Total factor productivity growth and employment protection of temporary workers in EU economies

Mirella Damiani*, Fabrizio Pompei*and Andrea Ricci**

ABSTRACT

The present paper analyses productivity disparities in EU economies over a period (1995-2007) which has witnessed a marked slow-down in average European efficiency growth and significant intra-Europe cross-country diversities.
From the mid-1990s onwards, large-scale liberalisations of labour markets have been recorded in Europe and, among the main policy turnarounds, new regulatory frameworks for temporary contracts have been introduced. These kinds of reform have characterised various countries, albeit at different speeds, and have been more frequently adopted than changes in rules for regular jobs. The main aim of this paper is thus to ascertain the role of these institutional changes in explaining the ample differentials in Total Factor Productivity (TFP) recorded in EU economies. This is done by making industry-level cross-country estimates which verify whether provisions regulating employment contracts are more stringent in those sectors where the propensity to use temporary arrangements is higher.
We find that deregulation of temporary workers negatively influences TFP growth rates in European economies, while changes in the restriction of regular jobs have no significant effect on efficiency. Within sectoral analysis, greater effects of employment protection liberalisation policies have been found in industry where firms are more used to making staff changes by opening short-term positions, whereas excessive product market regulation negatively influences TFP growth.

Keywords: productivity, labour regulation
JEL Classifications: O40, O43; O47; J58.

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1. Introduction

The present paper analyses productivity disparities in EU economies over a period (1995-2007) which has witnessed a marked slow-down in average European efficiency growth and significant intra-Europe cross-country diversities. Other studies have shown that, from the mid-1990s until 2005, EU countries have lost ground with respect to the US, not because of adverse

changes in labour composition, or insufficient rates of capital accumulation, but due to the lack of innovation capability (van Ark et al. 2008, Inklaar et al. 2008). These prior works also found that a prominent role in explaining EU divergences was played by Total Factor Productivity (TFP) growth, the efficiency component which reflects disembodied technical changes, not embodied in the quality of inputs, and attributable to organisational and institutional determinants. In this article, we update the analysis to 2007 and, in particular, examine the effect of labour regulation in explaining TFP heterogeneity *within* the EU economies, taking a closer look at the role of labour market reforms covering temporary jobs.

From the mid-1990s onwards, large-scale liberalisations of labour markets have been recorded in Europe and, among the main policy turnarounds are new regulatory frameworks for temporary contracts. These kinds of reform have characterised various countries, albeit at different speeds, and have been more frequently adopted than changes in rules for regular jobs. The main aim of this paper is thus to ascertain the role of these institutional changes in explaining the ample differentials in TFP recorded in EU economies. This was done by making industry-level cross-country estimates which verify whether provisions regulating employment contracts are more stringent in those sectors where the propensity to use temporary arrangements is higher.

There is limited empirical evidence on the relationship between employment protection and productivity. So far, many studies have considered employment protection as a cost incurred by firms, and the focus has been on employment and labour market flows. Among others, Bentolila and Bertola (1990) have shown that firing costs prevent lay-offs and discourage hiring, with an ambiguous overall influence on employment. Other works have analysed the relationship between labour market flows and jobs security provisions, reaching similar conclusions (Bentolila and Dolado, 1994; Bertola and Rogerson, 1997; Garibaldi, 1998; Hopenhayn and Rogerson, 1993; Mortensen and Pissarides, 1999; Garibaldi and Violante, 2005).

However, employment protection affects human capital accumulation and productivity, not only labour market flows. Especially in environments where training cannot be contracted between firms and workers because of the unverifiable and unenforceable nature of firm-specific human capital investments, economies are characterised by under-investment equilibria and, in turn, excessive lay-offs, lower job creation and sub-optimal outcomes (Belot and van Ours, 2007, Ricci and Waldman, 2010). In these contexts, restrictions on labour flexibility may represent a contractual solution to the under-provision of firm-financed training; conversely, liberalisation favouring short-term contracts may induce detrimental effects.

It should be noted that, in the related literature, few studies have estimated the influence of aggregate measures of employment protection on productivity, and most of the existing literature, like the works of Nickell and Layard (1999) and Dew-Becker and Gordon (2008), has used aggregate regression analysis to examine the relationship between employment protection legislation (EPL) and productivity. However, the validity of these kinds of investigations may be limited by confounding factors which influence the cross-country effects of EPL. This problem is handled by Micco and Pages (2006) and Bassanini et al. (2009), who use a difference-in-difference approach which can estimate the influence of country institutional variables by controlling for industry effects. The present paper adopts the same difference-in-difference approach and offers estimates for more recent years, 1995-2007. Its major contribution is also that it pays special attention to the regulation of temporary jobs, rather than aggregate measures of employment protection or protection of regular jobs, as done by the above authors. Two-tier reforms rather than liberalisation of permanent jobs, as noted above, were recorded in our estimation period, leading us to examine their role in explaining TFP patterns.

We find that deregulation of temporary workers negatively influences TFP growth rates in European economies, while changes in the restriction of regular jobs have no significant effect on efficiency patterns. Within sectoral analysis, the effects of EPLT liberalisation policies are greater in industry where firms are more used to making staff changes by opening short-term positions, whereas excessive product market regulation negatively influences TFP growth.

The paper is organised as follows: Section 2 discusses the literature which has explored the causal links between employment protection and productivity. Section 3 presents data and sources; Section 4 offers some descriptive statistics concerning the key variables used in the econometric analysis. Section 5 discusses econometric strategy and estimates, and Section 6 concludes.

2. Employment protection and productivity: relative literature

Many studies have analysed the influence of labour protection on employment and unemployment rates, or on unemployment inflows and outflows, but have reserved less space to productivity growth. For instance, Bentolila and Bertola (1990) and Bertola (1990) examined the role of firing costs in limiting lay-offs and discouraging hiring, with ambiguous overall influence on employment rates; similar conclusions were reached by Mortensen and Pissarides (1999) who found that EPL

restrictions negatively influence job mobility. However, employment protection affects not only labour market flows, but also productivity and welfare, as we discuss below.

Indeed, the deeper motives for promoting labour market flexibility are found in the theoretical literature on the potential costs of labour protection, which may generate direct and indirect effects on efficiency growth. This protection, as argued by Hopenhayn and Rogerson (1993) and Bertola (1994), perturbs the reallocation of resources from declining firms to more dynamic ones with above-average productivity growth. In addition, these protective devices tend to alter the allocation of resources among sectors. Economies with rigid labour markets show distortions in their innovation activities, since they adopt mainly secondary innovations, which cause cost reductions in existing goods, but they do not experiment with primary innovations, such as those related to new products, characterised by higher returns but also higher variance (Saint Paul, 2002).

Other key channels able to explain unfavourable consequences are related to capital returns and worker effort. Turnover costs, determined by obstacles to labour mobility, reduce returns on investments and cause a slower rate of growth, as shown by Bertola (1994). Similar negative effects are brought about by worker incentives, since labour protection lowers the probabilities of lay-offs for disciplinary reasons; under less threat of dismissal, opportunistic behaviour is encouraged (Boeri and Jimeno, 2005).

In addition, in the case of rigid regulations for *permanent* contracts, *temporary* workers play a role as 'buffer stock', since firms can adjust their workforces by varying the number of temporary contracts, thus quickly responding to demand and technological change. However, as theoretically argued by Blanchard and Landier (2002), deregulation of temporary contracts may merely increase the turnover in the labour market, rather than being "stepping stones" to permanent jobs, since the latter types of jobs remain costly to dissolve due to severe restrictions on dismissals. Blanchard and Landier also offer evidence for the French case - over the period 1983-2000 - which unambiguously confirms that partial reforms of employment protection may be perverse: when firms are allowed to hire workers on fixed-term contracts and keep them beyond those contracts, they cannot freely choose for later separation, which is normally subject to firing costs. In the same vein, Boeri and Garibaldi (2007) focus on the transitional "honeymoon effect" of labour market reforms, aimed at allowing some flexibility by implementing reforms 'at the margin'. Two-tier reforms, as argued by the authors with a dynamic model of labour demand, verified for the Italian case, produce an increase in the short-run of employment, but also a slowdown in productivity, due to a decrease in marginal returns of labour services[1].

[1] Boeri and Garibaldi (2007) examine the Italian experience in the period 1995-2000 and focus on the "honeymoon effect" of labour market reforms, aimed at allowing some flexibility by implementing reforms

Temporary contracts may also exert two probable but opposing effects on productivity. On one hand, they favour all reallocation processes triggered by shocks in technology or demand which call for faster adaptation and job changes. They may also have an incentive effect, under the assumption that fixed-term workers aim at obtaining permanent positions; hence, these arrangements may be screen devices to select new employees, and are thus potential "stepping stones to generally preferable permanent jobs" (Engellandt and Riphahn, 2004, p. 2).

Wasmer (2006) uses a matching model to show that employment protection, by reducing turnover and labour mobility, shifts human capital accumulation towards specific skills. In particular, workers are induced to invest in firm-specific skills when the employment relationship is expected to last. This kind of specialisation improves their productivity and makes it possible for them to obtain wages above their outside options. By contrast, workers tend to invest much more in general skills when they perceive a high risk of losing their jobs, as in the absence of employment protection.

Belot, Boone and van Ours (2007) also stress that, when effort and investments in human capital are non-contractible, employment protection solves hold-up problems. Protection of this kind encourages employees to invest in match-specific human capital by increasing the probability of the survival of the match, and this beneficial effect is stronger in those sectors where firm specialisation in competences is more important. This result is also relevant in all contexts where risk-averse employees are liquidity-constrained and cannot obtain insurance against dismissals. However, there is a trade-off between these positive effects and the negative consequences of EPL, which also raises the costs of separation. Belot, Boone and van Ours suggest an inverse U-shaped relationship between employment protection and economic growth: there is a positive optimal level of employment protection, so that, over some ranges, increasing employment protection does improve welfare. The exact level of optimal employment protection depends on other labour market institutions, such as minimum wages and wage bargaining institutions.

More general results, not conditioned by the presence of risk-averted employees and financial imperfections, are obtained by Ricci and Waldman (2010). In their matching model, à la Mortensen-Pissarides (1994), in which firms finance training of their employees, the introduction of a firing tax reduces hold-ups and opportunistic behaviour by employers and acts as a Pareto improving policy. Indeed, when the amount of training is chosen in the first stage of employment

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at the margin, i.e., those involving fixed-term but not open-end contracts. For the Italian case, other evidence has been obtained by examining the role of exemption clauses exonerating small firms from job security norms (Schivardi and Torrini, 2008).

relations, while the returns are realised at the second stage, workers are not able to influence the amount of training, which is chosen unilaterally by firms. In this economy, a firing tax combined with the use of hiring subsidies always increases the level of training, as well as job tenure, with unambiguous positive effects on welfare. The new firing tax imposes a second-order cost on the firm, but induces a first-order benefit to the worker, since it solves the hold-up problem: On political grounds, a firing tax for newly hired workers finds less resistance if the tax revenue derived from separations is used to subsidise new hiring. In sum, a well-designed policy which combines firing taxes for newly hired personnel and hiring subsidies acts as a Pareto improving intervention.

Concerning empirical evidence, and limiting our short review to comparative studies, it must be noted that a few works have estimated the relationship between EPL and productivity in cross-country (Nickell and Layard 1999; Autor et al. 2007; Dew-Becker and Gordon, 2008) or industry-level cross-country studies (Micco and Pages, 2006; Bassanini et al., 2009). So far, these empirical studies offer contradictory findings. For instance, Layard and Nickell (1999) performed cross-country estimates of labour productivity growth over the period 1976-1992, in which it appears that employment protection is the only institution that has a positive effect on labour productivity growth in OECD countries; the rationale behind this is that productivity improvements depend on workers' cooperation and on-the-job training investments which, in turn, are favoured by firing costs.

