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Exploring the Cross-country Inequality-Employment Trade-off. A Production Possibility Frontier Approach *

Abstract
Using a data-set of OECD countries from 1980 to 2009, we assess the cross-country evidence on the trade-off between wage inequality and labour-market performance. We lay stress on the possibility to achieve good performance without exacerbating wage inequality. We posit bad labour-market performance and inequality as two bad outcomes, and examine their trade-off using Data Envelopment Analysis. We attribute the variations in the rates of unemployment and non-employment to two components: the changes due to a variation in wage inequality along the inequality-employment trade-off and the changes in efficiency which simultaneously affect inequality and employment). We find that changes in efficiency are a fairly important component of total changes. In a second stage of the analysis, we draw some tentative relationships between efficiency and other features of the trade-off to product- and labour-market institutions.

Keywords
Labour-market performance, Wage inequality, Labour-market Institutions, DEA.

JEL Classification
E24, J08, J31.

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1. Introduction

During the 1980s, the labour-market performance of most European countries showed clear signs of worsening vis-à-vis the US. This situation was all the more surprising as it went against the experience of the previous two decades, when the US employment rate was consistently lower than that of most European countries. While some European countries have recently managed to improve their labour-market performance substantially, others appear to be still trapped at low employment rates. Also since the 1980s, wage inequality increased markedly in the US (and the UK), while the wage structure remained much more stable in most of continental Europe.

These diverging labour-market trends captured the attention of citizens and analysts from several countries. A "unified theory" (Blank, 1997) centred on labour-market rigidities in Europe emerged to explain both the increase in US wage inequality and the rise in European unemployment. Attention in Europe was drawn to strong unions, restrictive employment protection legislation, generous social-safety nets and large tax wedges (Layard et al., 1991). More specifically, Krugman (1994), argued that technological change and globalization had altered the skill distribution of labour income in favour of relatively skilled workers. Hence, low unemployment rates could only be maintained at the price of a rising skill gap in wages (like in the US and the UK).

Much has been written about these diverging trends, as well as about their recent evolution (Bertola et al., 2002; Nickell, 2003; Saint-Paul, 2004; Freeman, 2005; Checchi and Garcia Peñalosa, 2008). Widespread consensus has been difficult to reach., and recently, even amidst one of the most serious employment slumps of the last century, various authoritative commentators have singled out income inequality as a problem of the utmost importance for Western economies (including Italy). In this paper we want to deal jointly with the evolution of wage inequality and labour-market performance, analysing their determination in OECD countries since 1980.

First of all, we reassess the "unified theory" and find that, by itself, it does not provide a satisfactory explanation of trends in inequality and employment (Section 2). Then (in Section 3) we evaluate structural and institutional differences between the US and Europe. We concentrate on labour-market performance, but also extend our analysis beyond the labour markets. In Section 4 we propose an innovative research approach in order to shed light on the relationships between inequality and employment. We model them through Data Envelopment Analysis, a nonparametric technique usually employed in the analysis of productive efficiency. DEA allows for the simultaneous determination of inequality and employment and treats the potential trade-off between inequality and employment in a very flexible way. This will hopefully shed some light on the existence of institutional best-practices, and provide some information on the role of labour-market institutions. Data and main results are presented in Section 5. Some concluding remarks close the paper (Section 6).

2. Technological Change, Globalization and Inequality

There appears to be considerable evidence in numerous OECD countries that the relative wage of skilled workers has increased, along with a rise in their relative employment levels (OECD, 1997). The magnitude of these changes, however, varies significantly from one country to another. There have been large increases in wage inequality in the US and in the UK, while other countries (especially those in continental Europe) have had more stable wage structures.

In both the US and the EU, various studies provide evidence in favour of capital accumulation and technical change as the mainsprings of the skill upgrading that occurred in manufacturing during the 1980s. New technologies, embodied or disembodied in the capital stock, are skill-biased, either because of technological requirements or because of induced internal organizational changes in firms. Many papers (including, for the US, Bound and Johnson, 1992; Berman et al., 1994; and for several developed countries, Berman et al., 1998; Machin and Van Reenen, 1998) document the rising relative employment of skilled workers within industries despite rising relative skilled wages. Various papers (Krueger, 1993; Berman et al., 1994; Autor et al., 1998) illustrate the correlation between skill upgrading and measures of technological change such as computerization and expenditures on research and development. However, cross-country evidence suggests that the demand for skilled workers increased during the last twenty years much more than their supply in the US and the UK, but not in other countries for which appropriate data are available (Layard and Nickell, 1999).

The other oft-mentioned motive power of skill upgrading is the growth in international trade. Trade with countries having a comparative advantage in unskilled-labour-intensive production stimulates specialization in skill-intensive industries (between-industry effect). On the other hand, firms reorganize their activities by outsourcing to foreign countries (where labour is cheaper) the less skill-intensive tasks of production (a within-industry effect). The natural framework for analyzing the impact of trade on labour markets, at least from a maintained assumption of competitive markets, is the Stolper-Samuelson theorem and its various generalizations. Krugman (1995) concludes that the effect on unskilled wages in developed nations of plausible levels of increased trade with developing countries is small (but negative), and is swamped by other, positive effects. Leamer (1998) and Feenstra and Hanson (1999) extend this framework to incorporate technological change. Leamer concludes that technological change dominated price changes in the 1980s, while the reverse was true for the 1970s. Feenstra and Hanson find that only under assumptions of exogenous commodity prices and exogenous sector-specific wage differentials does outsourcing play a large role in generating wage inequality.

The conclusion that the impact of globalization on the rising skill premium is negligible may be sensitive, however, to the competitive-markets assumption. Studies allowing for imperfect competition generally find that increased trade has played some role in the deterioration of the relative wage of unskilled labour (Gaston and Nelson, 2000). Globalization is thought to have reduced union density and the bargaining power of trade unions, leading to higher wage inequality (OECD, 1997). We will come back to this point in Section 3.

Finally, most studies of the effect of immigration on wage inequality have found extremely small effects. Borjas (1994) concludes that there is no evidence that immigrants have had an adverse impact on the earnings and employment of native workers. This conclusion has been subsequently upheld by Borjas et al. (1997) and Friedberg (2001).

Let us now examine in greater detail the cross-country evidence on the evolution of wage dispersion. Each entry in Table 1 gives the average annual percentage change in the ratio of the average wage in the numerator decile to the average wage in the denominator decile for all full-time workers.

Table 1 – Wage Inequality in Upper and Lower Halves of the Distribution in the US and Selected European Countries; Annual Percentage Changes; 1979-2000

	9th decile / 1st decile	**9th decile / 5th decile**	**5th decile / 1st decile**
Austria	--	--	--
Belgium	--	--	--
Denmark	0.1	0.3	-0.2
Finland	-0.2	0.1	-0.4
France	-0.3	0.0	-0.3
West Germany	0.4	0.6	-0.2
Italy	0.8	1.4	-0.6
Netherlands	0.6	0.4	0.2
Norway	-0.4	0.3	-0.6
Portugal	--	--	--
Spain	--	--	--
Sweden	0.5	0.2	0.3
UK	0.7	0.6	0.1
US	1.0	0.7	0.3

Source: Glyn (2001)

Consider the second and third columns of Table 1, which decompose the change in overall wage dispersion into changes in upper-half (9-5) and lower-half (5-1) dispersion. It turns out that most of the increase in overall wage dispersion arises from changes in its upper half. This could imply some important role for labour market institutions.

The main argument here has been that the relative wages of less skilled workers are likely to fall if institutions that could prop up unskilled wages are less important in the some economies. This could also happen through time: union density in the UK now around 27%. It was as twice as high in 1979. In an important study, Layard and Nickell (1999) play down the role of institutions, but subsequent works (Koeniger et al. (2007; Checchi and Garcia Peñalosa, 2008) find different results. In particular, Koeniger et al. (2007) find that institutions account for a large part of the cross-country variation in wage inequality. EPL, unemployment benefit generosity and duration, union density and minimum wages reduce wage inequalities.

In an attempt at synthesis, Machin (2008) relates that falling unionisation has mattered in US and UK, and that, more generally, institution seem to be of relevance for the bottom part of the distribution, but of less relevance for the top. For instance, the introduction of national minimum wage to UK labour market in April 1999, has slowed down growth in 50-10 differential, especially for women (Dickens and Manning, 2004).

A different twist to the potential role for labour-market institutions has been given by Grabbing Hand Hypothesis (Atkinson and Piketty, 2010; Atkinson et al., 2011). This approach maintains that it is hard to account for observed variations with a marginal-product story. According to the unified theory, in the USA or UK today, the working rich get their marginal product (due to the impact of globalisation, as well as of some superstar effects). On the other hand, in Continental Europe today (and in the USA or UK of the 1970s), market prices for high skills are distorted downwards by labour-market institutions and social norms. However, we have very scant evidence on the marginal product of top executives; it could well be that shadow prices are distorted upwards. The grabbing hand model maintains that marginal products are unobservable. Top executives have an obvious incentive to convince shareholders and subordinates that they are worth a lot; there cannot be any market convergence because of constantly changing corporate and job structure (plus some switching costs). When pay setters set their own pay, there is no limit to rent extraction, unless perhaps quasi-confiscatory tax rates are set at the very top (the USA top tax rate (1m$+) in the 1932-1980 period was equal to 82%, with no more fringe benefits than today).

In any case, as pointed out by Atkinson (2003), the unified theory links technical change and globalization with reductions of relative wages in the lower half of wage distribution. A further distinctive conclusion of the unified theory is that unemployment remained fairly low for high-skilled workers, while it increased considerably for less-skilled groups. Krugman (1994) points to the rise in relative unemployment rates for unskilled workers in Europe. However, Nickell and Bell (1995) examine trends in relative unemployment rates by quartile in the skill distribution, and note that relative unemployment rates by skill show similar trends across industrialized countries and within the OECD. Further light on this issue can be shed by Table 2, where changes in the wage structure are considered in conjunction with changes in the *employment* distribution.

