and 12 service industries. For a definition of the sectors see Footnote 2.

differences in the cyclical behavior of job flows. While some of the country studies previously mentioned focus on establishment data for the manufacturing sector, other studies rely on firm level data for the whole economy.

Table 5.1 shows our own calculation of the correlation between job reallocation and net employment growth for the countries in our sample.[1] The correlations are calculated for each country across a total of 28 sectors.[2] We present the results for the

[1] The main advantage of our analysis comes from the fact that our data are comparable across countries and are available for both the service and manufacturing sectors. See section 5.4 for a detailed description of the dataset used in the analysis.

[2] The sectors are: Agriculture, forestry and fishing; Mining and quarrying; Food, Beverages and Tobacco; Textiles; Wood Products; Paper products, Publishing and Printing; Refined petroleum, nuclear fuel and chemical products; Rubber and plastic products; Other non-metallic products; Basic metals and fabricated metal products; Machinery and equipment; Electrical and optical equipment; Transport Equipment; Other manufacturing sectors; Electricity, gas and water supply; Construction; Sale, maintenance and repair of motor vehicles; Wholesale trade, except for motor vehicles; Retail trade, except for motor vehicles; Hotels and Restaurants; Transport and communications; Financial intermediation and insurance; Real estate and renting; Computer and related activities; Research and Development; Public Administration, Defense and Education; Health and Social Work; Other community, social and personal services

economy as a whole, and then for the service and manufacturing sectors separately. From Table 5.1 it emerges that job reallocation is strongly positively correlated with net growth in all countries. The correlation is still positive and significant in services. In manufacturing, job reallocation follows an a-cyclical or pro-cyclical pattern in Continental Europe, while job reallocation and net employment changes are significantly negatively associated in the UK. The latter is in line with previous empirical evidence and with Garibaldi's theoretical insights.

5.3 Empirical methodology

Davis et al. (1996) show the importance of firm and sectoral characteristics in the determination of job flows in the US. As shown in Chapter 4, in Europe firms operating in service industries consistently present a higher degree of job turnover. Thus, failing to control for compositional effects might seriously blur cross-country comparisons. The proposed methodology takes this fact into account. We calculate yearly job creation (JC_{ijt}), job destruction (JD_{ijt}) and job reallocation (JR_{ijt}) rates at the sectoral level for a total of 28 sectors. We follow the standard definitions of job flow measures as described in Davis and Haltiwanger (1990). JC_{ijt} in period t, country j and sector i equals the weighted sum of employment gains over all growing firms in sector i and country j between $t-1$ and t. Similarly, JD_{it} equals the sum of employment losses (in absolute value) over all contracting firms between $t-1$ and t. It follows that net employment change $NET_{it} = JC_{it} - JD_{it}$ and the job reallocation rate $JR_{it} = JC_{it} + JD_{it}$.

Our basic empirical strategy is based on the following reduced-form specification

$$JF_{ijt} = \alpha + N_{jt}\gamma + D\beta + I_{jt}\eta + (N_{jt} * I_{jt})\,\phi + \mu_j + \varepsilon_{ijt} \qquad \text{for } i = 1, ..., 28 \text{ and } j = 1, ..., 16$$

where JF_{ijt} denotes the different measures of job flows (JC_{ijt}, JD_{ijt} or JR_{ijt}), N_{jt} is a business cycle indicator, D is a set of sectoral and year dummies, I_{jt} denotes a vector of institutional indicators and μ_j is country unobserved heterogeneity. The coefficients of interest are captured by the vector ϕ, which corresponds to an interaction term between the different institutional indicators and the business cycle indicator. We consider two different indicators of the cycle, depending on the level of aggregation: the aggregate net employment change, which is measured per country and year; and the sectoral employment change, which is measured per country and year for the 7 macro-sectors of activity for which information on the use of temporary contracts is available.