Autor et al. (2007), using cross-state differences in the US, consider the adoption of wrongful discharge protection by US state courts from the late 1970s to the early 1990s and estimate the influence of dismissal costs on the distortion of production choices and thus on productivity. Their estimates suggest that job protection reduces TFP and firm entry, but increases capital investments. Dew-Becker and Gordon (2008) detect significant positive effects of EPL as well as of unemployment protection, measured by average replacement rates.

Belot, Boone and van Ours (2007) perform an empirical analysis of cross-country time-series data (17 OECD countries and three periods, ranging from the early 1960s to the late 1990s) and find that employment protection legislation, as predicted by their model, briefly described above, has a non-linear relationship with economic growth.

The limitation of these previous works is that the effects of labour policies, defined at aggregate level, may be obscured by confounding factors which influence cross-country (cross-state) variations. This problem is handled by recent studies which use a difference-in-difference approach and estimate the influence of country institutional variables by controlling for industry effects. If EPL has a different effect on sectors, EPL non-binding sectors are used as a control for EPL-

binding sectors, i.e., for the 'treated' group. This method was applied by Micco and Pages (2006) to a sample of 16 OECD and 18 non-OECD countries. They found that stricter job security regulation, as measured by alternative indicators, slows down job turnover, and that the magnitudes of these effects are larger in sectors which are intrinsically more volatile. However, they also found less robust results for productivity. Clearer and robust results are obtained by Bassanini et al. (2009), who adopt the difference-in-difference method for a sample of OECD countries for the period 1982-2003. They mainly focus on labour protection of regular contracts and estimate that dismissal restrictions have a negative effect on productivity growth, especially in sectors where firing restrictions are more binding. The estimated effect of protection of permanent contracts remains negative and significant when protection of temporary contracts is controlled for. In contrast, for the latter form of regulation, they find either positive or no influence on TFP.

The exploration of the role of temporary job restrictions and their effect on TFP growth is the main aim of our estimates for more recent years (1995-2007).

3 Data and sources

Our empirical investigation relies on several databases, EU KLEMS accounts, the OECD indexes on employment protection and product marker regulation, and EUROSTAT.

The key variables used to study the influence of employment protection and product market regulation on TFP growth, as well as other control variables, are included in these different databases; thus, the first step of our research involved matching them and carrying out disaggregated analysis at sector and country levels. First, the availability of data and the needs of a large and consistent sector-country profile led us to select only 14 countries out of the 27 European Union members and to re-arrange the NACE rev.1 sections into 10 industries.

This made it possible to compare the following economies: Austria, Belgium, the Czech Republic, Denmark, Spain, Finland, France, Germany, Hungary, Ireland, Italy, the Netherlands, Sweden, and the United Kingdom. This selection, as noted above, was dictated by data availability and includes two sets of countries: i) 12 Old Member States; ii) 2 New Member States. The second small set comprises Hungary and the Czech Republic, two "market-oriented" economies with some similarities to the Anglo-Saxon countries (European Commission, 2004).

The selected sectors consist of: 1) Agriculture; 2) Mining and Quarrying, 3) Manufacturing; 4) Energy sectors), 5) Construction, 6) Wholesale and Retail Trade, 7) Hotels and Restaurants, 8) Transport, Storage and Communications, 9) Financial Intermediation, Real Estate and Business Services, 10) Community, Social and Personal Services.

We drew the dependent variable of our econometric estimates, TFP growth, from the EU KLEMS database, which was extensively used in the study by van Ark et al. (2008). One of the main advantages of this database is the detailed breakdown of industries and service sectors and the decomposition of labour productivity; it is also worth noting that this decomposition was computed by considering differences in labour quality (highly skilled, medium-skilled and low-skilled) and a full variety of asset types (distinction between *ICT* capital and *non-ICT* capital services).

In addition, following Bassanini et al. (2009), we used EU KLEMS to estimate TFP levels, which allowed us to compute the distance of TFP from the technological frontier, i.e., the ratio of TFP in a specific country and industry to the TFP level of the leader in that industry (Aghion and Griffith, 2005; Griffith et al., 2004).

Other variables used in the descriptive analysis, value added and the contribution of inputs to growth, were also obtained from the EU KLEMS database.

The set of key explanatory variables related to labour and product market regulation, i.e., employment protection legislation for regular and temporary workers (EPLR and EPLT, respectively) and product market regulation (PMR), are given by the OECD database.

Important explanatory variables of TFP used as controls, particularly those describing unmeasured innovative input, sectoral R&D expenses, standardised to value added, were taken from EUROSTAT. The same database was used to gather the share of workers with temporary jobs to total employees at sector-country level. We also introduced, in our difference-in-difference model, the sectoral average level of this ratio for the UK as a benchmark, i.e., as the underlying propensity to use temporary workers, in the absence of EPLT. In addition, in the descriptive analysis we used the proportion of temporary workers by sector and country, for information on actual utilisation of labour market flexibility.

Lastly, UK industry-level layoff rates, defined as the percentage ratio of annual lay-offs to total employment, were introduced as a proxy for lay-off propensity in the absence of EPL, and were obtained from the waves of the UK Quarterly Labour Force Survey, released by the Office of National Statistics.

4 Descriptive statistics

4.1 Cross- country productivity differentials

Study of the relationship between regulatory framework and TFP, presented below, is accompanied by some evidence to show the decomposition of GDP growth into the growth of two components:

hours worked and labour productivity. An overall picture of cross-country differentials from 1995 to 2007 is given in Table 1, which also shows data for contributions to labour productivity.

The lowest position in terms of growth of value added is occupied by Italy, with a rate of only 1.42%, (column 1), mostly because of its collapse in productivity growth**.** It is followed by Germany where, however, the disappointing performance in output growth was primarily caused by a marked fall in hours worked. Conversely, at the top we find Ireland, Finland and Spain, but here too the difference between the three economies is worthy of note, since Ireland and Spain had extensive growth as a consequence of the greater output contributed by hours worked, whereas Finland recorded an acceleration in productivity gains.

Table 1 also shows that the slow productivity growth of the old member states of the European Union, below 2 percent, is a widespread phenomenon - with some notable exceptions, two in Northern Continental Europe, Finland and Sweden, and two in the Anglo-Saxon economies, Ireland and the UK.

Table 1: Output, hours and productivity growth in European economies: 1995-2007 (all sectors)

		Output contribution from		Labour productivity contributions from				
	Growth rate of Value Added	Hours Worked	Labour Productivity	Labour Composition	ICT capital per Hour	Non-ICT capital per Hour	TFP	LP contributions from knowledge economy
Austria	2.43	0.52	1.90	0.20	0.43	0.39	0.88	1.51
Belgium	2.13	0.63	1.50	0.21	0.77	0.74	-0.22	0.76
Denmark	1.87	0.83	1.03	0.10	0.84	0.38	-0.29	0.65
Finland	3.57	0.84	2.73	0.23	0.50	0.46	1.54	2.27
France	2.14	0.34	1.79	0.33	0.27	0.59	0.60	1.21
Germany	1.60	-0.09	1.69	-0.01	0.38	0.64	0.67	1.05
Ireland	6.94	1.93	5.01	0.54	0.41	3.46	0.61	1.56
Italy	1.42	0.65	0.77	0.12	0.25	0.70	-0.29	0.07
Netherlands	2.69	0.78	1.91	0.30	0.53	0.50	0.58	1.41
Spain	3.52	1.89	1.63	0.44	0.46	1.43	-0.69	0.21
Sweden	2.96	0.40	2.56	0.25	0.47	1.05	0.78	1.50
United Kingdom	2.72	0.60	2.13	0.43	0.74	0.58	0.38	1.56
Average (EU12)	*2.83*	*0.78*	*2.06*	*0.26*	*0.51*	*0.91*	*0.38*	*1.15*
Std. Dev. (EU12)	*1.46*	*0.59*	*1.08*	*0.16*	*0.19*	*0.86*	*0.63*	*0.63*
Czech Republic	2.74	-0.10	2.84	0.30	0.53	1.41	0.60	1.43
Hungary	3.92	0.23	3.67	0.61	0.30	0.36	2.40	3.32
Average (EU14)	*2.90*	*0.68*	*2.23*	*0.29*	*0.49*	*0.91*	*0.54*	*1.32*
Std. Dev.(EU14)	*1.38*	*0.60*	*1.10*	*0.17*	*0.18*	*0.81*	*0.79*	*0.82*

Source: EU KLEMS database. Contribution from knowledge economies is obtained by summing labour composition, ICT capital per hour and TFP. Labour composition is measured by changes in terms of age, gender and educational attainments. EU KLEMS cross-classifies labour input by educational attainment, gender, and age (to proxy for work experience) into 18 labour categories, respectively 3 x 2 x 3 types; see van Ark et al. (2008, p. A2).

Contributions to labour productivity growth reveal other cross-country diversities.

In Ireland, a significant increase in substitution of capital for labour and processes of deepening in (non-*ICT*) capital intensity are recorded. Similar measures characterised the mid-1970s to the late 1980s when, on average, European countries engaged in catching up with the US (van Ark et al. ,2008). For the other Anglo-Saxon country, the UK, two components of the knowledge economy (high quality of the labour workforce and capital *ICT* services) contribute to an important extent. Lastly, the Northern countries, and Finland in particular, were the only economies in Europe which showed the indubitable incidence of TFP growth.

Note, as already signalled by van Ark et al. (2008), that there is no significant slowdown in the quality of the labour force: the skill level of the workforce (captured by the labour composition effect) gives a positive contribution to efficiency growth (with the only exception of Germany). In addition, there is no large variation in labour composition effect across European countries, as shown by the standard deviations for EU12 and EU 14 (0.16 and 0.17, respectively).

We also consider the summed contributions of three factors: changes in labour composition, mostly determined by greater demand for skilled workers; investments in information and communication technology, and TFP growth, the last component, as indicated by van Ark et al. (2008, p. 35), "might include the impact of intangible investments such as organizational changes related to the use of information technology". Data for the period 1995-2007 show the lowest performances by Italy and Spain, while confirming the leading position of Finland.

To better evaluate the relative importance of the various components, we computed their percentage contributions to labour productivity, as shown in Table 2.

One of the main differences arising in the intra-European context is found not in differences in the intensity of the production factors, but in total factor productivity. Indeed, the standard deviation of TFP (32.79%) is much larger than that of the contribution of labour composition (6.54%) or of ICT and Non-ICT capital deepening (18.77 and 23.79%). This led us to extend analysis of TFP in terms of country-sectoral differentials.