Table 2 – Labour-market Inequality in the US and Selected European Countries; Annual Percentage Changes; 1979-2000

	9th decile / 1st decile of the wage distribution		4th quartile – 1st quartile of the employment distribution	
	1980s	**1990s**	**1980s**	**1990s**
Austria	--	--	--	--
Belgium	--	--	--	--
Denmark	0.1		0.6	0.6
Finland	0.8	-1.3	0.5	0.9
France	0.3	-0.8	1.3	-0.4
West			0.6	0.6
Germany	-0.6	0.9		
Italy	-0.1	1.1	0.9	1.1
Netherlands	0.4	-0.6	0.4	-0.6
Norway	-0.4		0.5	0.5
Portugal	--	--	--	--
Spain	--	--	--	--
Sweden	0.3	1.3	-0.1	-0.6
UK	2.2	0.7	1.3	0.3
US	2.1	0.9	0.0	-0.2

Source: Glyn (2000)

If growing wage dispersion actually was the main influence upon the evolution of employment dispersion, there should be a negative relationship among changes in wage and in employment inequality. However, no significant correlation between these two variables emerges from Table 2, shedding much doubt on the unified theory argument that rising wage dispersion was the necessary price to pay for a high unskilled employment rate. We must conclude that there is more to trends in wage structures than implied by the unified theory. This evidence is supported by the more detailed comparisons carried out in Card et al. (1999) and in Freeman and Schettkat (2001a).

This has led to further refinements of the skill-biased technical change hypothesis, where the nature of jobs being done is taken more seriously (see e. g. Autor et al., 2003). Computer capital substitutes for workers performing cognitive and manual tasks that can be done just by following rules. Computer capital complements non-routine jobs and tasks that require problem solving and communication skills. This "task-biased technical change" can lead to a polarisation of the labour market. Demand shifts favour the skilled (doing nonroutine jobs), while routine non-manual tasks (e.g. clerical work) may be replaced by computers. On the other hand some non-routine tasks done by manual workers (like cleaning) are largely unaffected by IT (something reminiscent, in a different stratum of the labour market, of Baumol's disease).

This leads to rising employment at the opposite edges of the skill spectrum: polarization of the labour market.

In the following sections we explore in greater detail the role of institutions, considering some of the factors most often mentioned in the literature as contributing to poor labour-market performance in Europe, and probing more deeply the alleged relationship between wage inequality and labour-market performance.

3. Labour-market Institutions and Performance

A sizeable empirical literature is consistent with the view that unions raise wages and, in most OECD countries, trade unions are highly relevant in wage negotiations. As shown in Layard and Nickell (1999, p. 3041, Table 7), even if union density (the percentage of workers who belong to a trade union) is very low, union coverage (the percentage of workers covered by a collective agreement) can be substantial. A very important aspect of collective wage agreements is the extent to which unions and/or firms coordinate their actions. Coordination is distinct from centralization, which strictly identifies the most dominant level at which wages are negotiated, plant, firm, industry, or economy. Obviously, nationwide wage agreements must be highly coordinated, but highly coordinated bargaining need not be centralized. There are well-known and established country rankings of bargaining coordination and centralization (Layard and Nickell, 1999, p. 3041, Table 7, provide various indices of union and employers' coordination). Clear cross-country patterns do emerge: the Scandinavian countries and Austria have the most coordinated and centralized systems, followed by continental Europe and Japan. By contrast, Anglo-Saxon countries have largely non-coordinated systems, despite having appreciably higher levels of union density and coverage in general.

Wages set nationwide are more responsive to variations in aggregate labour-market conditions if wage agreements are highly coordinated. On the other hand, if wage agreements are less coordinated or less centralized, firm or industry wages are more responsive to specific shocks. It follows that highly coordinated or centralized wage agreements may compress the distribution of wages too much relative to the distribution of skills (OECD, 1997, Ch. 3, Table 3.B.1). A recent and complete survey (Aidt and Tzannatos, 2003, Ch. 5) concludes that, on the whole, coordinated bargaining provides better macroeconomic outcomes than decentralized bargaining. This is consistent with the results from wage equations estimated over recent samples, according to which real-wage flexibility is highest in continental Europe (Cadiou et al., 1999; Peeters and Den Reijer, 2003). Indeed these results even suggest that a significant *increase* in the degree of real-wage flexibility took place in countries (among which Italy and the Netherlands) where the use of incomes policies contributed to raise bargaining coordination. It thus appears that strong unions, when in conjunction with coordinated bargaining, can achieve a satisfactory labour-market performance with a stable wage structure. In this sense, the spontaneous move toward decentralization that has been characterizing European industrial relations in the last decade (Calmfors, 1999) should be evaluated with care. Channelling this evolution within the bounds of economy-wide coordinated bargaining seems a noteworthy policy priority.

Indeed, it appears that the improvement of the labour-market situation taking place in continental Europe up to the current recession was not been accompanied by a rise in inequality comparable to that experienced by the US and the UK. Acemoglu and Pischke (1998) and Agell (1999), among others, have suggested that, in the presence of market failures, a more compressed wage structure can be conducive to *lower* unemployment. In particular, according to Acemoglu and Pischke (1998, 1999a, 1999b) non-competitive labour markets, by compressing wage structure, encourage firms to invest in general workers' training.

Among the other factors believed to have hampered labour-market performance in continental Europe during the 1970s and the 1980s, generous social-safety nets are perhaps most often blamed. In the US, lifetime entitlements to cash assistance for employable nonworking adults were eliminated in August 1996. The Temporary Assistance to Needy Families (TANF) programme replaced the Aid to Families with Dependent Children (AFDC). However, many features (time limitations, work requirements, etc.) that ultimately became part of the federal law had already been introduced by a number of individual US states prior to 1996. Other notable changes in the US included the expansion of the Earned Income Tax Credit (EITC) in the early 1990s. As individual US states experimented with welfare-to-work programmes throughout the late 1980s and the 1990s, many of these policy measures were evaluated through randomized assessments. The resulting evidence points to the effectiveness of welfare-to-work programmes in reducing welfare costs and increasing labour supply (most of the evidence is summed up in Bloom and Michalopolous, 2001). The EITC proved in particular to be an effective policy measure also because, being tied into the tax system, it can be limited to low-wage workers in low-income families, rather than being extended to all low-wage workers.

Also within Europe, labour-market performance has improved following either the shortening of the unemployment-benefit entitlement period or the enforcement of a stricter entitlement test. The experience of welfare-to-work programmes in Northern European countries, assessed in de Koning et al. (2004), is particularly relevant in this respect. However, in Nordic countries (as opposed to the UK), this experience has not dented a commitment to income equality, which has been enacted not only through the fiscal system, but also through active labour-market policies and generous unemployment benefits (Fischer and Matthiessen, 2005). In the US the EITC came along with an increase in minimum wages, and, child-care assistance and the availability of health insurance to low-income families became more generous during the 1990s.

Several recent studies (including Prescott, 2004) argue that higher European income and payroll tax rates help explain why hours of work are significantly lower in Europe. However, the bulk of the empirical labour-supply literature suggests that tax rates can explain only a small part of this difference (Alesina et al., 2005). In Europe, an influential study by Daveri and Tabellini (2000) found that virtually all the rise in European equilibrium unemployment rates was to be ascribed to increasing payroll taxes. However, according to Layard and Nickell (1999), a reasonable estimate would imply that a 5% reduction in the tax wedge (including income, consumption and payroll taxes) lowers the unemployment rate from 8% to 7%. Nickell (2003) concludes that there is considerable uncertainty about the impact of these taxes on unemployment. Indeed, lower taxes (as well as weaker employment protection) are unlikely to bring about sizable reductions in the unemployment rate, especially if coordinated wage bargaining reduces real-wage resistance.

During the last two decades employment protection legislation has been extensively modified in most European countries. However this was not so much true within regular employment as in the field of temporary employment and fixed-term contracts. As a consequence, reforms in employment flexibility mostly consisted in favouring the development of non-standard forms of employment. Generally speaking, empirical support for an impact of strict labour-market regulations on labour-market performance appears to be weak. Since employment protection legislation reduces both job destruction and job creation, the relation between protection and unemployment is theoretically ambiguous. The existing evidence (OECD, 2002, 2004) suggests that stricter employment protection does not raise aggregate unemployment, while increasing the duration of unemployment and reducing worker turnover. There is some evidence that employment protection legislation lowers employment rates for youth and women, while increasing them for prime-age men. These relationships however fade away when allowance is made for various control variables. The same reasoning applies for temporary jobs, whose development equally favours both job creation and job destruction (Cahuc and Postel-Vinay, 2002). There is no consistent evidence either of an association between aggregate employment rates and the incidence of part-time work (Garibaldi and Mauro, 2002).

In order to fully account for diverging labour-market trends, we surmise that structural and institutional differences between the US and Europe should also be evaluated outside the labour market. This brings us to examine the role of industrial structure and the housing sector.

Services generally are less open to international competition, and this has strongly contributed to their faster employment growth. Naturally, the key question is what has stopped the reallocation of labour from declining to growing industries in EU countries? In this regard, it is interesting to consider the arguments by Hopenhayn and Rogerson (1993), Bertola (1994), and Saint-Paul (2002). According to them, strict employment protection laws either slow down labour reallocation from declining to expanding sectors or they encourage specialization in the production of declining-sector goods. Yet, as pointed out by Layard and Nickell (1999, p. 3063), these arguments apply only to the closure of old plants and the opening of new ones since, by just relying on quits, continuing firms can reduce employment by up to 10% per annum. Moreover, although these arguments may carry some weight, they do not address the structural differences between Europe and the US in the relative growth of the service sector.