Two different assumptions will be made about the nature of the country unobserved heterogeneity. Our basic specification will include country fixed effects. The main limitation of the fixed effect specification is that it disregards the cross-country information in the data. This might severely affect the efficiency of the estimates of institutional variables given the slow moving nature of institutions and the short sample period of our panel. Thus, as Heckman and Pages (2000) point out, the reduced time-series variation in the institutional data may result in imprecise estimates (high standard errors) when country-specific fixed effects are included in the regressions. A second set of regressions overcomes this problem treating country unobserved heterogeneity as random. Differently from the fixed effect, the random effect methodology allows to exploit both the cross-country and time-series variation of the data, implying more precise estimates. The advantage of this approach in terms of efficiency comes with the cost of imposing the assumption of orthogonality between the individual effects and the covariates.

It is well known that in the presence of measurement error the bias incurred in a standard OLS regression might actually be exacerbated by the inclusion of fixed effects. One advantage of our synthetic panel is that we know the number of firms from which we draw the summary measures of job flows in each country, sector and year. This allows us to construct weights as the share of the number of firms in each sector in the total number of firms. The weights are country specific, such that each country has an equal weight in the final regression. Weighting the fixed effects regressions is expected to mitigate the impact of measurement error.

5.4 The data

Annual firm-level observations over the period 1992-2001 are available from Amadeus produced by Bureau van Dijk (BvD). Amadeus contains comparable firm-level data for European countries and covers all sectors with the exception of the financial sector. Information on balance sheets, sector of operation and number of employees is collected by the national Chambers of Commerce and homogenized by BvD applying uniform formats to allow accurate cross-country comparisons.[3]

[3] See section 5.4 of Chapter 4 for a detailed discussion of the advantages and limitations of the data set used in the analysis and Appendix 4.8 for an illustration of the data selection and cleaning

We have extended the data used in the previous chapter to include three countries originally excluded from the sample. These are Greece, Norway and Switzerland.[4] Thus, the final sample comprises 16 European countries. The yearly coverage varies depending on the country, but in most cases information is available for the period 1995-2000.

The institutional variables considered in the analysis are the following:

- Restrictions to hiring and firing: we consider an updated version of the time-varying index of EPL reported in Nickell et al. (2001) and a time-invariant index as described by OECD (1999). Both increase with the relative stringency of EPL.

- The availability of temporary contracts has been constructed from the National Labour Force Surveys. It is defined as the share of workers holding temporary contracts in the total number of employees measured for the 7 sectors of operation used for the definitions of the cells.

- Tax and benefits systems: including an index of the duration of unemployment benefits and the tax wedge between the real (monetary) labour cost faced by the firms and the consumption wage received by the employees. The latter is normalized by GDP, while the former ranges from 0 (if benefit provision stops before 1 year) to 1 (for a constant benefit after 5 years). Both series have been

strategy.

[4] Greece, Norway and Switzerland were excluded from the sample in Chapter 4 because of the lack of information on some of the institutional variables, namely sectoral employment subsidies and the index of co-ordination in the wage bargaining process. Since in this chapter we focus on EPL, temporary contracts, tax wedge and benefit duration only, we can reintroduce such countries.

updated from Nickell et al. (2001) using OECD information.

5.5 Empirical results

5.5.1 Job dynamics and firing restrictions

We concentrate first on the effects of employment protection on the relationship between job flows and the business cycle. Table 5.2 presents the results of the fixed effects regressions for JR, JC and JD on the aggregate NET employment change and its interaction with the index of employment protection. The specification also includes country, sector and year dummies. First note that according to the goodness of fit of the regressions, the proposed models do a much better job in explaining the patterns of JR and JC than in explaining the sources of JD, suggesting a more important role of idiosyncratic factors in the determination of the latter. We find consistent regularities in the sectoral patterns of job flows across countries. Typically, service industries present higher JR rates than manufacturing sectors, the difference lying especially on a higher JC rate. The sector with the highest turnover rate is Computer and related activities, while Electricity, gas and water supply presents the lowest JR rate in the sample. Note also that most of the sectoral dummies are clearly significant, suggesting the importance of controlling for compositional effects before drawing cross-country comparisons.