Table 2: Productivity growth components, 1995-2007
(all sectors; percentage point contributions)

	Labour Composition	ICT capital per Hour	Non-ICT capital per Hour	TFP	Labour Productivity
Austria	10.69	22.38	20.66	46.28	100
Belgium	13.84	51.47	49.52	-14.82	100
Denmark	9.77	81.29	37.03	-28.10	100
Finland	8.24	18.44	16.89	56.43	100
France	18.29	15.23	32.83	33.65	100
Germany	-0.38	22.79	37.67	39.92	100
Ireland	10.76	8.20	68.96	12.08	100
Italy	15.43	32.16	90.52	-38.11	100
Netherlands	15.66	27.96	26.24	30.14	100
Portugal	26.76	28.01	87.32	-42.09	100
Spain	9.94	18.42	41.19	30.45	100
Sweden	20.12	34.79	27.10	17.98	100
United Kingdom	12.72	24.57	44.26	18.45	100
Average (EU12)	*13.22*	*29.67*	*44.63*	*12.48*	
Std. Dev. (EU12)	*6.54*	*18.77*	*23.79*	*32.79*	
Czech Republic	10.47	18.85	49.56	21.12	100
Hungary	16.61	8.27	9.68	65.44	100
Average (EU14)	*13.26*	*27.52*	*42.63*	*16.59*	
Std. Dev.(EU14)	*6.17*	*18.39*	*23.87*	*33.31*	

Source: EU KLEMS database.

4.2 TFP and country-sectoral differentials

Many factors may cause changes in TFP, since this residual measure includes disembodied technological change, organisational improvements, and effects from unmeasured output and inputs which may be captured by R&D expenses. Hence, in addition to technical innovation, there are: i) effects due to organisational and institutional changes, ii) shifts in returns to scale, iii) any other deviations from competitive assumptions of equalities between prices and marginal costs; iv) all computing errors due to the existence of unmeasured inputs. All these effects cause different TFP contributions to economic growth at country and sectoral level, as shown in Figure 1.

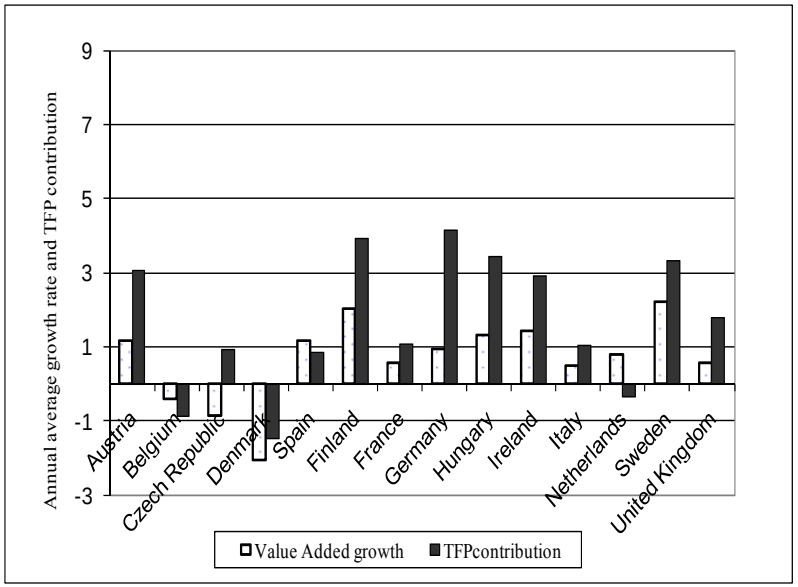
One general finding, common to almost all countries, is the positive and remarkable contribution of TFP in manufacturing. For a plausible explanation, we must recall that TFP, as a residual measure,

includes measurement errors: R&D and other intangible assets are the most prominent examples causing statistical errors when computing inputs. This component has great importance in manufacturing (Eurostat, 2010, p.52).

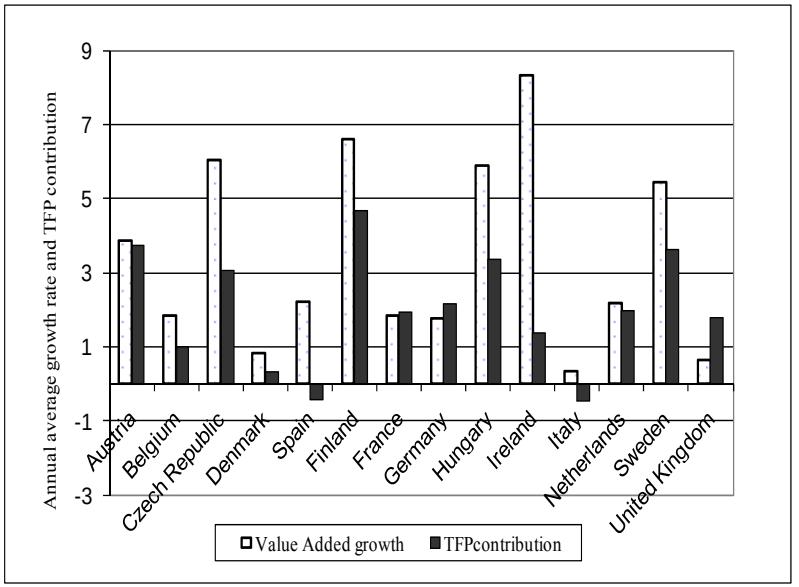
A second finding concerns the positive contribution of TFP to productivity growth in the Wholesale and Retail sector (see Figure 1). One probable explanation, as stressed in van Ark et al.(2008), is that the ample diffusion of chain stores and inventory systems applied to the trade sector are prominent examples of sectors where returns to scale, as already observed for the American economy (Foster et al., 2006), have played a significant role and explain faster growth in TFP. Good performance was also found in Agriculture and Transport, Storage and Communications. One reason for this finding in Transport and Communications concerns the role of deregulation and changes in entry barriers, since the removal of restrictions encourages innovation and promotes growth (Aghion and Griffith, 2005). These effects were empirically tested by Nicoletti and Scarpetta (2003), who examined the role of entry liberalisation in market services and found a positive spill-over effect on manufacturing but, unexpectedly, no benefits in services. These paradoxical results may be due to some statistical problems, since deregulations were introduced in Europe at *different times* in *different industries*, but their aggregation into broad sectors does not allow us to isolate the single institutional innovation and causes insufficient change over time of the explanatory variables which represent these innovations. Inklaar et al. (2008) report that moving to a more detailed analysis for individual service sectors is convenient, since it overcomes these problems; in particular, for Post and Telecommunications, the authors demonstrate that the effect of barriers to entry has a negative and significant effect on TFP growth, whereas no significant effects are detected for Transport and Storage. One explanation is "that the change in barriers to entry for the post telecommunication services was so strong that its effects became identifiable through the general noise in the data, while this was not the case in transport" (Inklaar et al., 2008, p. 167). In our study, in which the two sectors (Transport and Storage, Post and Telecommunications) are not considered separately, we simply find, on average, good results in terms of TFP growth in various countries, as shown in Figure 1. Performances in other services, such as hotels and restaurants, financial sectors or social and personal services, are more disappointing. In these cases, some failures due to the increasing use of fixed-term contracts may have been some of these organisational and institutional changes behind the TFP patterns. This point is examined in the next section.

Figure 1: Contributions of TFP to growth of sectoral added value European economy 1995-2007

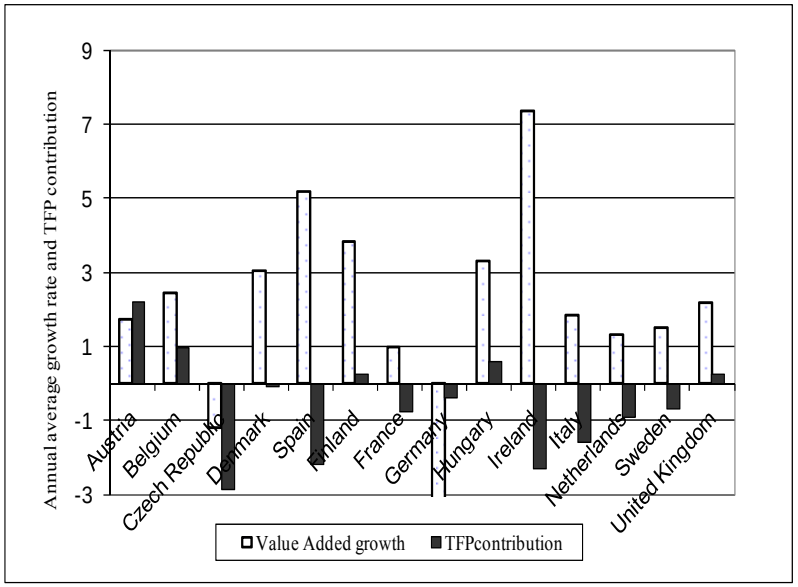
Agriculture



Manufacturing



Construction



Wholesale and Retail trade

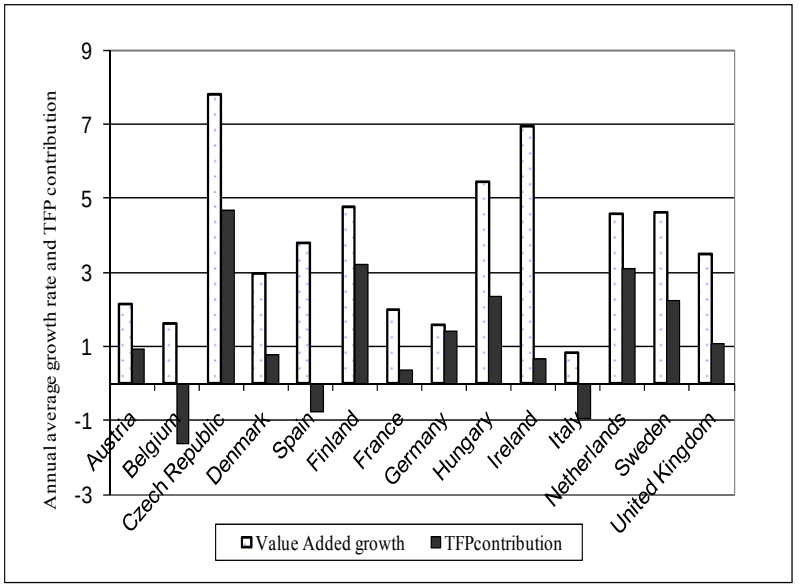
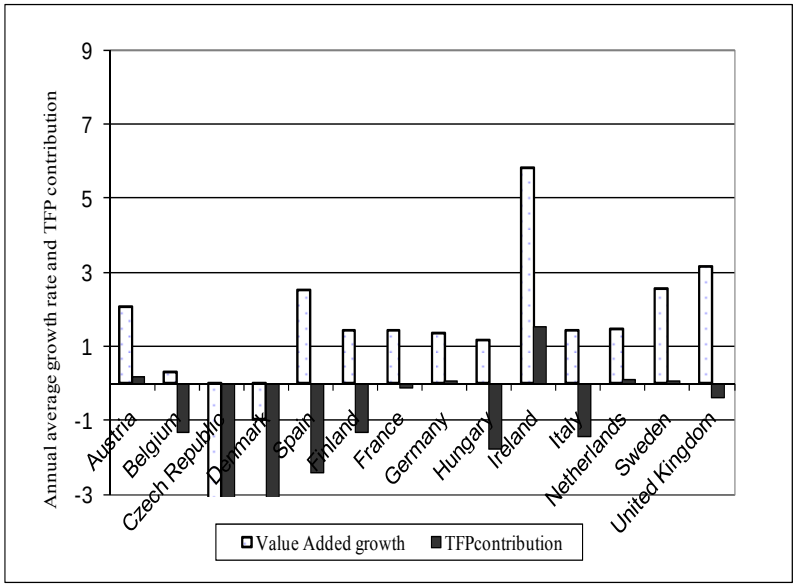
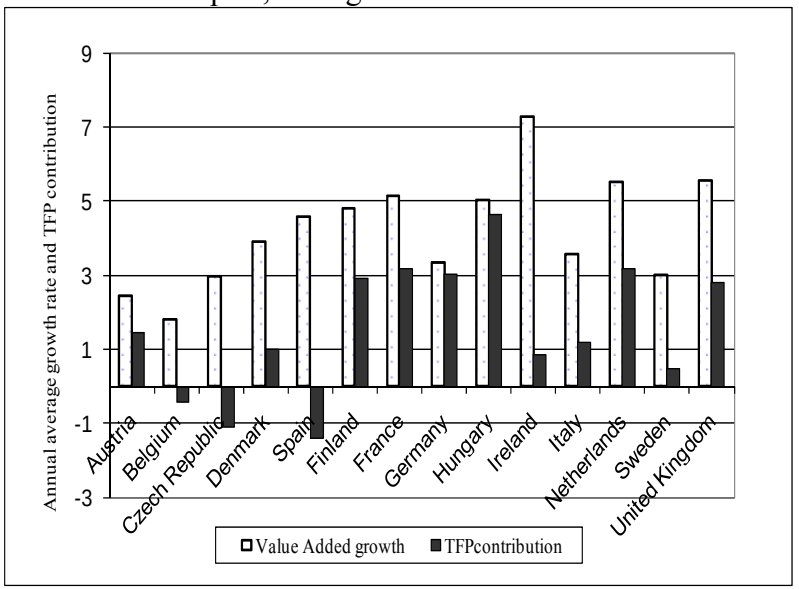


