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MARIANNA BELLOC

Do Labor Market Institutions Affect International Comparative Advantage? An Empirical Investigation

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Abstract - The aim of this paper is to explore the different determinants of international comparative advantage. Starting from a theoretically well founded neoclassical framework, where specialization depends on relative factor endowments and technological differences, we study the role of the institutional diversity in the labor market. We use an international trade model where endogenous effort is included in an otherwise standard production function. Since the effort level can be affected by country-specific labor institutions, the institutional context may in turn be able to influence the international comparative advantage. After illustrating the theoretical motivations for such an effect, we implement a rigorous econometric analysis on a group of OECD countries to test its empirical validity. We obtain that institutions have an important role in explaining the relative economic performance of a number of manufacturing sectors. In particular, stronger labor market institutions are found to advantage capital-intensive sectors and disadvantage labor-intensive ones. Policy implications are derived and discussed.

Keywords - Comparative Advantage, Labor Market Institutions, International Specialization

JEL Classification - F11, F10, J22, J52

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Marianna Belloc, Department of Economics, University of Siena, Italy. E-mail: belloc@unisi.it.

1 Introduction

The most part of trade in the world is within the group of countries that have the most similar factor endowments. This result, originally found by Trefler (1995), represents a strong rejection of the Heckscher-Ohlin theorem that assesses that capital-abundant countries export capital-intensive goods and labor-abundant countries export labor-intensive goods. Harrigan (1997a) provides a crucial contribution to the empirical analysis of the theory of comparative advantage. The author tests the hypothesis that international specialization is jointly caused by cross-country differences in relative factor endowments and technological levels. He finds that both determinants of comparative advantage are relevant and concludes in favor of the neoclassical model. However, the effects of relative factor abundance are not always very consistent with the theoretical predictions.

In this paper we argue that traditional trade theories based on comparative advantage overlook a third crucial determinant: the institutional context. Although a number of works have been addressed to the study of the relation between institutions and economic performance[1], the idea that domestic institutions affect the relative advantage of a certain country in engaging in a certain activity is new and has never been tested empirically. To give a clear focus and obtain testable predictions we only concentrate on labor market institutions.

Our study is not aimed at discussing which labor institutions are the best for economic competitiveness *tout court*. We approach the debate from a relative point of view. Indeed, since the quarrel on the optimal institutional model for economic success is far away from the end, the best approach seems to shed light on the combination of institutions that turns out to be (sub)optimal for each country considering its specific production system and institutional context. Then, a certain institutional arrangement may be good for a country and bad for another, may favor some sectors and disfavor others.

Our analysis is founded on a Heckscher-Ohlin model of international specialization that includes variable effort into the production function. Effort is endogenous and can be affected by country-specific labor institutions. We obtain that strong labor market institutions relatively advantage the high wage

[1] With specific regard to the labor market institutions, see, *e.g.*, Teulings and Hartog (1998), and for a collection of works, Mishel and Voos (1992).

and capital-intensive industries, while an institutional context that allows for low wage and high wage dispersion contracts creates a comparative advantage in the labor-intensive sectors.

To support our predictions, we employ an econometric analysis for a group of OECD countries in the 1970-1994 period. OECD (relative capital-abundant) countries trade more between each other rather than with relative labor-abundant (poor) countries. Since factor endowments and technological levels tend to be very similar within the OECD group, and since gains from trade stem from diversities between traders, these countries must differ along some other dimension that generates comparative advantage. It is empirically well documented (Freeman, 1999, 2000, 2002; Blau and Khan, 1999) that labor market institutions are the dimension in which OECD countries differ mostly. As Blau and Khan (1999) point out, while these countries offer a high degree of comparability along a number of important dimensions, strong differences still remain across them reflecting the characteristics of the labor market institutions. Furthermore, Freeman (2000) shows that labor market institutions (union density and collective bargaining coverage) in the OECD economies are changing in a way that is inconsistent with the prediction of convergence to a single peaked model of capitalism. So, on *a priori* grounds, different labor market institutions seem to be a good candidate to add information on the determination of international comparative advantage for this group of countries.

This paper is organized as follows. In section 2 we report some theoretical motivations for our empirical work and provide testable predictions. In section 3, we present our econometric strategy and a brief data description. In section 4 results are reported and commented. Finally, in section 5 some conclusions are drawn and policy implications are discussed.

2 Theoretical motivations

Consider a standard two-good two-factor Heckscher-Ohlin framework of international specialization and, following Leamer (1999), include variable effort into an otherwise standard production function. The effort-augmented production function embodies the capital cost savings from high-effort operations. Then, the effective labor supply shifts upwards as the effort level increases. The variable effort is a factor-neutral technological multiplier that depends on differences in "*industriousness*, *attentiveness*, *ability*, *skills*", and

so on. Since effort is variable, labor contracts are multidimensional accounting for different levels of wage and effort: higher wage offsets the disutility of higher effort. Capital is assumed to be indifferent to the effort level so that, *e.g.*, hard working pace and long operation time do not wear out the machine. Therefore, the capital cost savings from high effort are greater in the capital-intensive sector and this industry is characterized by relatively high wage-high effort contracts with respect to the labor-intensive one. As a consequence, the model implies that countries with similar levels of effort in the two sectors have a comparative advantage in producing labor-intensive goods, while in countries where the effort levels in the two industries are more unequal, the effort level is *relatively* higher in the capital-intensive sector that will be relatively advantaged. Finally, Leamer (1999) assumes that, in each country, the effort level is upward bounded by a *fixed* level.