An arguably more promising route focuses on economy-wide (screening procedures, tax-related requirements for start-ups) and sectoral regulations (zoning laws or restrictions on shop-opening hours). The stringency of entry regulations appears to be negatively associated with employment rates (Nicoletti et al., 2001) and entrepreneurial activity (Fonseca et al., 2001) across OECD countries. At the sectoral level, Bertrand and Kramarz (2002) find that entry regulation hinders job creation in the French retail sector.

In the presence of economy-wide entry regulations, the market price of services and rents in the economy increase, triggering a reduction in labour supply. This provides a rationale for the negative association between product-market regulations and the employment rate found in the literature, and is also consistent with the gap in the marketisation of service activities between the US and European economies found by Freeman and Schettkat (2001b). Accordingly, European households respond to tighter entry regulations by substituting away from the purchase of services in the market (child-care, home repairs and leisure activities) and towards home production while Americans, facing lower service prices, supply more hours of work purchasing equivalent services in the market. The simulations in Messina (2005a) show that economy-wide regulatory barriers to entry obstruct the natural pattern of structural change, hindering the development of those sectors whose demand is income elastic. Thus, countries with tighter restrictions on entry are expected to have a relatively underdeveloped service sector. This negative relationship persists even after controlling for a wide range of factors which might also shape cross-country differences in industrial structure (Messina, 2005b).

It could be asked whether after all a rise in wage inequality is a prerequisite for an increase in service employment. Iversen and Wren (1998) suggest that equality is likely to reduce employment growth in private consumer-oriented services, because productivity in these industries is low and slow-growing. Iversen and Wren find some empirical support for this proposition, but neither Kenworthy (2003) not Messina (2005b) are able to fully replicate these results. They find either weak or insignificant effects for wage inequality, once other explanatory variables are included in the estimates.

Barriers to geographical mobility are clearly an obstacle to the efficient functioning of the labour market. Layard and Nickell (1999, Table 13, p. 3047) provide convincing *prima facie* evidence that geographical mobility is lowest in southern Europe and highest in the US and the Scandinavian countries. Oswald (1997) suggests that home ownership is an important barrier to geographical mobility, as the propensity to move may be lower for homeowners, who have to liquidate their housing assets in a given locality to buy a new house elsewhere, thus facing sizeable transaction costs. If owning a house reduces geographical mobility, the consequences for the labour market of secularly rising homeownership could be profound. Could the rise in homeownership be part of the high European unemployment story? Levels of homeownership and unemployment rates are surprisingly highly correlated across countries and throughout time. Moreover, countries with the fastest growth in homeownership had the most rapid growth in unemployment (Oswald, 1997). Supportive evidence is also reported by Belot and Van Ours (2004), who carry out an empirical analysis for a panel of OECD countries.

4. The Empirical Approach

From the previous sections it clearly appears that wage inequality has various drivers (technical change, globalisation, social norms, …) which by no means should be thought of as mutually exclusive. It is however safe to say that labour market institutions have not been researched as intensely as the drivers. This is a bit strange, since they may be more policy-amenable. However, if we take labour market institutions seriously, we should allow for their simultaneous impact on wage inequality and (un)employment. Is there a trade-off between wage inequality and employment performance? Although the unified theory does not seem able to fully grasp the relationships between these variables, there seems to be some *prima facie* evidence on the existence of a trade-off between them. In order to see this, it is useful to start from Bertola (2004) who suggests to consider wage inequality and employment (or unemployment), *once fixed country- and common time effects are taken away from the data*. A trade-off then emerges, suggesting that in less regulated labour markets there is higher inequality, but less unemployment (or non-employment).

Fig. 1a. The Employment-Inequality Nexus (Bertola, 2004)

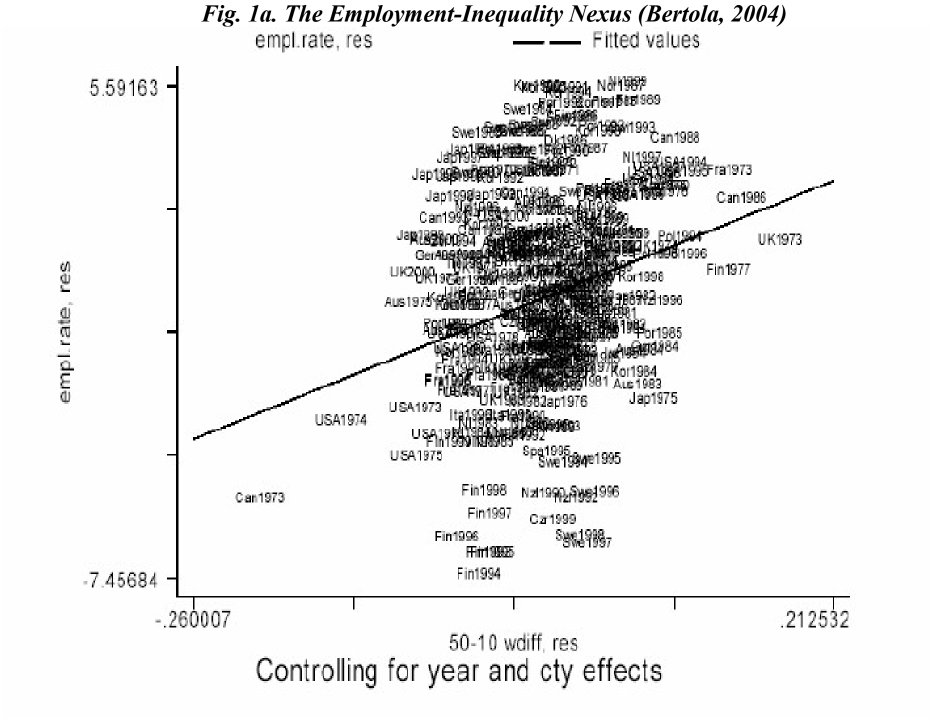
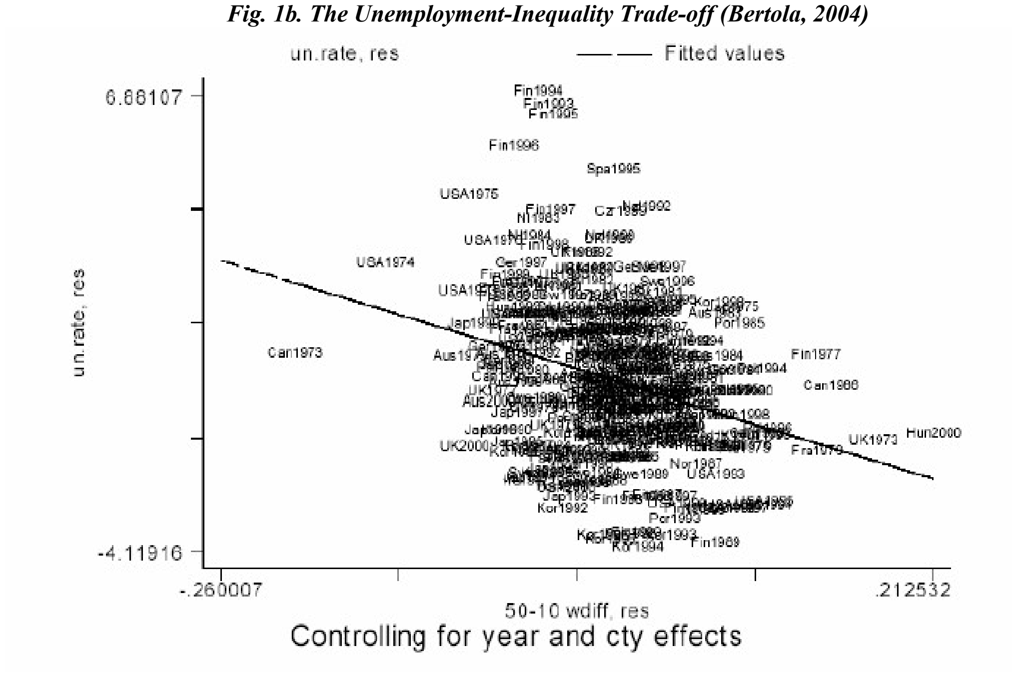


Fig. 1b. The Unemployment-Inequality Trade-off (Bertola, 2004)



Bertola (2004) is quick to point out thst the trade-off in Figs. 2a and 2b is not very steep, and that most of the employment performance is driven by country- and common time effects. Not only the the inequality-employment trade-off is rather flat, but there is very wide dispersion around the regression line (the R-squared is around 0.01).

Indeed, already in Bertola et al. (2002), it was found that increasing wage inequality by two standard deviations of the overall distribution increased the employment rate by some 4 percentage points only, and the unemployment rate by some 3 percentage points. Country and time effects mattered much more: together they explained over 80% of the variance of the unemployment rate, and some 45% of the variance of the employment rate.