Figure 1 (*continued*): Contributions of TFP to growth of sectoral added value European Economy 1995-2007

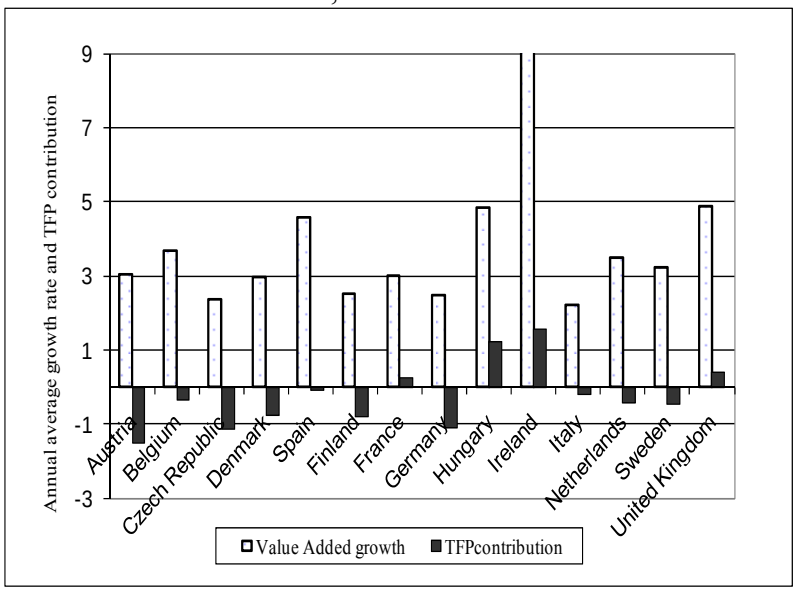
Hotels and Restaurants



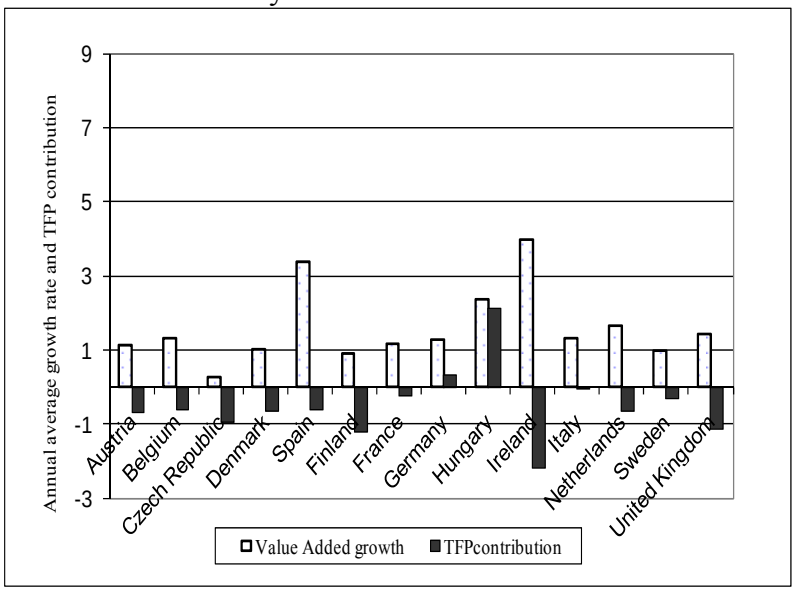
Transport, Storage and Communications



Financial Intermediation, Real Estate and Business Services



Community Social and Personal Services



4.3 Labour Protection

This section concerns job protection across countries and the most important changes which have characterised the European economies and which may have influenced their performance in terms of innovation and productivity.

Job protection considered in most of the estimates of the present paper is measured by using two time-varying cross-country data: the OECD Employment Protection Legislation index (EPL) for regular contracts (EPLR) and, for temporary contracts (EPLT).

The EPLR OECD index refers to eight items which weigh three major groups of restrictions: i) procedural inconvenience (such as notification procedures), ii) severance pay, and iii) difficulty of individual dismissals (definition of unfair dismissal and related items). The EPLT index includes norms for fixed-term contracts and temporary work agency employment. For both types of contract, the OECD sub-indexes include information on the valid cases for which these types of contracts are legal, restrictions on the number of renewals, and their maximum cumulated duration (OECD, 2004).

Our baseline regressions do not include the OECD indicator which covers a third area, i.e., restrictions on collective dismissals (EPLC). EPLC has only been available since 1998 and this does not allow comparisons over our observation period (1995-2007). In any case, for robustness checks, we also perform a set of estimates to test the role of EPLC and following Bassanini et al., (2009) introduce an aggregate indicator, obtained by a weighted average of EPLR (time-varying) and the 1998 value of EPLC. Note also that the information for EPLC for the years 1998-2007 confirm no changes in the restrictiveness of collective dismissals in our sampled European economies, with only two exceptions, Denmark and Finland where, however, only minor changes were made.

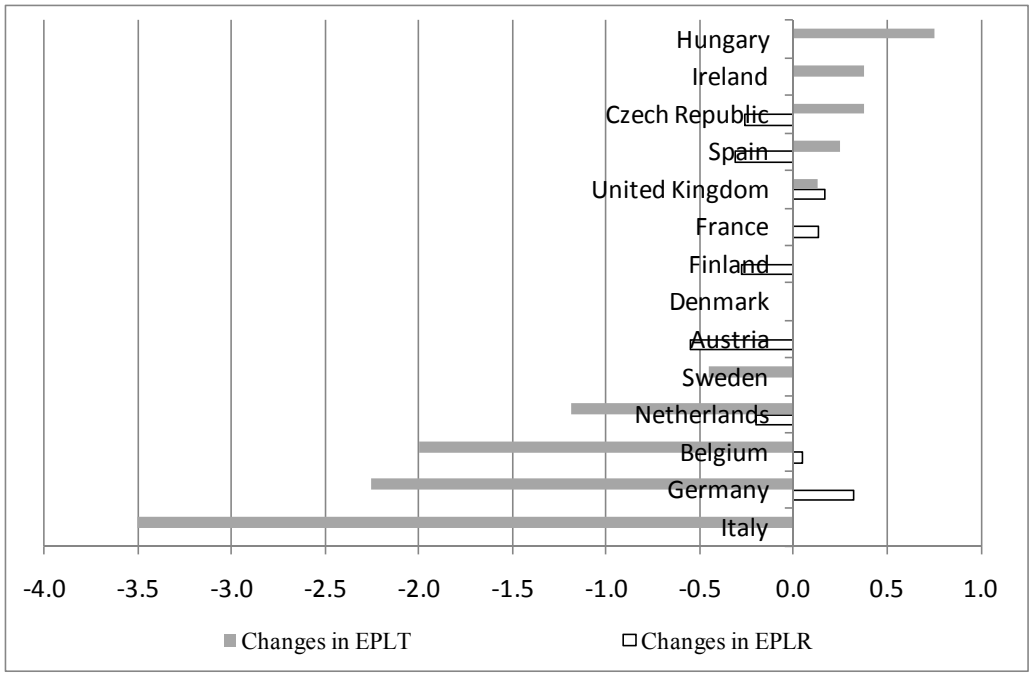
A general look shows considerable variations across EU economies, not only in the stringency of aggregate values of EPL (obtained by weighting EPLR, EPLT and EPLC), but also in the stance of these different components. There are economies, such as that of the United Kingdom, where all the various kinds of restrictions are small, but there are other countries where stringency widely differs by component. A case in point is Italy, with the highest EPLC values throughout our observation period (4.88) but where EPLR (1.77) is less than the EU average (Figure 3)[2].

In recent years, one of the main innovations in European labour markets has been new legislation for temporary job contracts. Reforms for these types of contracts have characterised various countries and have been more important than changes in rules for regular contracts. Indeed, the

[2]All OECD EPL indexes are measured on a 0-6 scale, from least to most restrictive.

changes recorded for our sampled countries, as shown in Figure 2, confirm that the greatest relaxation in strictness of rules is recorded for temporary contracts.

Figure 2: Changes in employment protection in EU countries 1995-2007



Source: OECD

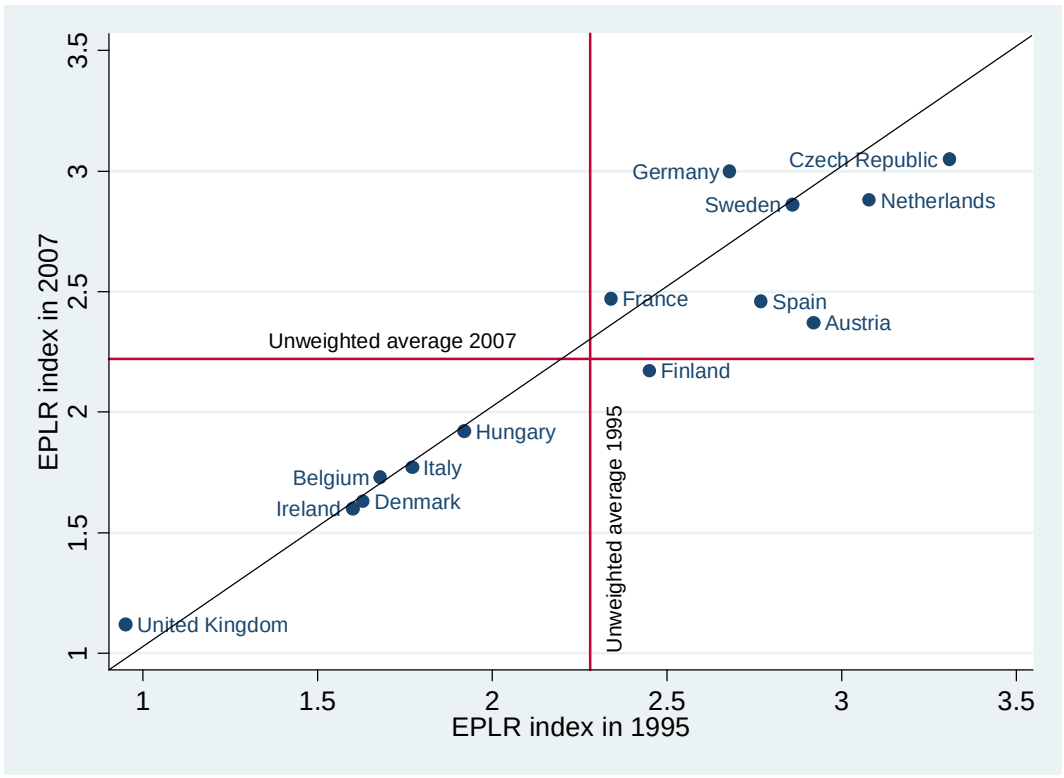
A broad picture of cross-country differences in EPLR shows that low and high EPLR countries have kept statutory protection of regular jobs almost unchanged (see also Venn, 2009). The highest easing is recorded in Austria, which has adopted a reform entailing only half a point reduction in the EPLR index (which ranges from 0 to 6), followed by Spain and the Netherlands (with reductions of 0.31 and 0.20, respectively). Conversely, Germany has slightly strengthened high protection for permanent workers (+ 0.32). A better visualisation of the stability of protection of regular workers is given in Figure 3, which compares the stance of policies in 1995 and 2007 on individual and collective dismissals, quite unchanged throughout the EU economies.