We can now introduce labor market institutions defined as "*the system of laws, programs, and conventions that can impinge on labor market behavior and cause the labor market to function differently from a spot market*" (Blau and Khan, 1999: 1400). Thus, labor market institutions affect the labor allocation into the production function. Following Leamer (1999) we maintain the hypothesis that different institutions cause the effort level to be variable between communities.

A number of interesting predictions follow. Institutions that raise the effort level through an improvement in the working conditions imply an increase in the effective labor supply and a rise of output in the whole economy. Consider for instance an increase in the minimum wages and examine the effects on wages and effort levels. The direct effect is higher wages in the (low effort-low wage) labor-intensive sector. The indirect effect is an upward shift in the effective labor supply. This leads to an increase in the demand for capital, so that the capital rental goes up and the wages go down in the capital-intensive sector. As a consequence of the two effects, wages become more equal between the two sectors. On the other hand, effort has increased in the whole economy, but, since it is upward bounded, in relative terms it has increased more in the labor-intensive industry. Then, the minimum wage has created a comparative advantage in the labor-intensive industry. In a similar vein, a high degree of coordination of the industrial relations is predicted to force the effort to be at the same level in different sectors. Capital-intensive (high effort) industries are disfavored and labor-intensive (low effort) ones are favored.

The above predictions on comparative advantage stem from the two crucial hypotheses that Leamer (1999) assumes: each community is characterized by a different "*attitude to work*"and an absolute maximum level of effort exists. In the following part of the paragraph, we discuss how these predictions change if we include into the framework Akerlof-Yellen's fair wage-effort hypothesis extended at the industry level.

In Akerlof and Yellen (1988, 1990)'s model the variable effort depends on "*fairness, morale and cohesiveness*" of labor that are negatively affected by wage dispersion[2]. As a consequence, the maximum level of effort that workers are willing to exert depends on the subjectively perceived fair wage. The fair wage is determined in a natural way as a function of the remuneration of the other members of the same industry and the relative working conditions. Then, if the reference point is a considerably high remuneration, people have in mind a high fair wage. If we consider an economy composed of only two sectors, it is natural to expect that in the capital intensive (high wage) sector[3] the fair wage is higher than in the labor-intensive (low wage) one.

We can now study the implications for comparative advantage. For the sake of clarity, we can focus the attention on trade unions and suppose that union power is the same across sectors. In our framework, union policies aimed at improving the working conditions (for instance providing higher wages for low wage workers) cause two effects: first the cost of one unit of labor increases, second the effort level goes up in both sectors as a consequence of reduced wage differentials at the industry level[4]. Here there is no reason why the increase in the effort level should be relatively smaller in the capital-intensive sector. Indeed the *endogenous* maximum effort level depends on the perceived fair wage that is higher in this industry than in the labor-intensive one. As a consequence we have that, on the one side, the capital cost savings from higher effort are relatively greater in the capital-intensive sector; on the other, the labor-intensive sector is relatively more disfavored by an increase in wages. Thus, the former industry is likely to be *relatively* advantaged and the latter disadvantaged by the institutional intervention.

[2] See also Levine (1991).

[3] As Freeman and Medoff (1984) notice, when plants are unionized white-collar workers and executives receive benefits to make their remunerations more similar to the higher wages of the white-collar workers. The case of the General Motors in 1982 is an interesting example of this phenomenon.

[4] The labor-augmenting effect of stronger trade unions is also discussed by Moene and Wallerstein (1997) using a model that compares union-effects on productivity respectively in local and centralized bargaining regimes. Evidence for these predictions is found for Finland, Norway, and Sweden until the '90s.

Empirical evidence consistent with our predictions is suggested by Davis and Henrekson (2004) in a comparative study of Sweden and the United States. The main idea of their paper is that rigid labor market institutions favor industrial categories with low wage dispersion and above-average mean wages (capital-intensive), while disfavor industries with high wage dispersion or low wages (labor-intensive).

In the remaining part of the paper we test the above predictions in a sample of OECD countries.

From an empirical point of view, the goal of testing the effects of labor institutions on comparative advantage is particularly difficult for at least three reasons that are listed below.

First, properly measuring comparative advantage is difficult since we cannot observe prices in autarchy. This is one of the reasons why it is hard to present conclusive evidence on the determinants of comparative advantage and theories based on comparative advantage generally perform very poorly on an empirical ground. So we have to rely on other indicators that derive from the observation about how certain sectors perform relatively to others.

Second, it is very problematic to provide comparable measures of institutions and to tackle the issues stemming from their interaction. Then, we have to control for different labor institutions. Unfortunately, some important variables cannot be included in our investigation due to data shortage. Indeed, since we intend to maintain our sample composed of the largest possible number of countries, we have to choose those institutions for which we have a sufficiently large number of observations for all the countries in the sample.