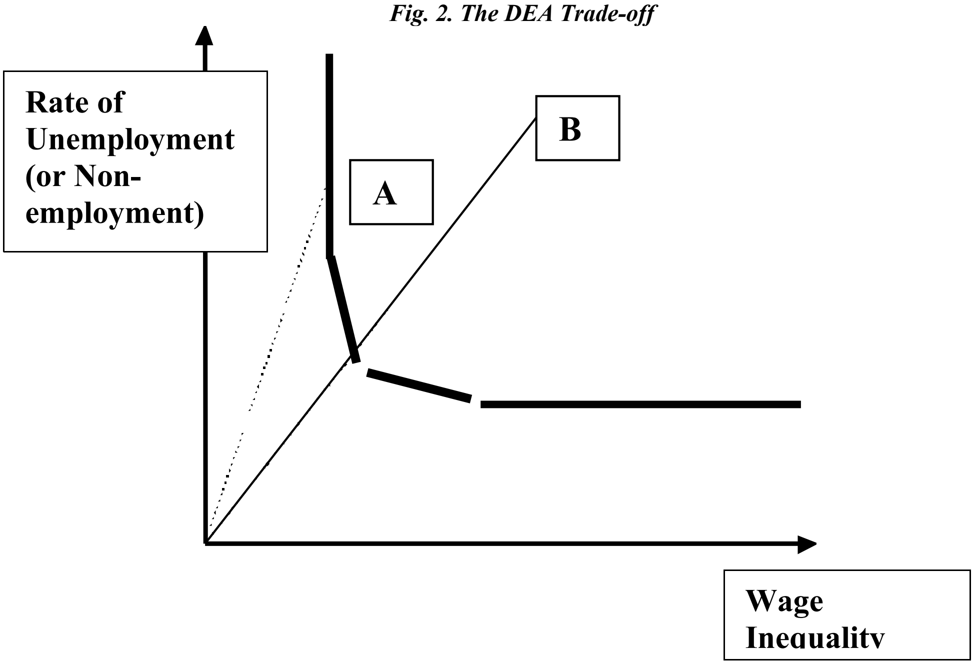
This suggests that moves not only along the tradeoff, but also toward-away from it, should be analysed. This should be done allowing great flexibility across time and countries, and affording as large a scope as possible for cross-country comparison with as few assumptions as possible about functional form and endogeneity. If possible, an explicit link should also be established between the determinants of the variability trade-off and the structural factors highlighted by the unified and alternative view.

In this paper, we follow this line of reasoning, comparing the progress in labour-market performance that can be bought at the price of higher inequality with efficiency gains that can profit both employment and equality. We lay stress on the possibility to achieve good performance without exacerbating wage inequality. We posit bad performance and inequality as two bads, and examine their trade-off relying on the non-parametric analysis of production frontiers.

More precisely, we apply frontier analysis to a production set where wage inequality and unemployment (or non-employment) are taken as inputs (they can be thought of as "bads"), *once allowance is made for fixed country- and common time effects*. In a second step of the analysis various indicators of supply-side structure are correlated with the technical efficiency scores (the distance from the frontier) and the ratio between the input shadow prices (the slope of the frontier, or marginal rate of substitution). The frontier is estimated through the non-parametric technique known as Data Envelopment Analysis, DEA: this technique easily deals with a multi-input multi-output set-up, does not incur in any simultaneity problems, and does not make any restrictive assumption about functional form (and then on the eventual interactions between the target variables and their exogenous determinants) in a field where usual functional forms provide little guidance. Also, the non-parametric approach easily allows for high behavioural heterogeneity (that is, in the trade-off) across time and countries. Within the non-parametric approach, DEA is to be preferred,[1] since we are highly interested in calculating shadow prices. Indeed, these shadow prices allow to assess empirically which is the relative weight policy-makers put upon the variability of inflation and of the level of activity. A graphical illustration of the DEA approach is provided in Fig. 2.

[1] A very thorough introduction to DEA is given in Cooper *et al*. (2000).

Fig. 2. The DEA Trade-off



Unit A (on the frontier) is efficient, while unit B is inefficient. Its distance from the frontier measures technical inefficiency. Formally, the postulates utilised to build the production possibility set $Z_{BCC}(Z°)$ are:

1. strong free input and output disposal;

2. convexity:

$$\forall \left(\mathbf{x}_i, \mathbf{y}_i\right) e \left(\mathbf{x}_j, \mathbf{y}_j\right) \in Z_{BCC}(Z^\circ),$$

$$\forall\ 0 \le \alpha \le 1, \quad \begin{pmatrix}\mathbf{x}\\ \mathbf{y}\end{pmatrix} = \alpha \begin{pmatrix}\mathbf{x}_i\\ \mathbf{y}_i\end{pmatrix} + (1-\alpha) \begin{pmatrix}\mathbf{x}_j\\ \mathbf{y}_j\end{pmatrix} \in Z_{BCC}(Z^\circ)$$

3. the vector 0 $\notin Z_{BCC}(Z°)$.

The production possibility set is defined by:

$$\hat{Z}_{DEA-V}(Z^\circ) = \{(x,y) \in R^{N+M} :$$

$$y \le \sum_{j=1}^{N} \gamma_j y_j;\ x \ge \sum_{j=1}^{N} \gamma_j x_j;\ \sum_{j=1}^{N} \gamma_j = 1;\ \gamma_j \ge 0,\ j = 1,\dots,N \}$$

and its frontier is characterised by variable returns to scale. The input-saving efficiency measure DF_I of the i-th observation, λ_i, is obtained from the input-oriented model B_{CCP}-I):[2]

$B_{CCP\text{-}I}$ (x_i, y_i):

$$\min_{\lambda_i,\ \gamma_j} \lambda_i \quad \text{s.t.}$$

$$y_{mi} \leq \sum_j \gamma_j \ y_{mj}, \qquad m = 1, ..., M$$

$$\lambda_i x_{ki} \geq \sum_j \gamma_j \ x_{kj}, \qquad k = 1, ..., K$$

$$\lambda_i \geq 0, \ \sum_j \lambda_j = 1, \quad j = 1, ..., N$$

Usually, observations are dominated by convex combinations of efficient observations situated on the frontier. The identification problem has been above formulated in its envelopment form. The dual expression, the multiplier form, is:

$$BCC_{D\text{-}I} \ (x_i, y_i):$$

$$\max_{\mu_i, \nu_i, \omega_i} \ \mu_i y_i + \omega_i \quad \text{s.t.}$$

$$\nu_i x_i = 1$$

$$\mu_i y_i - \nu_i x_i + \omega_i \leq 0$$

$$\mu_i \geq 0, \nu_i \geq 0$$

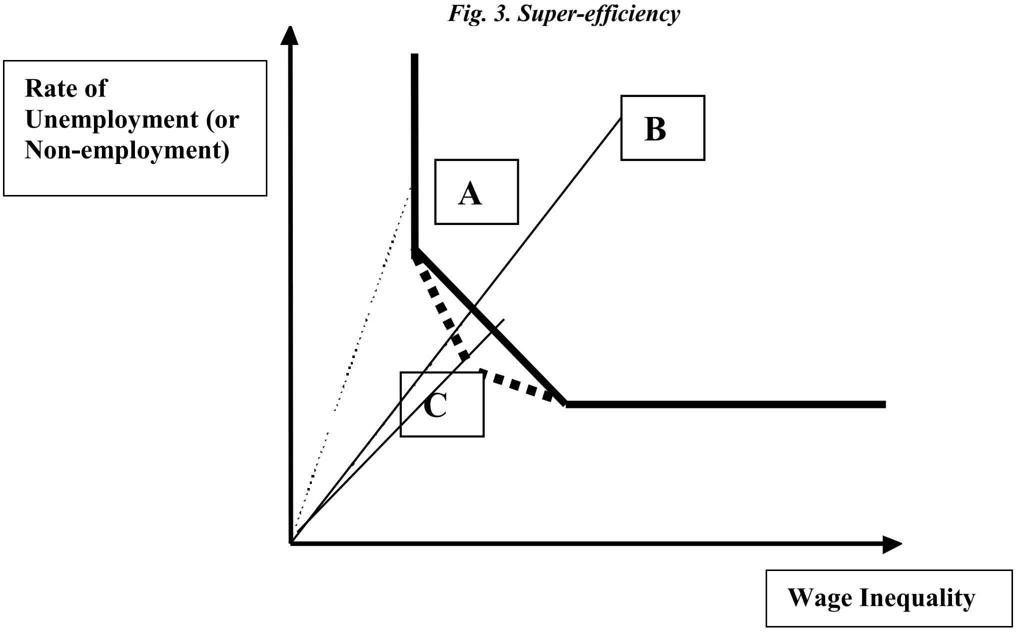
providing information on the shadow prices ν_i and μ_i; the ratios among the latter are the input and output marginal rates of substitution.

The main drawback of DEA is that it does not straightforwardly allow for stochastic noise in the data. A consequence of this is that DEA is very sensitive to the presence of outliers. The latter are particularly relevant if they are situated on the frontier of the production set. In order to ascertain their existence, we compute for all efficient observations the so-called super-efficiency scores – indicating the maximum radial contraction consistent with the observation remaining efficient (see for instance unit C in Fig. 3). Super-efficiency scores greater than 1.5 are likely to be associated with an outlier. In this case one must decide whether the efficiency scores must be recalculated excluding such an observation from the production set. In taking this decision it

[2] Formally, an output-oriented model can be set up, and output-increasing efficiency measures obtained. However, in the present context we need be interested only in the input-oriented model.

is useful to consider Tørgensen' rho (Tørgersen et al., 1996) which measures the importance of a reference unit for the efficiency potential of the inefficient units. A high (>0.10-0.15) value of the rho indicates that an efficient observation is important as a benchmark for other observations. Hence a combination of high super-efficiency scores and rho's singles out outliers that should be excluded from the production set.

Fig. 3. Super-efficiency



5. ***Data and Results***

The empirical application here provided relates to the measurement of labour-market performance during the 1980-2009 period in a sample of 21 OECD countries. Data about wage inequality are taken from the OECD database on Trends in Earnings Dispersion. Data on unemployment, employment, labour force and population are taken from the AMECO Eurostat database. Data about supply-side structure and institutions are mainly taken from Nickell (2006) with some interpolations from OECD sources.