The EPLT values shown in Figure 4 confirm the "highly selective approach" already signalled by Brandt et al. (2005). The figure shows the starting point of each EPLT country and its evolution up to 2007. Three groups of countries emerge. The first comprises five economies, characterised by increased protection over the period 1995-2007: Hungary, Ireland, the Czech Republic, Spain and the UK. These data also show that, with the exception of Spain, the initial EPLT levels in these countries were very low. Spain, which had liberalised the labour market in the early 1990s, later eased restrictions on temporary contracts, but temporary employment regulations in 2007 were still more stringent than the EU average.

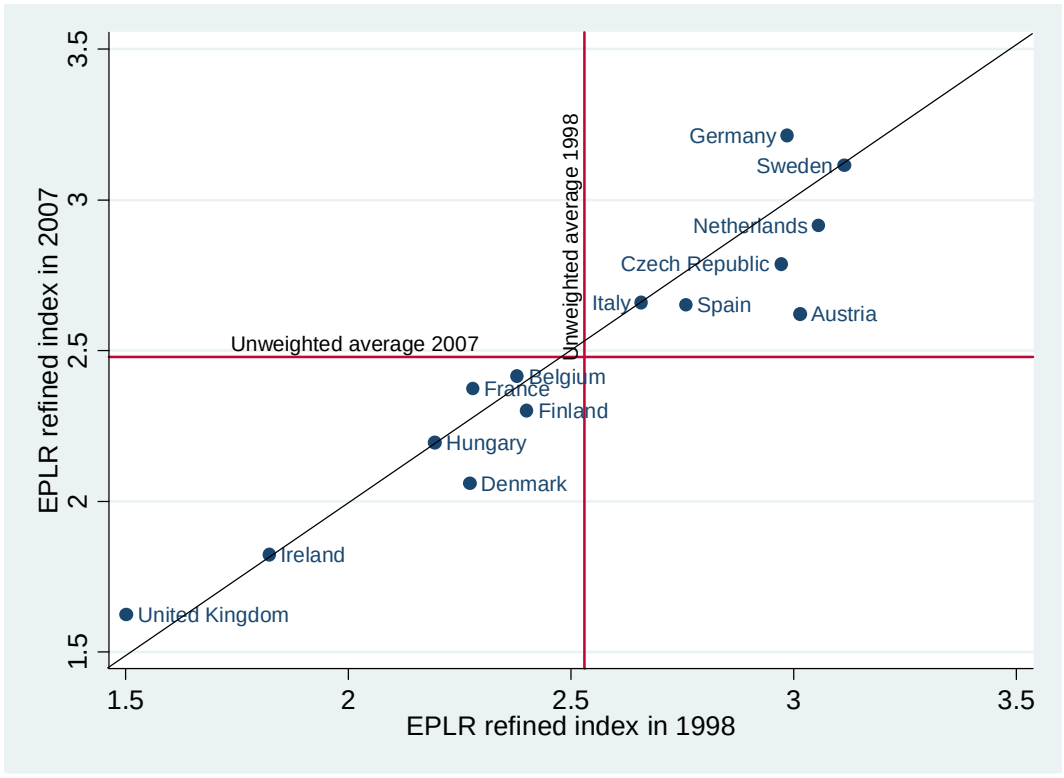
The second group comprises economies where changes did not occur (France, Finland, Denmark, Austria), and the third group consists of countries which lowered the level of protection for temporary workers, probably because of higher initial levels. In this group, we find Italy, which in 1995 had the strictest regulations for temporary contracts, and later adopted large-scale liberalisation for them, facilitating the use of a multiplicity of atypical contracts. This process led to a reduction of the EPLT index by 3.5 points (which also ranges from 0 to 6). Significant easing was recorded in Belgium (but with a lower reduction, of 2 points), a country which in 1995 had strict norms for temporary jobs.

Figure 3: Employment protection of regular contracts in EU countries

EPLR (only individual dismissals) 1995-2007

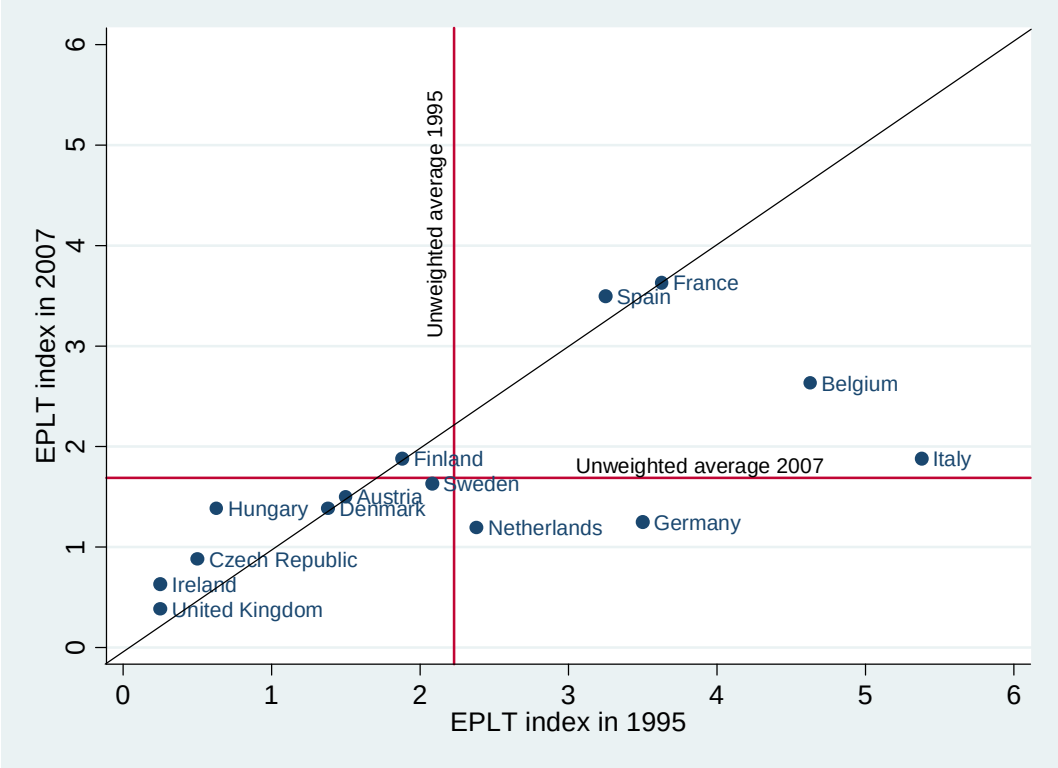


EPLR refined index (individual and collective dismissals) 1998-2007



Source: OECD

Figure 4: Employment protection of temporary contracts in US and EU countries, 1995-2007



Source: OECD

Although the role of changes in EPL is a matter for further study by means of econometric estimates, some evidence on the actual implementation of norms for fixed-term contracts are interesting.

Figure 5 shows that one group of economies has increased the adoption of these contracts. This group contains Italy, the country which has recorded the largest liberalisation of temporary jobs (i.e., the sharpest decline in EPLT) and also the highest acceleration of temporary jobs, with an annual average growth of more than 5%. Increases in these shares, around 4%, have been recorded in Belgium and the Netherlands, two countries which have also eased restrictions on these kinds of contracts.

A second group comprises economies (Spain, UK, Denmark, Ireland, Finland) which have recorded negative growth of the proportion of temporary workers (Figure 5), and they are all countries which have raised or kept unchanged their protection of temporary workers between 1995-2007 (Figure 3). The only exception is Hungary, which shows small positive growth in the proportion of temporary jobs, notwithstanding a slight increase in EPLT.

Our data also suggest that catching-up effects due to the use of temporary workers are negligible. In fact, by omitting the outlier case of our sample, Spain, we obtain a correlation of -0.34 between the share of temporary contracts and the average annual growth of those shares. This means that trends in the proportions of fixed-term contracts are weakly explained by their initial levels. Instead, complementary effects between protection of temporary and regular workers play a major role. For example, in 1995 the proportions of temporary workers in the UK, Italy, Belgium and Austria were very similar (6.77%, 7.21%, 5.31%, 5.99%, respectively). However, interesting divergences emerged in the following years, when the last three countries did not ease their strict legislation for regular workers but significantly liberalised the hiring of temporary workers, thus causing a considerable increase in the use of temporary contracts. In sum, our data suggest that changes in employment protection legislations are correlated with differing recourse to temporary contracts, and led us to explore their effects on productivity.

Figure 6 compares 1995 and 2007 proportions of temporary contracts (as shares of total employment) and shows that in many countries (UK, Ireland, Denmark, Austria, Belgium, Hungary, Czech Republic) recourse to temporary workers remains below the EU average, in both years. Conversely, we find a restricted group recording high, persistent proportions of temporary workers, again in 1995 and 2007 (Spain, Sweden, Finland). Lastly, there are a few economies (the Netherlands, Germany, Italy), which have recorded increasing use of temporary workers, a fact which, in 2007, led them to record above (or nearly above) the sample average.

Before discussing econometric results, it is useful to observe that the UK, as mentioned above, is a benchmark country in that it has the least protection for both regular and temporary workers, in comparison with other EU countries of our sample, without significant policy turnarounds (see also Figures 3 and 4). It also shows the lowest levels of proportions of temporary workers (Figure 6). Data by sector confirm that the UK is a benchmark, since both at the beginning and at end of the period its propensity to use temporary workers was much lower than the EU sample average (Figure 7).

Data on sectoral propensities to use temporary workers reveal uniform patterns across countries: in both the UK and other EU countries, we find the same group of industries with higher shares of temporary jobs (Agriculture, Hotels and Restaurants, Construction, Community, Social and Personal Services, Finance and Business Services). Conversely, trends by sectors are quite different. In Agriculture and services we note a falling trend in these arrangements in the UK, but increasing importance in EU countries.