Finally, labor institutions are supposed to be endogenous, since they are typically affected by other elements of the economic system. In particular, with regard to our main concern on comparative advantage, we have to consider that labor institutions may be highly correlated with factor endowments. Thus, implementing instrumental variable estimation and testing for misspecification is crucial in order to obtain reliable results.

In the following paragraph, we present our econometric strategy that is designed in order to deal with the problems just mentioned.

3 Econometric strategy

The starting point of our empirical strategy is provided by Harrigan (1997a). The author tests the effects of relative factor endowments and total factor productivity on the relative economic performance for a number of manufacturing sectors. He estimates the following trans-log function that is directly derived from an extension of the dual approach to international trade[5]:

$$S_{jct} = n_{jc} + t_{jt} + \sum_{k=1}^{N} \alpha_{kj} \ln(\theta_{kct}) + \sum_{i=2}^{M} \beta_{ij} \ln\left(\frac{v_{ict}}{v_{1ct}}\right) + \zeta_{jct} \tag{1}$$

where S_{jct} is the share of sector j in country c and period t, n_{jc} is the country fixed effect, d_{jt} the time fixed effect, θ_{kct} represents a Hicks-neutral technological parameter for sector k[6], v_{ict} is factor endowment of i, and ζ_{jct} is the residual term. N is the number of sectors and M is the number of factors. Model (1), that hereafter we call the *basic model*, represents a system of N equations (one for each sector) over a panel of countries and years. The country fixed effects control for unobserved heterogeneity across countries, whereas the time fixed effects control for macroeconomic shocks that may involve several countries in the sample in a certain year.

Three underlying assumptions are relevant for the following discussion. First, cross-sector technology effects are assumed to be symmetrical, so that $\alpha_{kj} = \alpha_{jk} \; \forall \; k, j$. Second, the free trade hypothesis holds, then each country is supposed to have the same prices in each period considered. As a consequence, the price effects are included in the time fixed effects. Finally, consistently with the neoclassical tradition in international trade literature, factor endowments are supposed to be exogenous with respect to the production structure.

Following Harrigan (1997a) and assuming the same theoretical background, we now introduce the hypothesis that the factor allocation takes time. Thus, we can rewrite model (1) to allow for slow adjustment to equilibrium and to include the lagged sector share:

$$S_{jct} = \gamma S_{jct-1} + n'_{jc} + t'_{jt} + \sum_{k=1}^{N} \alpha'_{kj} \ln(\theta_{kct}) + \sum_{i=2}^{M} \beta'_{ij} \ln\left(\frac{v_{ict}}{v_{1ct}}\right) + \zeta'_{jct} \tag{2}$$

where the coefficient reflecting the speed of adjustment, γ, is constrained to be the same for each sector

[5] See Harrigan (1997a) for details on the regression specification, and Dixit and Norman (1980) for the theoretical background.

[6] We remark that technology is assumed neutral across factors but nonneutral across sectors.

in order to maintain the symmetry restrictions.

Although models (1) and (2) are theoretically well founded, they overlook the possible effects of the labor institutions. Thus, we extend the general production function that Harrigan assumes to embed endogenous effort, which is affected by the diverse institutions of the labor market. Ideally, we should include industry-specific institutions to isolate the relative effects. However, in absence of industry-specific indicators of labor market regulations, we reformulate (1) and (2) as follows:

$$S_{jct} = n_{jc} + t_{jt} + \sum_{k=1}^{N} \alpha_{kj} \ln(\theta_{kct}) + \sum_{i=2}^{M} \beta_{ij} \ln\left(\frac{v_{ict}}{v_{1ct}}\right) + \sum_{l=1}^{L} \delta_{lj} \lambda_{lct} + \eta_{jct} \tag{3}$$

$$S_{jct} = \gamma S_{jct-1} + n'_{jc} + t'_{jt} + \sum_{k=1}^{N} \alpha'_{kj} \ln(\theta_{kct}) + \sum_{i=2}^{M} \beta'_{ij} \ln\left(\frac{v_{ict}}{v_{1ct}}\right) + \sum_{l=1}^{L} \delta'_{lj} \lambda_{lct} + \eta'_{jct} \tag{4}$$

where δ_{lct} $\left(\delta'_{lct}\right)$ is a parameter that includes the effect of institution l in country c at time t, λ_{lct} are the institutional variables, and L is the number of institutions that we control for.

Equation (1) through (4) are estimated extending Harrigan's sample, which consists of 10 OECD countries (Belgium, Canada, Denmark, Finland, France, Germany[7], Great Britain, Italy, Japan, Sweden, the United States) for the 1970-1988 period, to include 11 OECD countries (the same as above plus Finland) for the period 1970-1994. Including into the sample the first half of the '90s is particularly important for our purpose of testing institutional effects, since many changes in the labor market occurred in this period. The empirical study is implemented to analyze relative performance of seven manufacturing industries that are classified according to the International Standard Industrial Classification ($ISIC$) at the two-digit level (Food, Apparel, Paper, Chemicals, Glass, Metals, and Machinery).