Employment protection legislation (EPL) has a negative effect on both JC and JD, which translates into a lower JR rate. When evaluated at the average level of NET, the effect of EPL remains statistically significant on JC and JR. This

Table 5.2: Job Flows. Sectoral Effects

	(1) JR	(2) JC	(3) JD	(continued)	(1) JR	(2) JC	(3) JD
NET	-0.399	0.290	-0.689	Sector 15	-4.305	-3.844	-0.461
	(1.73)	(1.36)	(7.18)		(5.62)	(8.72)	(0.75)
NET * *EPL*	0.487	0.257	0.230	Sector 16	0.692	1.328	-0.636
	(5.21)	(3.03)	(6.65)		(1.01)	(2.66)	(1.50)
EPL	-1.824	-0.837	-0.987	Sector 17	-2.378	-0.373	-2.004
	(3.11)	(1.60)	(3.34)		(3.83)	(0.87)	(4.90)
Sector 2	-2.147	-1.630	-0.517	Sector 18	-0.408	0.750	-1.158
	(2.82)	(2.34)	(0.84)		(0.64)	(1.68)	(2.88)
Sector 3	-3.155	-2.130	-1.025	Sector 19	-1.094	1.024	-2.118
	(4.81)	(4.96)	(2.31)		(1.59)	(2.08)	(5.09)
Sector 4	-3.333	-2.569	-0.764	Sector 20	-0.482	0.601	-1.083
	(5.11)	(6.13)	(1.69)		(0.60)	(1.07)	(2.23)
Sector 5	-3.069	-1.253	-1.816	Sector 21	-2.902	-1.220	-1.682
	(4.62)	(2.76)	(4.09)		(4.59)	(2.73)	(4.01)
Sector 6	-3.861	-2.428	-1.432	Sector 22	4.238	3.341	0.896
	(6.31)	(5.74)	(3.40)		(4.91)	(4.32)	(1.64)
Sector 7	-3.907	-2.384	-1.523	Sector 23	2.557	1.997	0.560
	(6.05)	(4.33)	(3.45)		(3.43)	(3.65)	(1.16)
Sector 8	-3.092	-1.178	-1.914	Sector 24	8.316	9.670	-1.354
	(4.95)	(2.55)	(4.58)		(10.20)	(13.18)	(2.86)
Sector 9	-3.649	-2.277	-1.372	Sector 25	1.436	2.387	-0.951
	(5.79)	(5.28)	(3.09)		(2.22)	(5.32)	(2.25)
Sector 10	-2.638	-1.524	-1.114	Sector 26	-0.125	1.469	-1.594
	(4.27)	(3.71)	(2.44)		(0.15)	(2.35)	(2.85)
Sector 11	-2.608	-1.424	-1.184	Sector 27	-1.348	1.207	-2.555
	(4.35)	(3.50)	(2.81)		(2.02)	(2.38)	(6.16)
Sector 12	-0.712	-0.138	-0.574	Sector 28	-0.648	1.102	-1.750
	(1.03)	(0.29)	(1.25)		(1.07)	(2.58)	(4.35)
Sector 13	-2.809	-1.997	-0.812				
	(3.86)	(4.01)	(1.52)	Country Du	Yes	Yes	Yes
Sector 14	-1.828	-0.733	-1.095	Sectoral Du	No	No	No
	(2.95)	(1.75)	(2.44)	Countries	16	16	16
Sector 15	-4.305	-3.844	-0.461	Obs.	2727	2727	2727
	(5.62)	(8.72)	(0.75)	R-squared	0.52	0.57	0.23