Figure 5: Growth of proportion of temporary workers with respect to initial levels 1995-2007

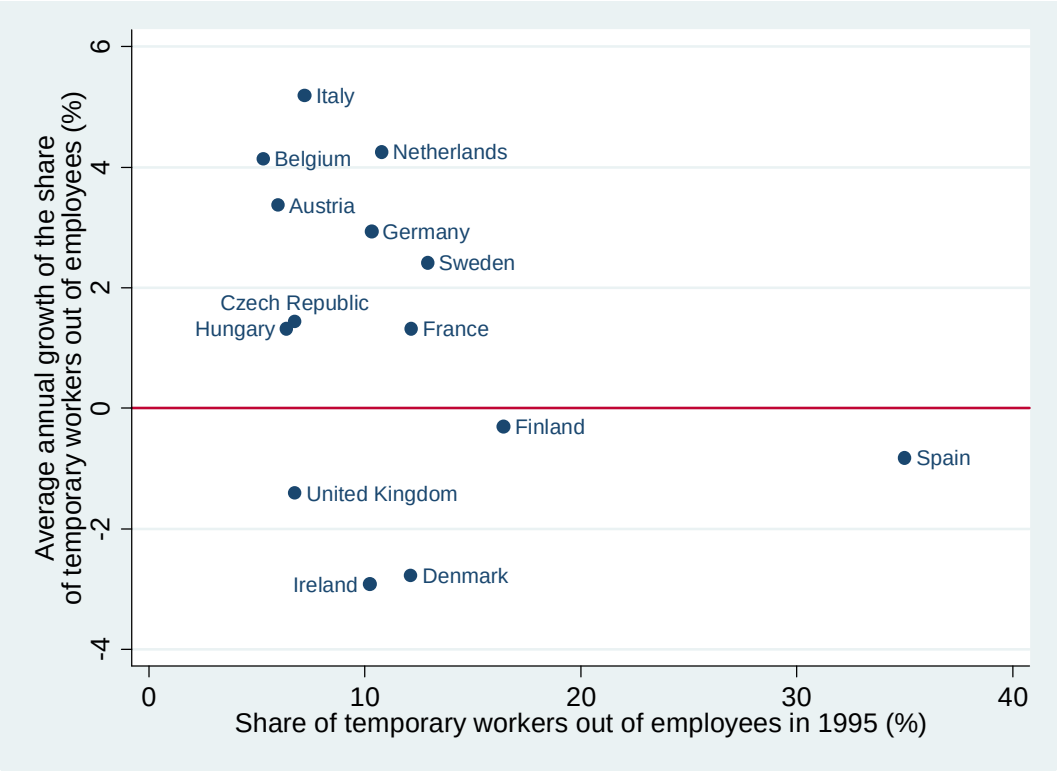


Figure 6: Proportion of temporary workers at beginning and end of period 1995-2007

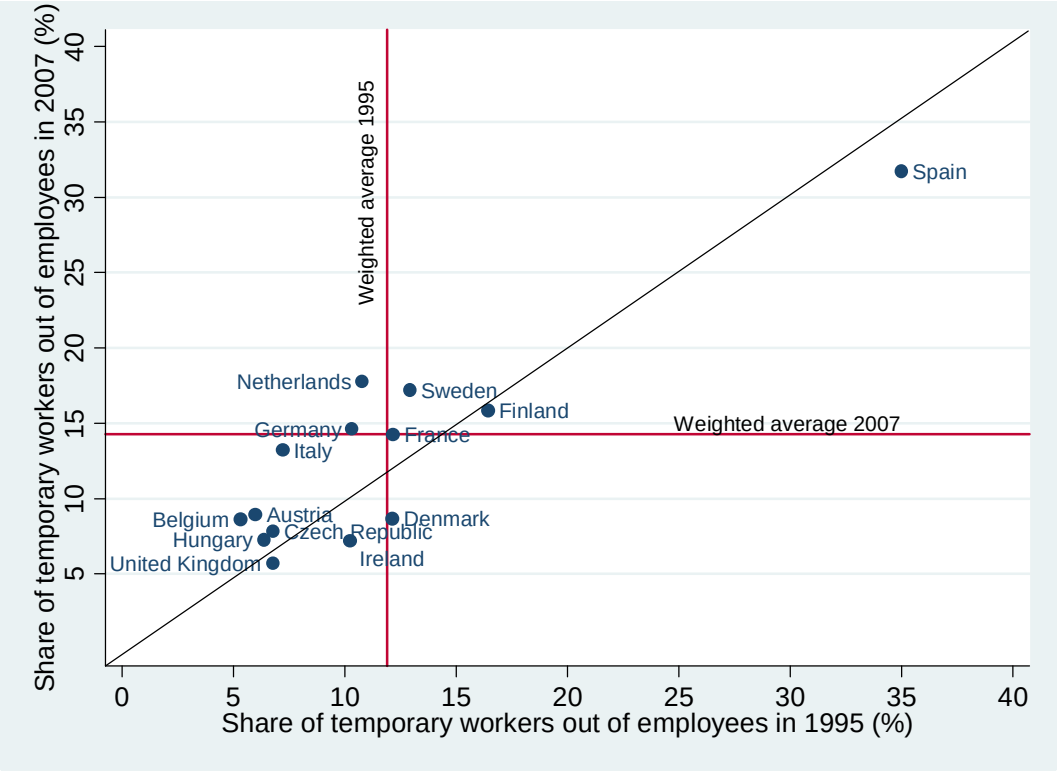
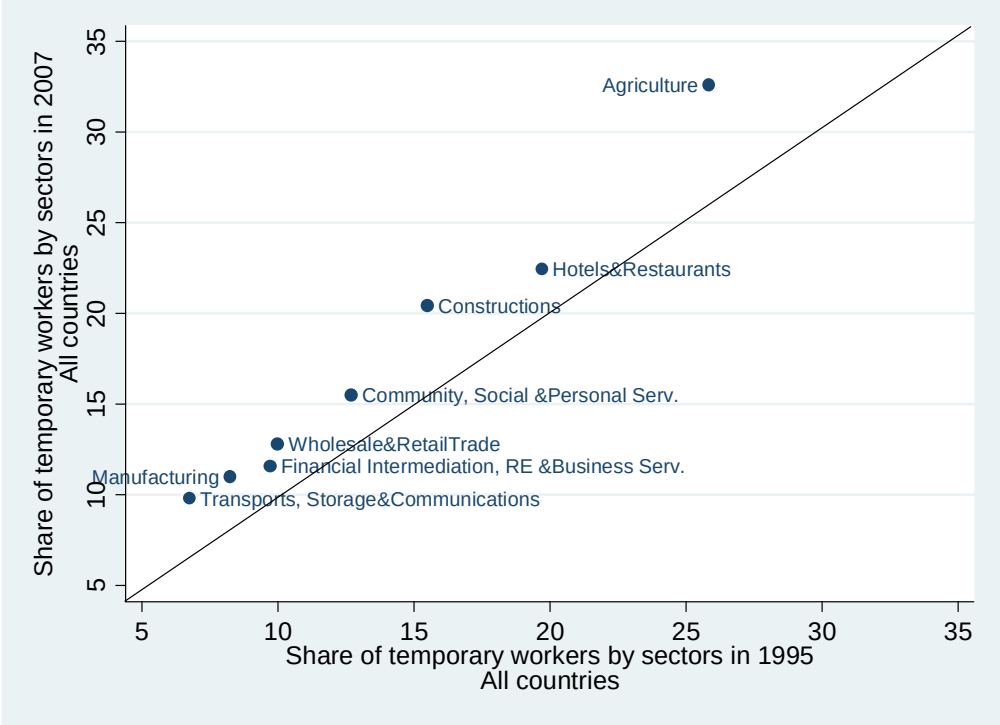
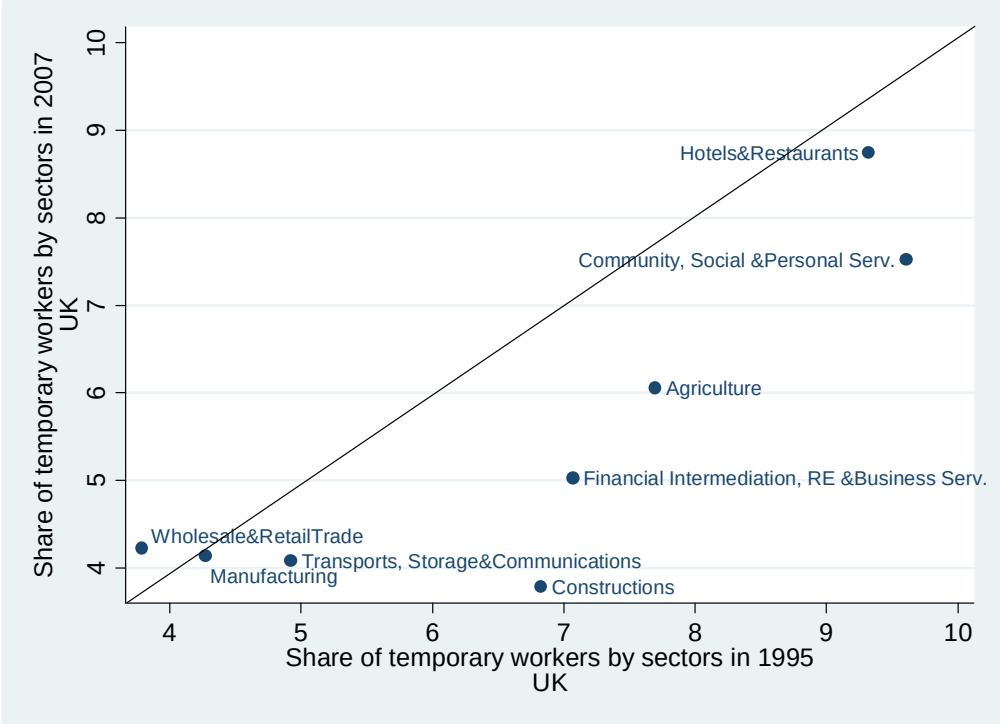


Figure 7 Proportion of *temporary workers by sector at beginning and end of period 1995-2007*

All countries



UK



5. Econometric analysis

5.1 Estimation strategy

In this section we focus on the causal relationship between protection of temporary workers (EPLT) and total factor productivity growth (TFP). We also include other control variables, i.e. protection of regular workers (EPLR); disembodied innovation (captured by R&D intensity) and product market regulation (PMR).

The empirical strategy is based on the assumption that EPLT influences efficiency growth in those sectors which need more flexibility to be successful and adjust employment more than others. We thus exploit differences across sectors to implement a difference-in-difference method for our sample of 10 industries in 14 EU economies. In this sample, we test the hypothesis that lower restrictions depress TFP growth in those industries where the propensity to use flexible employment arrangements are higher. This propensity is measured in the UK, since this country has the lowest employment protection levels, for both temporary and regular workers, as noted above. We assume that the differences in propensity to assume temporary workers in the UK are only motivated by technological and other sector-specific factors, irrespective of influences caused by protection legislation.

More precisely, following Rajan and Zingales (1998) and Bassanini et al. (2009), we assume that the difference in TFP growth between any pair of industries (*h* and *k*) is equal to the expected value (*E*) of a function of EPLT and its change, multiplied by a function *g* of the difference between the propensity to employ temporary workers which we find in the two industries. We also assume that *f* is linear and *g* is an identity function $g(x) = x$. We obtain:

$$E[\Delta \ln TFP_{ikt} - \Delta \ln TFP_{iht}] = f(ELPT_{it-1} g(\Lambda_k - \Lambda_h), \Delta ELPT_{it} g(\Lambda_k - \Lambda_h))$$

where TFP_{ikt} denotes TFP in country *i* and time *t, k,* and *h* index the pair of industries, and Λ is the average sectoral propensity to use temporary workers over the period 1995-2007 in the benchmark country (the UK). The difference in the "natural" propensity to employ temporary workers among various industries, multiplied by the different stringency of EPLT across the countries of our sample, explains the differences in TFP growth rates at sector-country level.

We adopt a similar strategy for protection of regular workers (EPLR). In this case, Λ is the average lay-off propensity over the period 2001-2007 in the benchmark country (UK). Since

we find a weak negative correlation between lay-off propensity and the propensity to employ temporary workers[3], in some specifications we also interact the latter with EPLR.