While detailed data description is reported in the Appendix, in the remaining part of the paragraph we provide some definitions and useful remarks.

The dependent variable of our model (S_{jct}) is *gdp* of sector j over *gdp* of total manufacturing for each country (c) and each sector (j) over time (t).

Total factor productivity is computed consistently with Harrigan (1997a) in order to maintain comparability of the results. The formula applied is reported below[8]:

$$TFP_{jbc} = \frac{y_{jb}}{y_{jc}} \times \left(\frac{\overline{l}_j}{l_{jb}}\right)^{\sigma_{jb}} \times \left(\frac{\overline{k}_j}{k_{jb}}\right)^{1-\sigma_{jb}} \times \left(\frac{l_{jc}}{\overline{l}_j}\right)^{\sigma_{jc}} \times \left(\frac{k_{jc}}{\overline{k}_j}\right)^{1-\sigma_{jc}} \tag{5}$$

[7] West Germany until 1989.

[8] For a more detailed treatment of formula (5) we refer to Cave et al. (1992) and Harrigan (1997a, 1997b, 1999).

where TFP_{jbc} denotes the total factor productivity of sector j in country b relative to the total factor productivity of sector j in country c expressed with reference to a certain base year; y_j is the value added in sector j; l and k are respectively the labor and capital inputs; $\overline{k}$ and $\overline{l}$ are respectively the geometric means per sector and year across countries. Finally, σ is equal to $(s+\overline{s})/2$, where s is labor's share in total cost and $\overline{s}$ is the arithmetic mean of s for each sector and year across countries. Formula (5) is a superlative index number and represents a relative measure. For the sake of comparability, the base country taken in this paper is the United States and the base year is 1988 as in Harrigan (1997a).

In order to deal with possible noises that affect the labor's share, we also employ a smoothing procedure that uses the fitted values from the following expression as labor's share in the TFP computation:

$$\widehat{s}_{cjt} = \pi_{cj} + \rho_j \ln\left(\frac{k_{cjt}}{l_{cjt}}\right) \tag{6}$$

Our results for the total factor productivity, computed with both the restricted sample (10 countries, 1970-88) and our extended sample (11 countries, 1970-94), and comparison with Harrigan's results are available upon requests.

As factor endowments, we use capital, labor and arable land. Moreover, we consider two different kinds of capital that are producer durable goods (*prod durable*) and other nonresidential constructions (*nonres constr*), whereas labor force is classified as: workers with high education (*high workers*), workers with medium education (*med workers*), and workers with low education (*low workers*).

Finally, we adopt two main measures for labor market institutions: the net union density (*union density*) as the ratio of total reported union members to wage and salaried employees and the index for bargaining coordination (*coordination*) that is increasing with the degree of coordination in the bargaining process on the employers' as well as on the unions' side.

4 Empirical results

4.1 The basic model

The first step of our empirical strategy consists in estimating the two models (1) and (2) using our extended sample[9].

[9] Hereafter, we always use our extended sample to obtain the reported results.

System (1) is estimated as a restricted SUR[10] model under linear cross-equation symmetry constraints using country-year panel data[11]. The within estimator is implemented by allowing for both country and time fixed effects. In estimating system (2), we apply a 3SLS[12] procedure and include the sector share two-period lagged as instrumental variable for the sector share one-period lagged in order to obtain consistent estimators (see Harrigan, 1997a, Hsiao, 1986).

Tables 1 and 2 report respectively our results for the two regressions. Comments are provided below.

All the own-TFP effect coefficients are positive and highly significant (with the only exception of the Food sector in eq. (1) that is significant only at the 20% level). We remark that Harrigan (1997a) finds a negative coefficient in the Food sector and a nonsignificant coefficient in the Paper sector for the model with instantaneous adjustment. The cross-TFP effects are mixed as theory predicts.

Turning to the effects of factor endowments, in Table 1, at least one of the two kinds of capital is positively significant in all sectors but the Paper and Machinery industries. In Table 2 the other coefficients referred to capital show somewhat lower significance, providing that in general (as Harrigan, 1997a, points out) the assumed slow adjustment obscures the factor endowments' effects that work in the instantaneous adjustment framework.

The estimated coefficients on relative labor supply in Table 1 suggest the following conclusions. All the three groups of workers (with respectively high, medium and low education) are always significant in the Apparel sector (which is the most relatively labor-intensive), and mostly negatively significant in the Chemicals and Metals sectors (which are the most relatively capital-intensive). Highly educated and medium educated workers enter significantly and positively into the equation of the Machinery sector. Finally, the coefficients on labor have no (or low) significance elsewhere (Food, Paper, Glass). In Table 2, the parameters on labor endowments are mostly nonsignificant, with the exception of the coefficient

[10] Seemingly unrelated regression.