We use a pooled sample. Changes in the "state of technology" can be tested through the significance of time (either pulse or shift) dummies. We consider four different "production sets". Output is simply taken to be the management service provided by the countries' helmsmen. Under some simple assumptions this implies that the output vector collapses to a scalar of value one for every country in every year. Inputs (or "bads") are respectively:

SET 1: rate of unemployment, ratio of the average wage in the 9th decile to the average wage in the 1st decile for all full-time workers.

SET 2: rate of non-employment (1 – civilian employment/working age population), ratio of the average wage in the 9th decile to the average wage in the 1st decile for all full-time workers.

SET 3: rate of unemployment, ratio of the average wage in the 5th decile to the average wage in the 1st decile for male full-time workers.

SET 4: rate of non-employment (1 – civilian employment/working age population), ratio of the average wage in the 5th decile to the average wage in the 1st decile for male full-time workers.

Using both the rates of unemployment and non-employment is justified mainly on the grounds of getting more robust evidence. If results were to widely diverge across these two measures, we would probably conclude that there is some unaccounted heterogeneity in the estimates. On the other hand, the previous discussion has made it clear that it could be interesting to contrast traditional measures of wage dispersion with measures more narrowly focused on the lower end of the wage distribution (5th decile to 1st decile).

In order to minimise the impact of stochastic noise, we smooth all time series (country by country) using the Extended Exponential Smoothing technique suggested in Mohr (2005), which has better end-of-sample properties than the Hodrick-Prescott filter. As was clarified in Section 4, our input variables are first regressed on a set of common time (year) and country dummies. Then, DEA is applied on the residuals from those regressions. Computation of the super-efficiency scores makes it quite apparent that sets 1-4 contain some outliers, which are detailed in Table 3.

Table 3 – Anomalous observations

SET 1	SET 2	SET 3	SET 4
Ireland 1999	Ireland 1998	Ireland 2000	Ireland 1998
Spain 2000	Ireland 1999	Spain 2002	Ireland 1999
Spain 2002	Ireland 2000	Spain 2003	Ireland 2000
Spain 2003	Spain 2002	Switzerland 2003	Spain 2002
Spain 2009	Spain 2003	Switzerland 2004	Spain 2003
USA 1980	Spain 2009	USA 1980	Spain 2009
USA 1981	USA 1980		Switzerland 2003
USA 1982	USA 1981		Switzerland 2004
	USA 1982		USA 1980

There is clearly a pattern in the presence of outliers, which are concentrated in four countries and in given years. We decide then that it is best to exclude them from the subsequent analysis. We report in the Appendix the main results.

In Tables A.1 and A.2 we respectively give the fixed country-effects for efficiency scores and marginal rates of substitution between un- or non-employment and wage inequality. We find significant cross-country differences in both variables. However, as shown in Table A.3, marginal rates of substitution tend to gather in all sets around a high and a low value. Indeed, the DEA frontiers are characterised by few changes in slope.

In Tables A.4 and A.5 we proceed to attribute the (absolute) variations in the rates of unemployment and non-employment in our sample to two components: the changes due to a variation in wage inequality along the frontier (and then attributable to the inequality-employment trade-off) and the changes in efficiency (which simultaneously affect inequality and employment). We find that changes in efficiency are a fairly important component of total predicted changes. We hence conclude that neglecting them potentially clouds the analysis of labour-market performance. Note that, although the differences between actual and predicted changes (the residuals) are sometimes very large, they obey to roughly symmetrical distributions, thus showing the lack of systematic bias in our analysis.

Finally, in Tables A.6-A.9 we explore the relationships between the efficiency scores, the marginal rates of substitution and various indicators of supply-side structure. From Table A.6 it turns out that high marginal rates of substitution (associated to relatively low inequality and employment) are rather consistently associated to low employment protection legislation, lack of coordination and high union density and tax rates. Table A.7 takes advantage of the distribution of marginal rates of substitution mainly around two values in order to repeat the former exercise in a logit framework. Very similar results emerge. High marginal rates of substitution are associated to low employment legislation, lack of coordination and high union density and tax rates,as well as with high benefit replacement ratio and low home ownership. Most of these signs agree with received wisdom. However, it is not immediately clear why low inequality and employment should be associated with low employment protection and home ownership.

Table A.8 highlights that, if anything, a negative relationship exists between high marginal rates and efficiency. The explanation of the latter is considered in Table A.9. Higher efficiency is associated with higher employment protection legislation, union coverage and bargaining coordination and with lower taxation rates. There is also some positive correlation between benefit replacement ratio and duration and efficiency.

All in all, the results from Tables A.6-A.9 are not immediately understandable. Certainly they do not endorse the unified view, but neither do they fully support an alternative view stressing the role of factors outside the labour market. Arguably a richer set of covariates (also including indexes of demographic and industrial composition) should be considered before drawing policy conclusions from this kind of exercise.

6. Concluding Remarks

In the early 1990s a "unified theory" centred on labour-market rigidities in Europe emerged to explain both the increase in US wage inequality and the rise in European unemployment. After more than ten years, it turns out that matters are not that simple, the trade-off between inequality and labour-market performance proving to be rather elusive. After considering in some detail various factors mentioned in the literature, we try to shed light on this issue adopting a relatively novel approach.

We assess the cross-country evidence on the trade-off between wage inequality and employment performance by relying on Data Envelopment Analysis, a nonparametric technique usually employed in the analysis of productive efficiency. Using DEA allows for the simultaneous determination of inequality and employment, assesses the potential trade-off between inequality and employment in a very flexible way, and is to a great extent robust with respect the potential endogeneity of some institutional variables (social safety nets, etc.). We consider a data-set of OECD countries from 1980 to 2009.

Our main findings can be summed up as follows. We attribute the variations in the rates of unemployment and non-employment to two components: the changes due to a variation in wage inequality along the inequality-employment trade-off and the changes in efficiency which simultaneously affect inequality and employment). We find that changes in efficiency are a fairly important component of total changes. Neglecting them is then likely to bias the analysis of labour-market performance. We also explore the relationships between the efficiency scores, the marginal rates of substitution and various indicators of supply-side structure, but do not find wholly understandable results.

In future work we would like to complement the filtering of fixed country- and common time effects before the application of the DEA with some explicit allowance for the business cycle and the inequality drivers discussed in the literature (technical change, globalisation, social norms, …). We would also like to take into account the possible relationships of labour-market polarisation with the inequality-employment trade-off. At any rate, a richer set of covariates (also including indexes of social norms, and of demographic and industrial composition) should be considered before drawing appropriate policy conclusions from this kind of exercise.

Appendix

TABLE A.1 – Efficiency Scores: Country Effects (*full regression given in table A.9****)***

	SET 1	SET 2	SET 3	SET 4
Australia	0.61	0.66	0.55	0.68
Austria	0.59	0.67	0.53	0.69
Belgium	0.65	0.68	0.60	0.74
Canada	0.65	0.72	0.60	0.77
Denmark	0.63	0.68	0.57	0.79
Finland	0.72	0.76	0.68	0.76
France	0.64	0.69	0.57	0.69
Germany	0.63	0.66	0.63	0.74
Greece	0.54	0.58	0.56	0.65
Ireland	0.52	0.60	0.56	0.67
Italy	0.59	0.64	0.53	0.67
Japan	0.65	0.71	0.56	0.71
Netherlands	0.62	0.67	0.62	0.72
New Zealand	0.64	0.68	0.56	0.68
Norway	0.64	0.64	--	--
Portugal	0.71	0.73	0.53	0.65
Spain	0.57	0.60	0.66	0.71
Sweden	0.70	0.70	0.69	0.64
Switzerland	0.76	0.66	0.52	0.72
UK	0.62	0.70	0.53	0.69
USA	0.60	0.68	0.56	0.67

TABLE A.2 – Marg. Rates of Substitution: Country Effects (*full regression given in table A.6****)***

	SET 1	SET 2	SET 3	SET 4
Australia	57.13	18.31	115.36	67.98
Austria	53.24	10.21	106.81	66.05
Belgium	50.54	0.81	100.92	15.85
Canada	50.78	0.60	103.61	36.75
Denmark	57.13	24.44	104.87	78.49
Finland	31.63	22.61	51.36	75.79
France	48.07	19.84	93.18	46.54
Germany	55.17	20.56	85.33	26.15
Greece	46.40	17.81	65.99	34.66
Ireland	44.20	18.31	74.35	54.39
Italy	56.91	10.21	113.61	246.59
Japan	58.90	0.81	115.36	86.92
Netherlands	43.84	0.60	64.93	57.26
New Zealand	49.96	24.44	95.89	51.24
Norway	51.22	22.61	--	--
Portugal	36.12	19.84	29.28	21.37
Spain	21.47	20.56	65.14	156.76
Sweden	31.86	21.37	31.87	60.83
Switzerland	12.83	20.54	124.82	90.97
UK	57.13	16.77	77.37	154.91
USA	35.26	12.84	74.35	51.04

TABLE A.3 – High and Low Marginal Rates of Substitution: Group Medians

SET 1

		Freq.	Percent
Low values (median)	**10.61**	59	17.61
High values (median)	**67.85**	276	82.39
N. obs		363	

SET 2

		Freq.	Percent
Low values (median)	**7.29**	205	61.38
High values (median)	**45.60**	130	38.62
N. obs		354	

SET 3

		Freq.	Percent
Low values (median)	**24.17**	66	21.15
High values (median)	**135.03**	246	78.85
N. obs		377	

SET 4

		Freq.	Percent
Low values (median)	**20.39**	217	70
High values (median)	**109.70**	93	30
N. obs		373	