Note: Reference Sector: Agriculture, Forestry and Fishing. Sectoral Definitions: Sector Definitions. 2: Mining and quarrying; 3: Food, Beverages and Tobacco; 4: Textiles; 5: Wood Prod.; 6: Paper Prod.; 7: Refined Petroleum and Chemical Prod.; 8: Rubber and Plastic Prod.; 9: Other Non-metallic Prod.; 10: Basic metals; 11: Machinery and Equipment.; 12: Electrical and Optical Equip.; 13: Transport Equip.; 14: Other manufacturing sectors; 15: Electricity, Gas and Water Supply; 16: Construction; 17: Sale, Maintenance and Repair of Motor Vehicles; 18: Wholesale Trade; 19: Retail Trade; 20: Hotels and Restaurants; 21: Transport and Communications; 22: Financial Intermediation and Insurance; 23: Real Estate and Renting; 24: Computer and Related Activities; 25: Research and Development; 26: Public Administration, Defense and Education; 27: Health and Social Work; 28: Other Community, Social and Personal Services. Robust standard errors. t-statistics in parenthesis finding supports the predictions of dynamic models of labour demand as discussed by Bertola (1990), and is in line with previous empirical studies and with the results in Chapter 4. JC (JD) presents a clear pro-cyclical pattern (counter-cyclical) when evaluated at the average level of EPL. Similarly, JR has also a pro-cyclical pattern, suggesting that the response of JC to a cyclical upturn is stronger than the response of JD to a cyclical downturn. Most importantly, the sign of the interaction term NET*EPL suggests that JD is less responsive to the cycle in countries with more stringent EPL. This finding supports Garibaldi's main theoretical prediction. For high values of EPL JD becomes even pro-cyclical. We also find that more stringent EPL increases the responsiveness of JC to the business cycle[5].

Table 5.3 shows that these results are fairly robust to a variety of specifications. For completeness, Column 1 repeats the results reported in Table 5.2. Column 2 shows that these results do not change when year dummies are included in the analysis. The interaction term NET*EPL is signed as expected and statistically significant at conventional levels. Random effect estimates, reported in columns 3 and 4, do not change the main results presented so far. Columns 5 to 8 repeat the specifications presented in Columns 1 to 4 using the sectoral NET instead of the aggregate NET as an indicator of the business cycle. Again, the main message of the regressions is not altered.

[5] In Garibadi's model the simulated effect of EPL on the cyclical behaviour of JC is not linear. JC is more pro-cyclical for higher or lower values of EPL and less pro-cyclical for intermediate values of EPL (U-shaped relationship). We do not look for the presence of such non-linearities and we treat JC and JD symmetrically.

Table 5.3: Employment protection and the cyclical behavior of job flows

	(1) FE	(2) FE	(3) RE	(4) RE	(5) FE	(6) FE	(7) RE	(8) RE
	Aggregate NET				Sectoral NET			
Job reallocation								
NET	-0.399	0.004	-0.278	-0.063	0.145	0.199	0.049	0.088
	(1.73)	(0.01)	(2.54)	(0.51)	(0.74)	(1.06)	(0.89)	(1.58)
NET*EPL	0.487	0.384	0.335	0.285	0.199	0.184	0.165	0.153
	(5.21)	(4.04)	(8.57)	(6.83)	(2.99)	(2.91)	(8.19)	(7.54)
EPL	-1.824	-3.496	-0.954	-0.932	-1.628	-2.847	-0.678	-0.667
	(3.11)	(5.05)	(3.34)	(3.02)	(3.06)	(4.87)	(2.50)	(2.24)
Overall NET[1]	0.789	0.940	0.539	0.632	0.631	0.648	0.451	0.462
	(8.79)	(9.22)	(13.25)	(12.71)	(8.28)	(8.65)	(5.17)	(18.13)
R-squared	0.51	0.52	-	-	0.54	0.56	-	-
Job Creation								
NET	0.290	0.528	0.356	0.531	0.503	0.528	0.437	0.495
	(1.36)	(2.23)	(3.94)	(5.18)	(3.83)	(4.12)	(10.42)	(10.67)
NET*EPL	0.257	0.196	0.163	0.118	0.113	0.105	0.090	0.080
	(3.03)	(2.22)	(5.08)	(3.45)	(2.41)	(2.34)	(5.82)	(5.16)
EPL	-0.837	-1.848	-0.256	-0.176	-1.005	-1.392	-0.288	-0.233
	(1.60)	(3.17)	(1.32)	(0.89)	(2.82)	(3.51)	(1.63)	(1.27)
Overall NET[1]	0.917	1.010	0.754	0.820	0.778	0.786	0.656	0.656
	(11.91)	(11.55)	(22.68)	(20.19)	(15.07)	(15.33)	(35.34)	(33.48)
R-squared	0.56	0.57	-	-	0.69	0.70	-	-
Job Destruction								
NET	-0.689	-0.524	-0.597	-0.547	-0.318	-0.329	-0.383	-0.366
	(7.18)	(4.79)	(9.32)	(7.53)	(5.40)	(4.63)	(4.67)	(10.98)
NET*EPL	0.230	0.188	0.163	0.156	0.081	0.078	0.075	0.073
	(6.65)	(5.10)	(7.12)	(6.35)	(3.84)	(3.23)	(6.31)	(6.04)
EPL	-0.987	-1.647	-0.578	-0.548	-0.247	-1.454	0.281	-0.287
	(3.34)	(4.64)	(4.22)	(4.09)	(2.78)	(4.50)	(2.38)	(2.41)
Overall NET[1]	-0.127	-0.067	-0.199	-0.168	-0.119	-0.138	0.199	-0.188
	(3.55)	(1.58)	(8.41)	(5.86)	(5.17)	(4.49)	(13.93)	(12.45)
R-squared	0.21	0.23	-	-	0.24	0.26	-	-
Time dummies	*No*	*Yes*	*No*	*Yes*	*No*	*Yes*	*No*	*Yes*
Sectoral du.	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*	*Yes*
Countries	16	16	16	16	16	16	16	16
Obs.	2727	2727	2727	2727	2727	2727	2727	2727