[11] To take account of the classical measurement errors that may affect the TFP values, Harrigan (1997a) uses instrumental variable estimators. The available instrument for TFP_{kct} is:

$$\frac{1}{C-1}\sum_{d\neq c}^{C} TFP_{kdt}$$

where C is the total number of countries, $k : 1, ...N$ is the sector index, and t is the year index. This procedure follows the assumption that technology levels are correlated between countries but classical measurement errors are not. We have also implemented this procedure, but the results do not differ in an important way from the ones obtained without instruments. Moreover, the Hausman test always leads not to reject the model without instruments.

[12] Three-stage least squares.

on workers with low education in the Apparel sector that still shows a relevant positive effect.

Tab. 1: Regression (1). Instantaneous adjustment

	Food	Apparel	Paper	Chemic.	Glass	Metals	Machin.
TFP food	0.0810	-0.1424	0.0188	0.0464	-0.1506	0.0033	0.0641
	1.32	-3.52**	0.42	1.59	-4.95**	0.10	1.01
TFP apparel	-0.1424	0.3945	0.0670	0.0672	-0.0741	-0.1215	-0.1187
	-3.52**	7.60**	1.63	2.74**	-2.52**	-4.17**	-2.12**
TFP paper	0.0188	0.0670	0.2197	-0.1025	0.1611	0.0736	-0.1180
	0.42	1.63	3.40**	-3.56**	5.17**	2.20**	-1.69*
TFP chemic.	0.0464	0.0672	-0.1025	0.3469	-0.0578	-0.0445	-0.2978
	1.59	2.74**	-3.56**	10.56**	-3.19**	-1.76*	-6.14**
TFP glass	-0.1506	-0.0741	0.1611	-0.0578	0.1942	-0.0207	-0.0367
	-4.95**	-2.52**	5.17**	-3.19**	5.68**	-1.02	-0.87
TFP metals	0.0033	-0.1215	0.0736	-0.0445	-0.0207	0.2198	-0.0077
	0.10	-4.17**	2.20**	-1.76*	-1.02	5.52**	-0.15
TFP machin.	0.0641	-0.1187	-0.1180	-0.2978	-0.0367	-0.0077	0.3328
	1.01	-2.12**	-1.69*	-6.14**	-0.87	-0.15	2.44**
Prod durable	0.2003	0.2535	0.0349	-0.0208	-0.0071	-0.3031	-0.0872
	4.02**	6.01**	0.75	-0.40	-0.26	-6.39**	-0.92
Nonres constr	-0.0344	-0.3779	-0.0723	0.1904	-0.0819	0.1789	0.1372
	-0.45	-6.24**	-1.01	2.47**	-1.98**	2.54**	0.93
High workers	-0.0169	0.0783	0.0107	-0.0859	-0.0260	-0.1917	0.1904
	-0.55	3.10**	0.37	-2.65**	-1.55	-6.53**	3.27**
Med workers	-0.0780	0.1620	-0.0909	-0.2595	0.0378	-0.0401	0.2439
	-1.73*	4.34**	-2.17**	-5.34**	1.56	-0.93	2.85**
Low workers	0.0489	0.1126	-0.1053	-0.0987	-0.0119	-0.0400	0.0546
	1.32	3.74**	-3.06**	-2.49**	-0.60	-1.09	0.78
Arable land	0.1458	0.0887	-0.0647	-0.2483	0.0528	0.0668	-0.1955
	1.60	1.21	-0.76	-2.50**	1.09	0.77	-1.13

t-statistics reported. ** 5% significance ($|\overline{t}|$=1.96); * 10% significance ($|\overline{t}|$=1.64).

Finally, arable land has in general either no or weak effect on relative sector share in all the equations. The correspondent parameter, in Table 1, is negative and significant only in the Chemicals sector, while it is positive and significant at the 20% level in the Food sector. This result is quite encouraging. We remark that Harrigan (1997a) obtained a negative and significant coefficient in the Food (relative land-intensive) sector, and positive and significant coefficients in the Chemicals and Metals (relative capital-intensive) ones. Again in Table 2, the parameters on land are mostly nonsignificant.