In addition, our linear regression model includes Product Market Regulation (PMR) and innovation, proxied by *R&D* intensity. These variables are taken at sector-country level and also work as controls. We therefore we estimated the following equation:

$$\Delta \log TFP_{ijt} = \beta \Lambda_j EPL_{it-1} + \gamma \Lambda_j \Delta EPL_{it} + \delta PMR_{ijt-1} + \vartheta \Delta PMR_{ijt} + D_{it} + D_j + \varepsilon_{ijt} \quad (1)$$

where i = 14 countries, j = 10 sectors, t = 1995,…2007, and EPL is the overall indicator, obtained by considering EPLT and EPLR, in turn multiplied by Λ, the indicator equal to the average industry propensity to use temporary workers in the years of our observation period. We also include country by year dummies, D_{it} and sector dummies D_j to control for highly sector-specific factors which probably influenced TFP growth and which cannot be captured by means of the labour policy control variables included in our analysis. For instance, unemployment protection, measured by replacement ratios and duration of unemployment benefits, should be included as determinants of TFP, but are omitted due to the lack of availability of time-varying data.

Lastly, we also control for the distance from the technological frontier by inserting the indicator mentioned in section 3.

$$\Delta \log TFP_{ijt} = -\alpha \log Rel\ TFP_{ijt-1} + \beta \Lambda_j EPL_{it-1} + \gamma \Lambda_j \Delta EPL_{it} + \delta PMR_{ijt-1} + \vartheta \Delta PMR_{ijt} + RD_{ijt} + D_{it} + D_{jt} + \varepsilon_{ijt} \quad (2)$$

The only difference in this second specification is the insertion of *log Rel TFP*, the distance from the technological frontier, and D_{it}, the sector by year dummies. This allows us to omit controlling for the growth rate of the industry productivity frontier, as reported in Bassanini et al. (2009).

It must be remarked that specific tests check both heteroscedasticity across panels and autocorrelation within panels. This is why we fitted a panel-data linear model by using the feasible generalized least squares method[4]. The results are shown below.

[3]This negative correlation (Spearman rank correlation -0.31) is not surprising. Indeed, the highest propensity to lay off regular workers in the UK is a consequence of the lowest protection against individual dismissals. This also explains the low recourse to temporary workers.

[4]All estimates were carried out by STATA 10. Routines adopted, preliminary and post-estimate tests are available upon request.

5.2 Econometric results

5.2.1 Effects of regulation of temporary workers

This subsection presents our main results. Table 3 lists the estimates for the baseline specifications testing the role of job protection for temporary and regular contracts (EPLT and EPLR) and their changes (ΔEPLT and Δ EPLR). As noted above, the effects of EPLT on total factor productivity growth were estimated by means of a difference-in-difference model on industry-level data, the assumption being that the effect of liberalisation policies for temporary jobs on TFP growth is greater in industries where the propensity to use temporary contracts ("policy-binding industries") is higher.

Analogously, we estimated the role of EPLR on TFP growth assuming that the effect of liberalisations of regular jobs is more important in industries where the layoff propensity is higher ("policy-binding industries") (see Bassanini et al., 2009).

The UK temporary contract rates or lay-off rates for each industry are thus used to proxy for the natural propensity of industries to make high recourse to numerical flexibility in labour arrangements.

Table 3 shows the positive influence that protection of fixed-term and temporary work agency (EPLT) exert on TFP growth: both variables, EPLT and Δ EPLT, induce increases in differences in TFP growth between the two sectors.

Let us now consider the role of EPLT. According to our estimates, one-point restriction on this legislation should increase by 0.10-0.12 percentage points the difference in TFP growth between two industries whose average propensity to employ temporary workers rate differs by 1 percentage point. Note that, even if the estimated effect for EPLT appears to be small, it is not negligible, since it depends both on the magnitude of change in the EPL indicator and on sectoral propensities to employ temporary workers. An interesting case in point is Italy, the country of our sample, which has made the most radical changes in relaxing temporary job provisions and at the same time recorded the worst performance in efficiency growth. Let us consider the case of two Italian industries: i) Financial Intermediation, Real Estate and Business Services and ii) Manufacturing. The first sector has shown higher use (an average difference around 2.40 percentage points over the period 1995-2007) of temporary contracts with respect to the other. According to our estimates, the difference in TFP annual growth between these two sectors would have increased by 0.24 percentage points in favour of the former for each easing of EPLT by 1 point. This also implies that, if from the mid-1990s Italy had not lowered restrictions for temporary contracts by 3.5 points, the difference in the cumulate growth rates of TFP between the same industries would be

10.9 percentage points higher in favour of Finance Real Estate and Business Services (instead of the differential rate of 3% actually obtained).

The underlying propensity to use temporary contracts and make workforce adjustments in the absence of EPLT regulation has been also proxied by industry-level UK lay-off rates – defined as the percentage ratio of annual redundancies to total employment – as done by Bassanini et al. (2009)[5]. Our results show that using lay-off rates is not a good choice for testing the role of EPLT, as revealed by the non-significant effect shown in our estimates (column 2), and our preferred specifications (see also other estimates reported below) include the share of temporary workers[6].

Our findings also signal no significant effects of restrictions for regular jobs and their changes, as seen from the non-significant coefficients for EPLR and ΔEPLR. Analogous non-significant effects are obtained for both the lay-off-based and temporary-based classifications of EPL-binding industries (columns 4 and 5). Controlling for EPLR, we further have checked our main results and have found that the estimated effect of EPLT is negative and significant and has approximately the same magnitude (see columns 4 and 5).

Lastly, the estimates of Table 3 have two important specific controls. Countries may be in different stages of their development and exposed to different demand dynamics; we thus inserted country-time dummies in all specifications, to take into account country-specific development and business cycle effects. In addition, we include sector dummies, since different industries may be in very different stages of their life-cycles and industry-specific effects must also be taken into account.

[5]The authors also use alternative indicators, such as turnover rates, which are more appropriate than lay-off rates to test the role of EPLT

[6] We also ran all specifications listed in Table 3 with interaction terms EPLT x Lay Off and Δ EPLT x Lay Off, but found that the coefficients were never significantly different from zero. All these results, not reported in Table 3 for reasons of space, are available upon request.

Table 3: TFP estimates for period 1995-2007, baseline specifications

Obs.	1670	1169	1670	1670	1670
Groups	140	140	140	140	140
Dependent Variable: TFP (growth rate)	**1**	**2**	**3**	**4**	**5**
Explanatory variables					
EPLT x Temporary Workers Share	0.103***		0.105***	0.120***	0.118***
	(0.026)		*(0.027)*	*(0.017)*	*(0.028)*
EPLT x Lay Off		0.009			
		(0.031)			
ΔEPLT x Temporary Workers Share				0.004**	0.004*
				(0.002)	*(0.002)*
EPLR x Lay Off			-0.022	-0.019	
			(0.063)	*(0.063)*	
ΔEPLR x Lay Off				0.011	
				(0.013)	
EPLR x Temporary Workers Share					-0.040
					(0.052)
ΔEPLR x Temporary Workers Share					-0.002
					(0.009)
Country -by-year dummies	Yes	Yes	Yes	Yes	Yes
Sector dummies	Yes	Yes	Yes	Yes	Yes
Wald chi2	663.17	391.75	659.77	669.61	676.75
Prob > chi2	0.00	0.00	0.00	0.00	0.00

Standard errors in parentheses.

*** significant at 1% level; ** significant at 5% level; *significant at 10% level

5.2.2 Robustness checks

Product market regulation and R&D may induce changes in TFP growth. As seen above, in our sample some sectors had better TFP performance than others, indicating that there are important product market characteristics which determine these outcomes. One probable candidate is the degree of competition, which varies across industries.

There is now a consensus view that product market regulation (PMR) has an autonomous effect on cross-industry productivity differences, since competition may boost innovation and growth. Two main channels can be identified to explain this causal link: i) competition stimulates incumbent companies to increase their TFP by adopting new technologies and innovations; ii) and favours a process of creative destruction generated by the entry of new innovators and exit of former innovators, as clearly shown in the new Schumpeterian approach proposed by Aghion and Griffith (2005).

Within the EU, regulatory reforms have never differed so greatly as in recent times, and the different pace of product market reforms may contribute towards explaining EU divergences in TFP. This point has been stressed by Nicoletti and Scarpetta (2003) in presenting OECD evidence for regulation and productivity growth. They signal that "regulatory policies diverged in relative

terms, with a widening variance of approaches across countries in the most recent period. Paradoxically, the recent divergence in policies is widest within the EU, despite efforts by the European Commission to harmonize the business environment in the Single Market."(p. 18). In addition, most of the regulatory reforms were driven by *sector-specific* easing of regulation.

Previous works have verified these hypotheses and estimated the role of product market regulation through cross-country studies. Among others, the study mentioned above, Nicoletti and Scarpetta (2003) tested the role of PMR on total factor productivity for a sample of 23 industries in 18 OECD countries over the period 1984-1998. They found that productivity growth was closely and positively linked to liberalisation of product markets, suggesting that limited regulatory reforms may contribute to explaining the poor performance of European countries, especially in sectors where Europe has accumulated a technology gap.

In our study, we also address the importance of sector-specific regulatory interventions by including time-varying measures of product market regulation (PMR) differentiated by sector. We also control for the role of changes in PMR to capture the role of modifications in competition in each industry by using the OECD indicator updated to 2007. Lastly, we include as sectoral covariates not only time-varying measures of product market regulation, but also by-sector R&D. The results are reported in Table 4.

Our results confirm the significant role played by the regulatory framework, since we find that TFP improves more in sectors where PMR is lower (column 1), which means that organisational improvements, captured by the residual measure TFP, are more likely to be adopted where firms are operating in competitive product markets. We also include changes in PMR and find that all these covariates have the expected negative sign, although they are not always significant.

The second sectoral covariate is R&D intensity (Table 4, columns 3 and 4). We expect, as clearly reported by Inklaar et al. (2008, p. 148-149), that many factors cause changes in TFP, including all computing errors due to the existence of unmeasured inputs.[7] Our estimates for R&D confirm this hypothesis. It is worth noting that, even with these controls, EPLT exerts a positive influence on TFP growth.

[7] A recent work documents the importance of computing intangible assets to obtain more precise estimates of TFP (Corrado et al., 2009). From their case-study on the the US non-farm business sector, the authors find that the average annual growth of total factor productivity for the period 1995-2003 falls from 1.42 to 1.08 when intangibles are included. They show that "On the input side, intangibles reached parity with tangible capital as a source of growth after 1995, and when the two are combined, capital deepening supplants MFP as the principal source of growth" (p. 683).

Table 4: TFP estimates for period 1995-2007, inclusion of PMR and R&D

Obs.	1670	1670	1471	1471
Groups	140	140	130	130
Dependent Variable: TFP (growth rate)	**1**	**2**	**3**	**4**
Explanatory variables				
EPLT x Temporary Workers Share	0.094***	0.114***	0.122***	0.141***
	(0.027)	*(0.028)*	*(0.031)*	*(0.019)*
ΔEPLT x Temporary Workers Share		0.004*		0.004*
		(0.002)		*(0.002)*
EPLR x Lay Off	-0.021	-0.018	-0.032	-0.012
	(0.062)	*(0.063)*	*(0.057)*	*(0.064)*
ΔEPLR x Lay Off		-0.008		0.002
		(0.013)		*(0.013)*
PMR	-0.024*	-0.015	-0.028*	-0.018
	(0.015)	*(0.015)*	*(0.016)*	*(0.016)*
ΔPMR		*-0.074***		*-0.088****
		(0.029)		*(0.028)*
R&D			0.266***	0.249***
			(0.006)	*(0.065)*
Country-by-time dummies	Yes	Yes	Yes	Yes
Sector dummies	Yes	Yes	Yes	Yes
Wald chi2	655.32	658.70	405.66	661.99
Prob > chi2	0.00	0.00	0.00	0.00

Standard errors in parentheses.