TABLE A.4 –The Variations in the Rates of Unemployment and Non-Employment: the Inequality Trade-off and Changes in Efficiency – Sets 1 and 2

country	9th decile / 1st decile W -ratio (abs. changes)	Rate of Non-Employment (abs. changes) **Actual (0)**	Efficiency - **set 1** (perc. changes)	Rate of Non-Employment (abs. changes) **due toTrade-off (1)**	Rate of Non-Employment (abs. changes) **due to Eff. Changes (2)**	Rate of Non-Employment (abs. changes) **Predicted (1+2)**	Rate of Non-Employment (abs. changes) **Residual (0)-(1+2)**
Australia	0.00	-0.76	0.07	-0.11	-0.61	-0.72	-0.04
Austria	0.06	-5.32	0.19	-3.59	-1.94	-5.53	0.21
Belgium	0.00	0.47	-0.08	-0.16	0.68	0.52	-0.05
Canada	0.02	-1.33	-0.04	-1.08	0.35	-0.73	-0.60
Denmark	0.01	1.83	-0.27	-0.71	2.43	1.71	0.12
Finland	-0.19	8.02	0.08	7.87	-0.31	7.56	0.46
France	-0.13	3.79	0.28	7.89	-1.26	6.63	-2.84
Germany	-0.01	-2.98	0.54	0.45	-4.57	-4.12	1.13
Greece	0.00	-1.04	0.06	-0.33	-0.46	-0.80	-0.25
Ireland	-0.30	-7.05	1.70	17.79	-14.13	3.65	-10.70
Italy	-0.03	3.50	-0.08	1.83	0.53	2.36	1.14
Japan	-0.08	0.78	0.94	5.36	-8.88	-3.52	4.30
Netherlands	0.33	-9.51	0.60	-17.54	-5.13	-22.68	13.17
New Zlnd	-0.02	4.77	-0.53	1.05	2.26	3.31	1.46
Norway	0.00	1.75	-0.19	0.04	0.85	0.89	0.86
Portugal	0.03	0.87	-0.38	-1.68	4.03	2.35	-1.48
Spain	-0.24	-9.92	1.81	7.22	-18.63	-11.41	1.50
Sweden	-0.14	10.79	-0.33	5.83	1.20	7.02	3.76
Switzerland	-0.01	2.90	-0.36	0.41	3.91	4.33	-1.43
UK	0.03	0.60	-0.33	-2.03	2.62	0.59	0.01
USA	0.16	-1.17	-0.55	-8.22	6.41	-1.81	0.64
MEDIAN	*0.00*	***0.60***	*-0.04*	***0.04***	***0.35***	***0.59***	***0.21***
MEAN	*-0.02*	***0.05***	*0.15*	***0.97***	***-1.46***	***-0.49***	***0.54***

country	9th decile / 1st decile W-ratio (abs. changes)	Rate of Un-Employment (abs. changes) **Actual** **(0)**	Efficiency - **set 2** (perc. changes)	Rate of Un-Employment (abs. changes) **due toTrade-off** **(1)**	Rate of Un-Employment (abs. changes) **due to Eff. Changes** **(2)**	Rate of Un-Employment (abs. changes) **Predicted** **(1+2)**	Rate of Un-Employment (abs. changes) **Residual** **(0)-(1+2)**
Australia	0.00	-1.34	0.17	-0.04	-1.14	-1.18	-0.16
Austria	0.06	-0.56	0.06	-0.74	-0.34	-1.08	0.52
Belgium	0.00	-0.04	-0.03	-0.02	0.20	0.18	-0.22
Canada	0.02	-0.10	-0.03	-0.12	0.14	0.03	-0.13
Denmark	0.01	-2.13	-0.06	-0.30	0.48	0.18	-2.31
Finland	-0.19	2.56	0.15	5.00	-0.70	4.30	-1.74
France	-0.13	1.93	0.18	3.24	-0.96	2.28	-0.35
Germany	-0.01	3.55	0.06	0.17	-0.46	-0.29	3.83
Greece	0.00	-0.53	0.04	-0.22	-0.31	-0.54	0.01
Ireland	-0.30	-6.56	1.02	2.16	-5.54	-3.38	-3.18
Italy	-0.03	1.24	-0.07	0.39	0.59	0.98	0.26
Japan	-0.08	2.01	0.67	6.60	-4.88	1.72	0.29
Netherlands	0.33	-5.89	0.30	-9.42	-2.61	-12.03	6.14
New Zlnd	-0.02	0.91	-0.33	0.46	1.60	2.06	-1.15
Norway	0.00	1.43	-0.19	0.00	0.99	0.99	0.44
Portugal	0.03	1.54	-0.34	-0.82	3.01	2.19	-0.65
Spain	-0.24	-5.24	1.27	1.78	-9.22	-7.43	2.19
Sweden	-0.14	2.16	-0.15	3.51	0.88	4.39	-2.23
Switzerland	-0.01	3.00	-0.33	0.40	2.83	3.23	-0.23
UK	0.03	-3.34	-0.01	-0.63	0.10	-0.53	-2.82
USA	0.16	-3.02	-0.42	-3.47	4.17	0.70	-3.72
MEDIAN	*0.00*	***-0.04***	*-0.01*	***0.00***	***0.10***	***0.18***	***-0.22***
MEAN	*-0.02*	***-0.40***	*0.09*	***0.38***	***-0.53***	***-0.15***	***-0.25***

TABLE A.5 –The Variations in the Rates of Unemployment and Non-Employment: the Inequality Trade-off and Changes in Efficiency – Sets 3 and 4

country	5th decile / 1st decile W -ratio (abs. changes)	Rate of Non-Employment (abs. changes) **Actual** **(0)**	Efficiency - **set 3** (perc. changes)	Rate of Non-Employment (abs. changes) **due toTrade-off** **(1)**	Rate of Non-Employment (abs. changes) **due to Eff. Changes** **(2)**	Rate of Non-Employment (abs. changes) **Predicted** **(1+2)**	Rate of Non-Employment (abs. changes) **Residual** **(0)-(1+2)**
Australia	0.00	-0.76	0.01	-0.38	-0.08	-0.46	-0.30
Austria	0.03	-5.32	0.35	-3.05	-2.50	-5.54	0.22
Belgium	0.01	0.47	-0.24	-1.01	1.88	0.87	-0.40
Canada	-0.01	-1.33	0.47	0.91	-4.17	-3.26	1.93
Denmark	0.01	2.21	-0.35	-1.05	1.99	0.94	1.27
Finland	-0.07	8.02	-0.21	18.92	0.76	19.68	-11.66
France	-0.06	3.79	0.08	6.24	-0.35	5.88	-2.09
Germany	0.05	-2.98	-0.31	-5.90	2.62	-3.28	0.30
Greece	-0.02	-1.04	0.04	3.05	-0.34	2.71	-3.75
Ireland	-0.07	-7.05	1.40	6.23	-11.60	-5.37	-1.68
Italy	-0.04	3.50	0.09	4.74	-0.64	4.09	-0.59
Japan	-0.01	0.78	0.62	1.30	-5.80	-4.50	5.28
Netherlands	0.20	-13.25	0.35	-52.54	-1.93	-54.48	41.23
New Zlnd	0.03	4.77	-0.56	-4.05	2.38	-1.67	6.44
Portugal	-0.04	0.87	0.50	3.27	-1.78	1.49	-0.61
Spain	-0.10	-9.92	2.01	4.48	-21.21	-16.73	6.81
Sweden	0.00	10.79	-0.44	0.16	1.58	1.74	9.04
Switzerland	-0.12	2.90	0.63	8.07	-6.95	1.12	1.78
UK	0.02	0.60	-0.53	-3.16	4.22	1.07	-0.47
USA	-0.06	-1.17	-0.48	6.17	5.62	11.78	-12.95
MEDIAN	*-0.01*	***0.53***	*0.06*	***1.10***	***-0.35***	***0.91***	***-0.04***
MEAN	*-0.01*	***-0.21***	*0.17*	***-0.38***	***-1.82***	***-2.20***	***1.99***

country	5th decile / 1st decile W-ratio (abs. changes)	Rate of Un-Employment (abs. changes) **Actual** **(0)**	Efficiency - **set 4** (perc. changes)	Rate of Un-Employment (abs. changes) **due toTrade-off** **(1)**	Rate of Un-Employment (abs. changes) **due to Eff. Changes** **(2)**	Rate of Un-Employment (abs. changes) **Predicted** **(1+2)**	Rate of Un-Employment (abs. changes) **Residual** **(0)-(1+2)**
Australia	0.00	-1.34	0.14	-0.73	-0.93	-1.66	0.32
Austria	0.03	-0.56	0.09	-0.03	-0.60	-0.63	0.07
Belgium	0.01	-0.04	-0.12	-0.91	0.74	-0.17	0.13
Canada	-0.01	-0.10	0.20	0.70	-1.19	-0.49	0.39
Denmark	0.01	0.95	-0.25	-0.56	1.44	0.89	0.06
Finland	-0.07	2.56	-0.10	5.61	0.48	6.10	-3.54
France	-0.06	1.93	0.04	3.95	-0.22	3.73	-1.80
Germany	0.05	3.55	-0.46	-1.79	3.32	1.52	2.02
Greece	-0.02	-0.53	0.03	0.46	-0.19	0.27	-0.80
Ireland	-0.07	-6.56	0.85	2.06	-4.65	-2.59	-3.97
Italy	-0.04	1.24	0.04	1.41	-0.31	1.10	0.15
Japan	-0.01	2.01	0.49	1.31	-3.53	-2.22	4.23
Netherlands	0.20	-4.61	-0.03	-10.31	0.15	-10.16	5.55
New Zlnd	0.03	0.91	-0.35	-3.07	1.71	-1.36	2.27
Portugal	-0.04	1.54	0.27	3.96	-1.22	2.74	-1.20
Spain	-0.10	-5.24	1.37	2.63	-10.39	-7.75	2.51
Sweden	0.00	2.16	-0.22	0.68	1.24	1.92	0.24
Switzerland	-0.12	3.00	0.60	7.73	-5.16	2.57	0.43
UK	0.02	-3.34	-0.20	-6.55	1.49	-5.06	1.72
USA	-0.06	-3.02	-0.36	1.52	3.58	5.10	-8.12
MEDIAN	*-0.01*	***0.44***	*0.03*	***0.69***	***-0.21***	***0.05***	***0.19***
MEAN	*-0.01*	***-0.27***	*0.10*	***0.40***	***-0.71***	***-0.31***	***0.03***