Note: Robust standard errors. t-statistics in parenthesis. [1]The overall cyclical effect is evaluated at the sample mean of the EPL indicator.

5.5.2 Temporary employment and other labour market institutions

The previous section shows the importance of firing restrictions in the determination of the cyclical movements of job turnover. In this section, we extend the analysis to consider the effects of other labour market institutions which are likely to play a role in the responses of JC and JD to cyclical movements. We consider in turn the effects of temporary employment, unemployment benefits and the tax wedge.

Temporary employment might facilitate employment adjustment in countries with stringent employment protection legislation (see for instance Dolado et al., 2002). In most cases, fixed-term contracts have lower firing restrictions, with shorter advance notice periods and less generous severance payments. Even if fixed-term and open-ended contracts imposed the same restrictions to firing, repeated fixed-term contracts for a short period of time might be used as a way-out of stringent employment protection legislation. Hence, we expect that temporary employment counter-balance the effects of EPL in the job flow dynamics. Other things being equal, JD should react more rapidly to an economic downturn in sectors with a larger usage of temporary workers, resulting in more counter-cyclical movements of JR in those countries where fixed-term contracts are more extended.

Many empirical studies have showed that longer-term unemployment insurance entitlements lead to longer unemployment duration[6]. Using a search and matching framework, Pissarides (2000) shows that more generous unemployment insurance increase labour costs, resulting in an increase of equilibrium unemployment due to a

[6] See for instance Bover et al, 2002 and the references therein.