*** significant at 1% level; ** significant at 5% level; *significant at 10% level

5.2.3 Augmented model: the distance from the technological frontier and other controls

The final set of estimates includes the variable *Rel TFP*, which measures the distance from the technological frontier of a given industry and is defined as the difference between the log of TFP in industry *j*, country *i*, time *t,* and the log of TFP country leader in the same industry, at the same time. Hence, the country-industry having the maximum TFP among all sample countries in a given year is identified as the technological leader for that year. Catch-up implies that the country-sector is able to shorten the distance from the frontier and, according to this hypothesis, the expected sign for Rel TFP is negative. Our findings support the convergence hypothesis, as shown by the negative and significant coefficient for *Rel TFP* in all specifications (Table 5, panel A, columns 1-4).

Until now, we have tested the role of protection of regular workers, focussing only on firing costs for individual dismissals and obtaining their irrelevance on TFP growth. A robustness check has been performed by including, as done by Bassannini, Nunziata and Venn (2009), a refined indicator of EPLR which also takes collective dismissals into account[8]. Replacing EPLR with the new and more comprehensive indicator, the estimated effects for regulations on individual and collective

[8] This indicator is computed as the weighted average of EPLR (time-varying) and EPLC (in 1998) with weights 5/7 and 2/7.

dismissals remain non-significant, whereas temporary protection is still positive and significant (Table 5, Panel B).

These results appear to be robust to the last sensitivity test, performed by excluding the aggregate of 'Community, Social, Personal Services and No-Market Services' (Table 6, columns 1-4). The elimination of this sector, which includes government, health and education, is due to measurement problems, which make calculations of output and productivity highly problematic, thus justifying its exclusion, as done in similar analyses (see also EU KLEMS guidelines, 2007)[9]. Our findings, restricted to market economy, confirm significant and negative effects of EPLT: lower restrictions on temporary jobs have negative effects in industries of the market economy where, in the absence of regulations, firms tend to rely on short-term positions to make workforce changes.

[9] http://www.euklems.net/.

Table 5: TFP estimates – inclusion of distance from technological frontier

PANEL A (period 1995-2007)				
Obs.	1418	1418	1257	1257
Groups	119	119	111	111
Dependent Variable: TFP (growth rate)	**1**	**2**	**3**	**4**
Explanatory variables				
Rel TFP	-1.593***	-1.533***	-1.342***	-1.265***
	(0.385)	*(0.387)*	*(0.420)*	*(0.423)*
EPLT x Temporary Workers Share	0.076***	0.076***	0.106***	0.106***
	(0.028)	*(0.029)*	*(0.033)*	*(0.034)*
ΔEPLT x Temporary Workers Share		-0.000		-0.000
		(0.002)		*(0.003)*
EPLR x Lay Off	-0.006	-0.003	-0.008	0.003
	(0.058)	*(0.060)*	*(0.059)*	*(0.061)*
ΔEPLR x Lay Off		-0.007		0.000
		(0.012)		*(0.013)*
PMR	-0.091***	-0.085***	-0.104***	-0.095***
	(0.018)	*(0.018)*	*(0.020)*	*(0.020)*
ΔPMR		*-0.056**		*-0.072***
		(0.030)		*(0.030)*
R&D			0.226***	0.232***
			(0.076)	*(0.075)*
Country-by-Year dummies	Yes	Yes	Yes	Yes
Sector-by-Year dummies	Yes	Yes	Yes	Yes
Wald chi2	939.74	934.91	832.10	842.76
Prob > chi2	0.00	0.00	0.00	0.00
PANEL B (refined EPLR, period 1998-2007)				
Obs.	1061	1061	975	975
Groups	119	119	111	111
Dependent Variable: TFP (growth rate)	**1**	**2**	**3**	**4**
Explanatory variables				
Rel TFP	-1.328***	-1.276***	-1.396***	-1.331***
	(0.403)	*(0.406)*	*(0.459)*	*(0.460)*
EPLT x Temporary Workers Share	0.126***	0.124***	0.171***	0.167***
	(0.031)	*(0.031)*	*(0.034)*	*(0.035)*
ΔEPLT x Temporary Workers Share		-0.000		-0.001
		(0.003)		*(0.003)*
EPLR(individual and collective dismissals) x Lay Off	-0.013	-0.028	0.000	-0.010
	(0.083)	*(0.084)*	*(0.085)*	*(0.086)*
ΔEPLR(individual and collective dismissals) x Lay Off		-0.009		-0.014
		(0.019)		*(0.019)*
PMR	-0.046**	-0.041**	-0.052**	-0.048**
	(0.020)	*(0.020)*	*(0.021)*	*(0.021)*
ΔPMR		*-0.050**		*-0.058**
		(0.030)		*(0.031)*
R&D			0.186**	0.197**
			(0.086)	*(0.086)*
Country-by-Year dummies	Yes	Yes	Yes	Yes
Sector-by-Year dummies	Yes	Yes	Yes	Yes
Wald chi2	832.33	837.77	801.18	803.91
Prob > chi2	0.00	0.00	0.00	0.00

Standard errors in parentheses.

*** significant at 1% level; ** significant at 5% level; *significant at 10% level

Table 6: TFP estimates for period 1995-2007, inclusions of distance from – market economy

Obs.	1275	1275	1119	1119
Groups	107	107	99	99
Dependent Variable: TFP (growth rate)	**1**	**2**	**3**	**4**
Explanatory variables				
Rel TFP	-1.492***	-1.451***	-1.280***	-1.209***
	(0.398)	*(0.399)*	*(0.427)*	*(0.431)*
EPLT x Temporary Workers Share	0.084**	0.092**	0.126***	0.128***
	(0.034)	*(0.035)*	*(0.045)*	*(0.047)*
ΔEPLT x Temporary Workers Share		0.002		-0.0005
		(0.003)		*(0.004)*
EPLR x Lay Off	-0.009	-0.012	-0.016	-0.027
	(0.098)	*(0.102)*	*(0.099)*	*(0.103)*
ΔEPLR x Lay Off		0.012		0.013
		(0.020)		*(0.022)*
PMR	-0.096***	-0.088***	-0.106***	-0.097***
	(0.019)	*(0.018)*	*(0.022)*	*(0.022)*
ΔPMR		*-0.055**		*-0.071***
		(0.032)		*(0.032)*
R&D			0.198***	0.201***
			(0.080)	*(0.080)*
Country-by-Year dummies	Yes	Yes	Yes	Yes
Sector-by-Year dummies	Yes	Yes	Yes	Yes
Wald chi2	889.70	890.44	799.92	817.27
Prob > chi2	0.00	0.00	0.00	0.00

Standard errors in parentheses.

*** significant at 1% level; ** significant at 5% level; *significant at 10% level

Summing up, our results confirm the negative influence of liberalising fixed-term and temporary work employment, which probably tends to discourage training and the acquisition of firm-specific skills. These results are explained by the model formalized by Ricci and Waldmann (2010). In the context of a typical situation faced by young, newly hired workers in economies where workers are liquidity-constrained, those workers cannot afford the cost of training by accepting a wage cut – with the implicit promise of receiving some kind of training financed by the firm. In addition, under contract incompleteness, this promise is not enforceable and there will be hold-up problems, the consequence being that firms will train less than would be socially optimal. In such a situation, the introduction of a small (or a positive change in) firing tax for new hired workers would increase training and productivity. All our findings give support to these claims.

Conclusions

We find that, since 1995, EU countries have not followed homogenous patterns of growth, and further heterogeneity has been caused by sectoral diversities: between-sector gaps are crucial and the worst performances of total factor productivity are recorded in some service sectors.

We have analysed these country-sector disparities in 14 EU economies and then have focussed on some driving forces such as the stringency of employment protection of temporary jobs. Our empirical results suggest that liberalisation has had a detrimental influence on TFP, especially in sectors where firms are more used to opening short-term positions.

One interpretation of these findings is that low levels of employee protection, discouraging long-term relationships, do not offer incentives for workers to upgrade their skills and produce under training investments financed by firms. Our results, obtained including the sectoral dimension, show that, in industries where the propensity to use flexible labour arrangements is higher, labour deregulation may have perverse effects. In contrast, we find no evidence of significant effects of reforms concerning regular contracts for the years 1995-2007.

Our estimates also confirm the significant role played by the regulatory framework, since we find that TFP has improved more in sectors where PMR is lower, which means that organisational improvements, captured by the residual measure TFP, are more likely to be adopted where firms operate in competitive product markets. Expectedly, efficiency does accelerate with distance to the technological frontier.

These findings have been validated by various robustness checks. We have controlled for employment protection of regular workers, considering restrictions on individual and collective dismissals, and have used alternative indicators for the propensity to use flexible employment arrangements. Lastly, our regressions cover whole sectors, but are also restricted to the market economy, the growth accounting of which is affected by minor measurement problems.

Concerning policy implications, our first general consideration refers to the opposite effects which liberalisation of the labour and product markets have produced over the years 1995-2007, characterised by remarkable recourse in various EU economies to fixed-term contracts. For these years, unlike other studies focussing on the mid-1980s to the early 2000s, we have found that protection for regular workers did not play any significant role, whereas protection for temporary workers and pro-competitive product market policies did. In other words, deregulation of the product market probably plays a positive role in efficiency growth, whereas liberalisation of the labour market for temporary contracts negatively offsets this positive influence.

In addition, our results suggest that the scope of two-tier reforms seems to be limited, not only in terms of non-lasting employment growth (as shown in other studies, e.g., Boeri and Garibaldi, 2007), but also on efficiency grounds. Countries can reach the *same level* of aggregate labour flexibility, but they reach different TFP performance when they choose a different *composition* of regular and temporary restrictions. If firms in high-EPL countries can circumvent strict regulations by hiring workers for short-term jobs, they pay for this form of liberalisation in terms of poor TFP improvements.

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APPENDIX

TABLE A1: DESCRIPTION OF VARIABLES

TFP (growth rate)	Growth rate of Total Factor Productivity (sectoral-country data) Source: EU KLEMS database
EPLT	Employment Protection of Temporary Contracts. Source: OECD
Temporary workers share	Share of Temporary Contracts (fixed-term and temporary employment): sectoral-country data. Source: EUROSTAT
EPLR	Employment protection of regular workers against individual dismissal Source: OECD
EPLR (individual and collective dismissals)	Index of employment protection for regular contracts including additional provisions for collective dismissals: weighted average of EPLR and EPLC, with weights 5/7 and 2/7, respectively. Source: our elaborations of OECD indicators.
PMR	Product Market Regulation Source: OECD
R&D	Sectoral R&D expenses standardised to value added Source: EUROSTAT
Rel TFP	Difference between log of TFP in industry j, country I, time t, and log of European productivity frontier for that industry. frontier defined for each industry as country with highest level of TFP. Source: Our elaborations of EUKLEMS and OECD databases
Lay-off UK	Lay-off rates: UK Source: Quarterly Labour Force surveys, UK
Lay-off US	Lay-off rates: US CPS Displaced Workers Supplement, UK