Tab. 2: Regression (2). Slow adjustment

	Food	Apparel	Paper	Chemic.	Glass	Metals	Machin.
S_{jct-1}	0.7298	0.7298	0.7298	0.7298	0.7298	0.7298	0.7298
	35.41**	35.41**	35.41**	35.41**	35.41**	35.41**	35.41**
TFP food	0.1619	-0.0785	0.0233	0.0371	-0.0619	-0.0929	-0.0637
	3.10**	-3.33**	0.61	1.52	-2.69**	-3.07**	-1.34
TFP apparel	-0.0785	0.1204	-0.0211	0.0502	-0.0310	-0.0230	-0.0317
	-3.33**	4.41**	-0.86	3.76**	-1.65*	-1.82**	-1.09
TFP paper	0.0233	-0.0211	0.1666	-0.0468	0.0443	0.0195	-0.0980
	0.61	-0.86	3.07**	-1.95*	1.86*	0.67	-0.0980
TFP chemic.	0.0371	0.0502	-0.0468	0.0882	-0.0308	-0.0058	-0.0982
	1.52	3.76**	-1.95*	3.09**	-2.35**	-0.27	-2.76**
TFP glass	-0.0619	-0.0310	0.0443	-0.0308	0.1302	0.0015	-0.0485
	-2.69**	-1.65*	1.86*	-2.35**	5.04**	0.10	-1.66*
TFP metals	-0.0929	-0.0230	0.0195	-0.0058	0.0015	0.1519	-0.0150
	-3.07**	-1.82**	0.67	-0.27	0.10	4.39**	-0.39
TFP machin.	-0.0637	-0.0317	-0.0980	-0.0982	-0.0485	-0.0150	0.3191
	-1.34	-1.09	-1.87*	-2.76**	-1.66*	-0.39	3.73**
Prod durable	0.1089	0.0641	-0.0144	0.0585	0.0094	-0.0796	-0.1596
	2.81**	3.09**	-0.39	1.42	0.48	-2.09**	-2.62**
Nonres constr	0.0739	-0.1132	-0.0157	0.0354	-0.0444	-0.0120	0.0915
	1.17	-3.49**	-0.26	0.54	-1.47	-0.20	0.89
High workers	0.0352	0.0224	0.0080	0.0142	-0.0162	-0.0678	-0.0166
	1.41	1.84*	0.34	0.54	-1.40	-2.78**	-0.42
Med workers	0.0085	0.0239	-0.0581	-0.0277	-0.0014	-0.0581	0.0562
	0.23	1.28	-1.67*	-0.68	-0.08	-1.61	0.96
Low workers	0.0405	0.0364	-0.0472	-0.0070	0.0045	-0.0205	-0.0241
	1.33	2.46**	-1.65*	-0.22	0.32	-0.66	-0.51
Arable land	-0.0905	0.0534	0.0365	-0.1166	-0.0244	0.1336	0.0227
	-1.25	1.54	0.54	-1.45	-0.73	1.89*	-0.20

t-statistics reported. ** 5% significance ($|\overline{t}|$ =1.96); * 10% significance ($|\overline{t}|$=1.64).

Tables 3 and 4 report diagnostic tests for the joint significance of the parameters. The null hypothesis that all the coefficients are equal to zero is always rejected for the two specifications. Moreover, we run the regression-based form of the Hausman test[13] for model (2) to examine the endogeneity of the lagged sector shares as independent variables. We find that the null hypothesis that the lagged sector shares are exogenous is rejected at the 1% level suggesting to use instrumental variables.

[13] See Hausman (1978, 1983).

Tab. 3: Diagnostic test Reg. (1)

Equation	χ^2	p-value
Food	107.420	0.0000
Apparel	173.571	0.0000
Paper	89.382	0.0000
Chemicals	270.059	0.0000
Glass	146.914	0.0000
Metals	169.802	0.0000
Machinery	108.818	0.0000
N. of obs = 265 N. of params = 13		

Tab. 4: Diagnostic test Reg. (2)

Equation	χ^2	p-value
Food	1557.791	0.0000
Apparel	2058.957	0.0000
Paper	1396.796	0.0000
Chemicals	1770.729	0.0000
Glass	1483.237	0.0000
Metals	1573.938	0.0000
Machinery	1531.995	0.0000
N. of obs. = 243 N. of params = 14		
Hausman: χ^2_7= 32.71 p = 0.0000		

4.2 The effects of the labor institutions

In this paragraph we turn to test if the inclusion of variables that reflect the cross-country diversity in the institutional setting of the labor market provides any impact on the relative performance of different production sectors. To this extent, the econometric framework introduced in paragraph 4.1 is a tremendously useful tool as it already includes the two main determinants of comparative advantage maintained by the literature: relative factor endowments and technological levels. In this paragraph we use two measures of labor institutions: the union density rate and the degree of bargaining coordination. In the following paragraph we include some additional variables to check the robustness of our results..

A first issue to face when we deal with institutions is the one of endogeneity. To this regard, we employ a 3SLS procedure that allows for instrumental variable estimator, using the same panel country-year for each sector as in the previous paragraph[14]. The strategy is fully consistent since the 3SLS method generalizes the 2SLS[15] to take account of the correlations between equations in the same way as SUR generalizes OLS. As instrumental variables for the labor market institutions, we have chosen political variables that summarize the cumulative number of respectively left and right seats held by all government parties from 1946 to the year of observation. These political variables are supposed to be highly correlated with changes in the labor market institutions. This intuition is confirmed by the results shown in Table 5 that contains information on the first stage regressions. As one can notice, the null hypothesis that all the coefficients are jointly zero is always rejected at a high confidence level.

[14] Results obtained without including instrumental variables are available upon request.

[15] Two-stage least squares.

Furthermore, due to the time lag, the instruments are considered exogenous with respect to the dependent variable. For these reasons our instruments may be reckoned reliable.

Tab. 5: First stage information

Regression (3)

Instrumented	R^2	F	p-value
Union dens.	0.7048	39.80	0.0000
Coordination	0.4112	11.64	0.0000
N. of obs = 250, N. of params = 15			

Regression (4)

Instrumented	R^2	F	p-value
Union dens.	0.7840	36.47	0.0000
Coordination	0.4584	8.50	0.0000
N. of obs = 221, N. of params = 22			

Respectively, in Tables 6 and 7, we report the estimation results for model (3) with instantaneous adjustment and for model (4) with slow adjustment to equilibrium.