TABLE A.6 – Marginal Rates of Substitution: the Regression Evidence (OLS)

	SET 1		SET 2		SET 3		SET 4	
Regressor	Coef.	T-ratio	Coef.	T-ratio	Coef.	T-ratio	Coef.	T-ratio
y81	0,00	*0,00*	0,00	*0,00*	-1,19	*-0,07*	18,01	1,17
y82	-0,92	*-0,10*	0,00	*0,00*	-2,58	*-0,14*	18,95	0,11
y83	2,68	*0,30*	3,28	*0,43*	6,27	*0,33*	18,95	0,12
y84	4,59	*0,52*	0,37	*0,05*	-4,17	*-0,21*	24,72	0,16
y85	4,78	*0,54*	3,57	*0,49*	6,48	*0,33*	27,30	0,19
y86	9,31	*1,29*	2,52	*0,36*	7,75	*0,43*	33,83	0,23
y87	9,47	*1,32*	3,08	*0,43*	20,12	*1,42*	35,23	0,25
y88	10,10	*1,40*	8,98	*1,21*	24,12	*1,74*	42,97	0,30
y89	10,10	*1,39*	3,08	*0,41*	24,12	*1,73*	42,97	0,30
y90	10,10	*1,38*	0,14	*0,02*	24,12	*1,70*	42,97	0,29
y91	17,40	*2,40*	-3,55	*-0,59*	30,20	*1,82*	47,43	0,32
y92	13,49	*1,75*	-0,82	*-0,13*	30,20	*1,89*	54,30	0,37
y93	9,58	*1,20*	4,66	*0,74*	15,68	*0,91*	61,17	0,41
y94	6,53	*0,79*	7,53	*1,07*	20,48	*1,20*	82,11	0,52
y95	11,76	*1,34*	10,73	*1,53*	18,78	*1,20*	46,71	1,19
y96	12,47	*1,52*	10,73	*1,62*	20,02	*1,30*	43,08	1,16
y97	16,53	*2,03*	8,62	*1,36*	20,10	*1,28*	79,83	0,51
y98	16,17	*1,98*	6,02	*0,97*	26,65	*1,68*	66,60	0,43
y99	15,78	*1,95*	6,05	*0,99*	36,31	*2,33*	70,52	0,46
y00	15,94	*2,23*	2,50	*0,39*	33,88	*2,15*	57,80	0,38
y01	16,93	*2,36*	6,10	*0,95*	30,17	*1,93*	53,92	0,35
y02	18,45	*2,57*	6,05	*0,94*	32,69	*2,04*	41,19	0,27
y03	18,76	*2,60*	14,69	*0,95*	35,79	*2,28*	40,96	0,26
y04	18,00	*2,26*	3,90	*0,59*	35,79	*2,32*	40,96	0,26
y05	18,09	*2,15*	10,30	*0,65*	38,09	*2,39*	37,98	0,24
y06	18,19	*2,06*	4,47	*0,40*	38,97	*2,49*	35,17	0,22
y07	18,14	*1,92*	7,65	*0,37*	40,89	*2,59*	33,15	0,20
y08	18,07	*1,78*	3,77	*0,17*	41,96	*2,67*	30,98	0,19
y09	18,06	*1,65*	5,48	*0,11*	43,71	*2,76*	28,88	0,17

epl		-3,15	***-1,85***	-4,31	***-3,07***	-8,06	***-1,61***	3,11	*0,43*
ud		0,75	***2,28***	1,43	***4,7***	0,01	*0,01*	1,49	*1,2*
uc		-0,36	*-2,06*	-0,21	*-1,23*	1,22	*2,15*	3,3	*0,44*
uncoord		4,91	***1,95***	7,51	***3,34***	7,27	***1,08***	83,5	***1,59***
brr		0,02	*0,07*	0,18	*0,41*	1,42	***1,57***	12,51	*0,75*
bd		2,43	*1,23*	-6,66	*-3*	2,68	*3,8*	-50,8	*-1,22*
ho		-0,52	*-0,87*	-0,13	*-0,71*	-5,46	*-2,66*	-23,95	*-0,67*
tax		3,31	***4,81***	2,26	***5,34***	3,41	***1,71***	42,32	***1,15***
pmr		-3,86	*-1,01*	6,69	*1,62*	-8,63	*-1,06*	-58,75	*-0,97*
constant		46,4	*7,39*	17,8	*3,4*	8,83	*7,55*	-4,43	*-0,03*
R-square	within		0.2177		0.2929		0.2287		0.1219
	between		0.0029		0.0742		0.001		0.0023
	overall		0.1556		0.2606		0.1571		0.1559

TABLE A.7 – High Marginal Rates of Substitution: the Regression Evidence (Logit)

	SET 1		SET 2		SET 3		SET 4	
Regressor	Coef.	T-ratio	Coef.	T-ratio	Coef.	T-ratio	Coef.	T-ratio
y81	-0,22	*-0,12*	0	*0*	3,99	*0,23*	13,71	*0,01*
y82	-0,31	*-0,16*	-0,32	*-0,21*	5,27	*0,68*	13,34	*0,01*
y83	0,77	*0,39*	0,44	*0,27*	5,53	*0,82*	13,16	*0,01*
y84	0,7	*0,31*	-0,07	*-0,05*	3,6	*0,55*	8,45	*0*
y85	0,61	*0,24*	0,93	*0,71*	5,32	*0,99*	8,35	*0*
y86	5,05	*1,49*	1,25	*0,97*	7,83	*1,66*	8,21	*0*
y87	3,82	*1,53*	1,25	*0,97*	10,49	*2,42*	7,85	*0*
y88	3,23	*1,27*	2,34	*1,86*	9,44	*2,02*	9,35	*0*
y89	2,49	*0,96*	1,6	*1,28*	7,78	*1,63*	9,65	*0*
y90	4,55	*1,29*	1,37	*0,97*	14,34	*5,02*	11,17	*0,01*
y91	11,33	*1,35*	-0,25	*-0,17*	11,32	*3,63*	9,34	*0*
y92	5,09	*1,83*	0,44	*0,32*	10,7	*2,7*	10,23	*0,01*
y93	2,32	*0,97*	1,67	*1,23*	8,92	*1,84*	11,37	*0,01*
y94	0,97	*0,42*	2,53	*1,92*	7,85	*1,31*	12,64	*0,01*
y95	0,83	*0,37*	3,02	*2,29*	6,35	*0,96*	13,65	*0,01*
y96	2,04	*0,86*	2,93	*2,25*	6,85	*1,15*	12,66	*0,01*
y97	3,44	*1,5*	2,51	*1,89*	7,15	*1,28*	12,66	*0,01*
y98	3,86	*1,62*	2,21	*1,63*	9,02	*1,85*	12,71	*0,01*
y99	3,2	*1,39*	1,68	*1,25*	9,74	*1,92*	14,14	*0,01*
y00	3,03	*1,29*	0,69	*0,49*	8,96	*1,84*	11,61	*0,01*
y01	3,67	*1,52*	1,69	*1,25*	9,46	*1,93*	11,61	*0,01*
y02	3,93	*1,5*	1,62	*1,2*	11,52	*3,21*	12,37	*0,01*
y03	4,95	*1,58*	0,91	*0,68*	13,15	*2,47*	12,64	*0,01*
y04	2,41	*0,91*	0,16	*0,1*	15,05	*1,12*	12,23	*0,01*
y05	3,93	*1,5*	1,62	*1,2*	11,52	*3,21*	12,37	*0,01*
y06	4,95	*1,58*	0,91	*0,68*	13,15	*2,47*	12,64	*0,01*
y07	2,41	*0,91*	0,16	*0,1*	15,05	*1,12*	12,23	*0,01*
y08	2,13	*0,89*	-0,03	*0,39*	18,50	*0,94*	12,55	0,01
y09	2,08	*0,91*	-0,26	*0,95*	15,30	*0,75*	12,92	0,01

epl	-2,93	***-3,6***	-9,78	***-3,22***	-2,28	***-1,97***	-2,24	***-3,51***
ud	0,46	***1,78***	0,29	***3,96***	0,57	*0,9*	0,15	***1,52***
uc	0,15	*0,76*	0,01	*0,18*	0,75	*2,67*	0,26	***3,48***
uncoord	4,91	***2,34***	2,11	***3,67***	16,95	***1,85***	2,86	**2,99**
brr	0,33	***1,98***	0,12	***1,65***	0,89	***4,66***	0,75	***4,7***
bd	3,15	***3***	-1,66	*-4,08*	5,17	--	3,99	***3,13***
ho	-1,03	***-1,79***	0,16	*1,05*	-1,45	***-2,65***	-1,35	***-3,83***
tax	0,5	***2,01***	0,58	***4,15***	0,9	***1,93***	0,39	***1,95***
pmr	0,43	*0,35*	0,44	*0,73*	-1,53	*-0,89*	1,43	*1,65*
constant	-0,22	*-0,12*	0	*0*	3,99	*0,23*	3,71	*0,01*

TABLE A.8 – High Marginal Rates of Substitution: their Correlation with Efficiency (Logit)