Table 5.4: Institutions and the cyclical behavior of job reallocation

	(1) FE	(2) FE	(3) RE	(4) RE	(5) FE	(6) FE	(7) RE	(8) RE
Job reallocation								
NET	0.161	0.222	0.063	0.114	1.279	1.335	1.096	1.204
	(0.81)	(1.18)	(1.14)	(2.01)	(3.93)	(4.33)	(8.07)	(8.74)
NET*EPL	0.207	0.193	0.181	0.173	0.216	0.197	0.153	0.142
	(2.98)	(2.96)	(8.33)	(7.91)	(3.44)	(3.18)	(5.12)	(4.72)
EPL	-1.485	-2.815	-0.756	-0.824	-2.342	-3.328	-1.064	-1.403
	(2.81)	(4.80)	(2.81)	(2.71)	(4.68)	(5.41)	(3.39)	(3.62)
NET*Temp. Empl.	-0.288	-0.361	-0.425	-0.532	-0.965	-1.054	-0.850	-1.012
	(0.89)	(1.09)	(2.09)	(2.61)	(2.84)	(3.13)	(4.10)	(4.86)
Temporary Empl.	7.055	7.985	4.930	5.730	11.287	12.331	7.336	8.380
	(2.25)	(3.13)	(2.65)	(3.04)	(3.71)	(4.07)	(3.89)	(4.38)
NET*U Benefits	–	–	–	–	-0.602	-0.612	-0.622	-0.637
					(3.00)	(3.01)	(6.35)	(6.53)
U Benefits Duration	–	–	–	–	-1.263	-3.046	0.066	-1.446
					(0.74)	(1.80)	(0.07)	(1.26)
NET*Tax Wedge	–	–	–	–	-2.108	-2.047	-1.605	-1.680
					(3.19)	(3.21)	(3.39)	(5.71)
Tax Wedge	–	–	–	–	2.623	3.325	5.106	7.058
					(0.57)	(0.46)	(1.97)	(2.41)
Overall NET[1]	0.632	0.652	0.455	0.474	0.547	0.566	0.413	0.438
	(8.09)	(8.47)	(18.29)	(18.08)	(9.30)	(9.44)	(16.07)	(16.28)
Time dummies	*No*	*Yes*	*No*	*Yes*	*No*	*Yes*	*Yes*	*No*
Countries	16	16	16	16	16	16	16	16
Obs.	2727	2727	2727	2727	2727	2727	2727	2727
R-squared	0.55	0.56	-	-	0.56	0.58		

Note: Robust standard errors. t-statistics in parenthesis. [1]The cyclical overall effect is evaluated at the sample mean of the institutional indicators.

lower JC rate and higher JD rate. The effect of the tax wedge on job flow dynamics are expected to go in the same direction (Pissarides, 2000).

Table 5.4 presents the results of the extended institutional analysis on the dynamics of job turnover. Since the indicator of temporary employment is available at the sectoral level, we restrict the analysis to the sectoral NET. Columns 1 to 4 present the basic results including the share of workers holding temporary contracts. The results suggest a clear positive direct impact of temporary contracts on JR. Moreover, the interaction term TEMP*NET presents a negative sign, suggesting that job turnover is less pro-cyclical in sectors (and countries) where fixed-term contracts are extensively used. Note that this effect is only statistically significant in the random effect specifications. Columns 5 to 8 include the tax wedge and duration of unemployment benefits in our regressions. Both the interactions of the two institutional variables with the cycle are negatively signed and statistically significant. This suggests that in countries with more generous unemployment benefits and a higher tax wedge job creation becomes less responsive to the cycle relatively to job destruction. As a result, job reallocation is more pro-cyclical. Moreover, the interaction term TEMP*NET becomes statistically significant even in the fixed effect specifications when these two variables are included in the analysis. Finally, note that the coefficient of EPL*NET is in line with the previous regressions.

5.6 Conclusions

This chapter provides a set of comparable cross-country estimates of job flows dynamics using a unique homogenous firm level data set that covers the whole spectrum of productive sectors for 16 European countries. Relying on data for 28 sectors, this chapter characterizes the dynamics of job flows during the 1990s, examining differences and regularities across sectors and countries. In line with the results found in the previous chapter, we find consistent sectoral patterns across countries, with job flows responding more rapidly to net employment changes in services than in manufacturing sectors. Differences across countries confirm the prevailing view, where job reallocation in the manufacturing sector presents a higher correlation with net employment changes in Continental Europe than in the UK. However, differences across countries in the volatility of job creation and job destruction of the service sector present less clear patterns.

Garibaldi (1998) shows that differences in employment protection legislation may explain the differences in the cyclical behavior of job flows across countries. The tighter the firing restrictions, the less volatile is job destruction and the higher the correlation between job reallocation and net employment changes. Using standard panel techniques this chapter provides an empirical test of Garibaldi's theoretical insights, which are strongly supported by the data. Consistently across a variety of specifications, we find that more stringent employment protection increases the responsiveness of JR to the business cycle. When the role of other labour market institutions in job flow dynamics is considered, we find that more generous unemployment benefits, a higher tax wedge and a larger use of temporary employment at the sectoral level counter-balance the effects of employment protection, reducing the correlation between job turnover and net employment changes.

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