First, we discuss the direct effects of labor market institutions on relative sector performance. As one can observe, the conclusions vary significantly between sectors. The coefficient on union density is in general negative in the relatively labor-intensive sectors and positive in the relatively capital-intensive ones. In particular, the highest positive value is in the Machinery industry (2.5396) and the highest negative value is in the Apparel industry (-1.4623); the coefficients in the other sectors are within this range. The effects of the degree of the bargaining coordination are quite different providing that institutions work in a different way in different sectors. Indeed, the values for the parameter on bargaining coordination are positive and significant in both Apparel and Machinery categories, whereas they are negative and significant in the Paper and Chemicals sectors, and not significant elsewhere.

Turning to the effects of the introduction of labor institutions on the other parameters, firstly we observe that the TFP coefficients are almost always consistent with Table 1. The only exception is in the Apparel sector where the own-TFP effect turns out to be nonsignificant after the labor market institutions are taken into account. The coefficients on production durable goods in general show the same sign and significance as before, while the coefficients on nonresidential constructions change somewhere. Finally, arable land's effect never turns out to be significant once labor institutions are included into the model.

We find very interesting results also with regard to the labor endowments. Comparing Table 6 with Table 1, we observe that the coefficients on workers with high education have mostly unchanged sign and significance, but in the Apparel and in the Chemicals sectors. Indeed, in the former industry the

considered coefficient, that was positive before, now becomes negative, while in the latter the opposite is true. This result is relevant since the relative effect of workers with high education is much more plausible to be positive on the *gdp* share of the Chemicals sector and negative on the *gdp* share of the Apparel sector. Similar conclusions hold for workers with medium education, whose coefficients are not significant elsewhere once we control for labor institutions. Finally, interestingly enough, the parameters on workers with low education retain unchanged sign and significance in the two specifications. In particular, the coefficient in the Apparel sector remains significant at a high confidence level and positive, consistently with theoretical predictions.

Tab. 6: Regression (3). Instantaneous adjustment

	Food	Apparel	Paper	Chemic.	Glass	Metals	Machin.
TFP food	0.1091	-0.1287	-0.0003	0.0269	-0.1467	0.0225	0.0589
	1.79*	-2.51**	-0.01	0.83	-4.91**	0.52	0.97
TFP apparel	-0.1287	0.0749	0.0507	0.0205	-0.0823	0.1397	-0.0811
	-2.51**	0.88	0.90	0.48	-2.31**	2.67**	-1.14
TFP paper	-0.0003	0.0508	0.3666	-0.0719	0.1676	-0.0257	-0.2935
	-0.01	0.90	5.05**	-2.18**	5.08**	-0.55	-4.26**
TFP chemic.	0.0268	0.0204	-0.0719	0.4319	-0.0527	-0.1632	-0.2773
	0.83	0.48	-2.18**	9.65**	-2.74**	-5.04**	-5.29**
TFP glass	-0.1467	-0.0823	0.1676	-0.0527	0.1866	-0.0047	-0.0118
	-4.91**	-2.31**	5.08**	-2.74**	5.65**	-0.16	-0.29
TFP metals	0.0224	0.1400	-0.0256	-0.1632	-0.0047	0.2524	-0.0924
	0.52	2.67**	-0.55	-5.04**	-0.16	4.20**	-1.55
TFP machin.	0.0589	-0.0811	-0.2935	-0.2773	-0.0118	-0.0924	0.3874
	0.97	-1.14	-4.26**	-5.29**	-0.29	-1.55	3.20**
Prod durable	0.1720	0.4412	-0.0602	-0.2989	0.0034	-0.1786	0.0407
	2.85**	5.59**	-1.04	-3.67**	0.11	-2.86**	0.38
Nonres constr	0.0013	-0.5390	0.0934	0.3622	-0.1032	0.1673	0.0102
	0.02	-5.27**	1.21	3.36**	-2.46**	2.21**	0.07
High workers	0.0011	-0.2530	0.0374	0.1103	-0.0691	-0.0835	0.3410
	0.02	-3.72**	0.72	1.74*	-2.34**	-1.59	4.02**
Med workers	-0.0314	-0.2180	-0.0372	-0.0114	0.0118	0.0444	0.2045
	-0.50	-2.54**	-0.60	-0.14	0.33	0.70	1.90*
Low workers	0.0593	0.2106	-0.0841	-0.1906	0.0129	-0.0525	-0.040
	1.40	3.74**	-2.13**	-3.06**	0.62	-1.32	-1.20
Arable land	0.1283	-0.0358	-0.0684	-0.1098	0.0632	-0.0735	-0.1745
	1.36	-0.29	-0.76	-0.81	1.31	-0.82	-1.02
Union density	-0.2359	-1.4623	-0.3613	0.3174	-0.3319	0.8971	2.5396
	-1.01	-4.76**	-1.50	1.04	-2.51**	3.74**	6.34**
Coordination	-0.2078	0.9566	-0.40132	-1.0619	0.0201	0.2337	0.8138
	-1.52	5.25**	-3.02**	-6.23**	0.25	1.55	3.56**

t-statistics reported. ** 5% significance ($|\overline{t}|$ =1.96); * 10% significance ($|\overline{t}|$=1.64).