	SET 1		SET 2		SET 3		SET 4	
Regressor	Coef.	T-ratio	Coef.	T-ratio	Coef.	T-ratio	Coef.	T-ratio
y81	0,07	*0,05*	-0,01	*-0,01*	1,27	*0,78*	0,81	*0,58*
y82	0,17	*0,12*	-0,04	*-0,03*	1,26	*0,78*	0,81	*0,58*
y83	1,2	*0,84*	0,27	*0,28*	1,3	*0,8*	0,81	*0,58*
y84	1,53	*1,11*	-0,1	*-0,11*	1,38	*0,9*	0,36	*0,27*
y85	1,48	*1,08*	0,26	*0,28*	2,33	*1,53*	0,23	*0,17*
y86	2,2	*1,57*	0,21	*0,23*	2,24	*1,48*	0,18	*0,14*
y87	2,07	*1,49*	0,22	*0,23*	2,84	*1,82*	0,19	*0,14*
y88	1,92	*1,4*	0,89	*0,97*	2,75	*1,77*	0,73	*0,56*
y89	1,78	*1,31*	0,24	*0,26*	2,67	*1,73*	0,73	*0,56*
y90	1,6	*1,2*	-0,09	*-0,1*	2,54	*1,66*	0,74	*0,57*
y91	3,35	*2,08*	-0,59	*-0,6*	2,93	*1,91*	0,65	*0,5*
y92	2,2	*1,56*	-0,19	*-0,2*	2,98	*1,93*	1,06	*0,84*
y93	1,37	*1,06*	0,44	*0,49*	2,37	*1,59*	1,43	*1,13*
y94	0,99	*0,8*	0,7	*0,78*	2,55	*1,73*	1,76	*1,4*
y95	1,38	*1,11*	1,04	*1,13*	2,43	*1,66*	2,08	*1,65*
y96	1,99	*1,54*	1,06	*1,14*	2,34	*1,6*	1,42	*1,13*
y97	2,77	*1,99*	0,84	*0,91*	2,36	*1,61*	1,51	*1,19*
y98	2,91	*2,11*	0,53	*0,58*	2,89	*1,93*	1,52	*1,2*
y99	2,75	*1,99*	0,56	*0,61*	3,72	*2,37*	1,8	*1,44*
y00	2,49	*1,75*	0,1	*0,11*	3,2	*1,95*	1,28	*1*
y01	3,06	*2,13*	0,54	*0,58*	2,96	*1,86*	1,07	*0,84*
y02	3,08	*2,01*	0,54	*0,59*	3,09	*1,89*	1,06	*0,84*
y03	2,96	*1,93*	0,23	*0,25*	3,36	*1,91*	1,19	*0,92*
y04	1,98	*1,44*	0,41	*0,43*	3,57	*1,96*	1,18	*0,92*
y05	1,78	*1,37*	0,49	*0,39*	4,08	*2,18*	1,38	1,02
y06	1,46	*1,21*	0,51	*0,95*	4,30	*2,31*	1,39	1,09
y07	1,05	*1,00*	0,54	*0,94*	4,72	*2,43*	1,54	1,15
y08	0,64	*0,81*	0,59	*1,34*	4,99	*0,17*	1,59	1,21
y09	0,27	*0,63*	0,63	*1,44*	5,39	*1,17*	1,72	1,28
eff	-3,82	***-2,41***	1,4	*1,09*	-3,7	***-2,76***	0,66	*0,49*
constant	-0,22	*-0,12*	0	*0*	3,99	*0,23*	13,71	*0,01*

TABLE A.9 – Efficiency Scores: the Regression Evidence (OLS)

	SET 1		SET 2		SET 3		SET 4	
Regressor	Coef.	T-ratio	Coef.	T-ratio	Coef.	T-ratio	Coef.	T-ratio
y81	0	*0,04*	0,01	*0,21*	0,05	*0,67*	0,04	*0,67*
y82	0,01	*0,27*	0,02	*0,51*	0,03	*0,58*	0,03	*0,57*
y83	0,07	*1,04*	0,07	*1,25*	0,04	*0,59*	0,03	*0,59*
y84	0,08	*1,23*	0,08	*1,63*	0,04	*0,51*	0,04	*0,67*
y85	0,07	*1,24*	0,08	*1,59*	0,02	*0,23*	0,02	*0,42*
y86	0,07	*1,23*	0,07	*1,58*	0	*0,01*	0,02	*0,42*
y87	0,06	*1,11*	0,07	*1,45*	-0,02	*-0,27*	0,01	*0,26*
y88	0,04	*0,91*	0,06	*1,28*	-0,03	*-0,53*	0	*0,09*
y89	0,03	*0,66*	0,05	*1,1*	-0,04	*-0,77*	0	*-0,02*
y90	0,01	*0,29*	0,04	*0,9*	-0,06	*-1,11*	-0,01	*-0,23*
y91	0	*-0,09*	0,03	*0,71*	-0,06	*-1,16*	-0,01	*-0,27*
y92	0	*0,05*	0,03	*0,62*	-0,05	*-0,95*	-0,01	*-0,21*
y93	0,01	*0,18*	0,03	*0,75*	-0,04	*-0,76*	-0,01	*-0,15*
y94	0,03	*0,66*	0,04	*1,06*	-0,03	*-0,63*	-0,01	*-0,11*
y95	0,04	*0,76*	0,06	*1,41*	-0,02	*-0,42*	0,01	*0,18*
y96	0,03	*0,59*	0,06	*1,46*	-0,04	*-0,74*	0	*-0,07*
y97	0,02	*0,47*	0,07	*1,63*	-0,05	*-0,97*	0	*0,01*
y98	0,02	*0,54*	0,05	*1,18*	-0,06	*-1,12*	-0,02	*-0,49*
y99	0	*-0,09*	0,04	*0,88*	-0,05	*-0,87*	-0,03	*-0,73*
y00	-0,05	*-0,97*	0,01	*0,29*	-0,11	*-1,97*	-0,05	*-0,96*
y01	0	*-0,08*	0,04	*0,87*	-0,07	*-1,18*	-0,02	*-0,37*
y02	-0,04	*-0,71*	0,01	*0,32*	-0,1	*-1,72*	-0,04	*-0,75*
y03	-0,04	*-0,76*	0,02	*0,31*	-0,13	*-2,31*	-0,07	*-1,47*
y04	-0,05	*-0,73*	0,03	*0,54*	-0,12	*-2,12*	-0,06	*-1,26*
y05	-0,06	*-0,86*	0,04	*0,63*	-0,13	*-2,37*	-0,07	*-1,41*
y06	-0,08	*-0,99*	0,04	*0,66*	-0,15	*-2,63*	-0,08	*-1,63*
y07	-0,09	*-1,08*	0,04	*0,74*	-0,16	*-2,83*	-0,08	*-1,80*
y08	-0,10	*-1,18*	0,05	*0,83*	-0,17	*-3,01*	-0,09	*-1,93*
y09	-0,11	*-1,28*	0,05	*0,91*	-0,18	*-3,22*	-0,10	*-2,09*

epl		0,45	***3,61***	0,45	***5,16***	0,43	***3,22***	0,5	***5,24***
ud		0	*1,79*	0	*1,05*	0	*-1,5*	0	*-2,28*
uc		0	***2,28***	0	***3,17***	0,01	***5,35***	0,01	***4,88***
uncoord		-0,01	***-0,76***	-0,02	***-1,82***	-0,03	***-1,35***	-0,04	***-2,83***
brr		0	*0,74*	0	*0,63*	0,01	***3,5***	0,01	***2,74***
bd		-0,13	*-1,05*	0,14	***1,6***	0,36	***2,65***	0,32	***2,6***
ho		0	*-0,13*	0	*2,22*	-0,01	*-1,08*	0	*-0,93*
tax		-0,01	***-2,71***	-0,01	***-4,19***	-0,01	***-2,99***	-0,01	***-3,22***
pmr		0	*0,13*	0	*0,25*	0,03	***1,52***	0,04	***2,45***
constant		0,64	*17,89*	0,68	*17,78*	0,65	*13,58*	0,71	*16,05*
R-square	within		0.1331		0.2274		0.3477		0.3801
	between		0.0224		0.1010		0.0037		0.0155
	overall		0.1173		0.1910		0.2811		0.3566

Legend of the Tables

Y$_{nn}$: common time (year) effect.
Epl: Employment protection legislation data from the OECD labour market statistics database using version 1 of the indicator: the strictness of employment protection legislation.
Ud: Union density is Union membership/Employment and was calculated using administrative and survey data from the OECD labour market statistics database. Series extended by splicing in data from Visser (2006).
Uc: Union coverage, referring to the number of workers covered by collective agreements normalised on employment. Series constructed as an interpolation of both the Ochel (2001) and the OECD (2004) data.
Uncoord: Index *of lack of* bargaining coordination. It is constructed from the index of bargaining coordination with range {1,5} taken from OECD (2004), Table 3.5. It is decreasing in the degree of coordination in the bargaining process on the employers' as well as the unions' side.
Brr: Gross benefit replacement rates data are provided by OECD with one observation every two years for each country. In this case the data refer to the first year of unemployment benefits, averaged over three family situations and two earnings levels. The benefits are a percentage of average earnings before tax.
Bd: Benefit duration index. This index is constructed as bd = 0.6*brr23/brr1 + 0.4*brr45/brr1. This captures the level of benefits available in the later years of a spell relative to those available in the first year.
Ho: Housing owner occupation rate based on data by Oswald (1996) and OECD (2005).
Tax: Average effective tax wedge. Ex-post wedge computed from national accounts taken from Nicoletti institutions data.
Pmr: The OECD indicators of regulatory reform summarise regulatory provisions in seven non-manufacturing sectors: telecoms, electricity, gas, post, rail, air passenger transport, and road freight. The range is {0,6}, increasing in regulation.

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