In Table 7, we show the results of the estimation of model (4) under the assumption of slow adjustment

to equilibrium. As one can notice, the estimated coefficients are in general consistent with the conclusions suggested by Table 6, although again they are significant at a lower confidence level than before. In particular, the values of the parameters on factor endowments represent evidence for weaker effects on comparative advantage. On the contrary, labor market institutions have almost always the same sign and significance as in Table 6, providing robustness of the above conclusions.

Tab. 7: Regression (4). Slow adjustment

	Food	Apparel	Paper	Chemic.	Glass	Metals	Machin.
S_{jct-1}	0.6331	0.6331	0.6331	0.6331	0.6331	0.6331	0.6331
	23.77**	23.77**	23.77**	23.77**	23.77**	23.77**	23.77**
TFP food	0.1511	-0.0946	0.0224	0.0355	-0.0686	-0.0726	-0.0598
	2.92**	-3.73**	0.55	1.38	-3.00**	-2.02**	-1.25
TFP apparel	-0.0946	0.0999	0.0541	0.0368	-0.0598	0.0126	-0.0521
	-3.73**	3.26**	1.78*	2.39**	-2.93**	0.55	-1.66*
TFP paper	0.0224	0.0541	0.2851	-0.0547	0.0787	-0.0189	-0.2213
	0.55	1.78*	4.41**	-1.97**	2.94**	-0.49	-3.80**
TFP chemic.	0.0355	0.0368	-0.0547	0.1501	-0.0435	-0.0421	-0.1102
	1.38	2.39**	-1.97**	4.76**	-3.08**	-1.59	-2.91**
TFP glass	-0.0686	-0.0598	0.0787	-0.0435	0.1292	0.0269	-0.0462
	-3.00**	-2.93**	2.94**	-3.08**	5.08**	1.34	-1.58
TFP metals	-0.0726	0.0126	-0.0189	-0.0421	0.0269	0.1951	-0.0483
	-2.02**	0.55	-0.49	-1.59	1.34	4.11**	-1.05
TFP machin.	-0.0598	-0.0521	-0.2213	-0.1102	-0.0462	-0.0483	0.4219
	-1.25	-1.66*	-3.80**	-2.91**	-1.58	-1.05	4.80**
Prod durable	0.1363	0.0897	-0.0456	-0.0146	0.0180	-0.0528	-0.1222
	3.14**	3.64**	-1.04	-0.31	0.86	-1.16	-1.76*
Nonres constr	0.0546	-0.1410	0.1014	0.1020	-0.0566	0.0046	-0.0215
	0.87	-3.80**	1.50	1.46	-1.81*	0.07	-0.20
High workers	0.0225	-0.0519	0.0181	0.0248	-0.0533	-0.0790	0.1034
	0.67	-2.45**	0.51	0.70	-3.11**	-2.31**	1.91*
Med workers	-0.0208	-0.0429	-0.0145	-0.0040	-0.0386	-0.0574	0.1161
	-0.46	-1.55	-0.32	-0.08	-1.72*	-1.22	1.60
Low workers	0.04110	0.0610	-0.0333	-0.0131	0.0078	-0.0171	-0.0826
	1.30	3.71**	-1.08	-0.37	0.55	-0.54	-1.61
Arable land	-0.0783	0.0488	0.0424	-0.0838	-0.0264	0.0909	-0.0776
	-1.07	1.28	0.58	-1.01	-0.78	1.23	-0.65
Union density	0.0248	-0.5341	-0.3749	-0.1810	-0.1996	0.0692	1.3484
	0.14	-4.93**	-2.04**	-0.99	-2.32**	0.39	4.71**
Coordination	0.0576	0.0850	-0.3014	-0.2585	0.0692	0.0966	0.2933
	0.69	1.71*	-3.54**	-2.83**	1.67*	1.05	2.24**

t-statistics reported. ** 5% significance ($|\bar{t}|$ =1.96); * 10% significance ($|\bar{t}|$=1.64).

Tables 8 and 9 offer some diagnostic tests. The hypothesis of no significance of all the parameters is always rejected at the 1% level. We also report the results obtained from the regression-based form of the Hausman test. We obtain that the institutional variables are possibly endogenous supporting our

choice of implementing a 3SLS estimation procedure.

Tab. 8: Diagnostic test Reg. (3)

Eq.	χ^2	p
Food	113.8595	0.0000
Apparel	90.9174	0.0000
Paper	80.6405	0.0000
Chemicals	222.2223	0.0000
Glass	163.6632	0.0000
Metals	202.1106	0.0000
Machinery	176.1196	0.0000
N. of obs = 265 N. of params = 15		
Hausman: χ^2_{14}= 186.67 p = 0.0000		

Tab. 9: Diagnostic test Reg. (4)

Eq.	χ^2	p
Food	827.5030	0.0000
Apparel	1656.2160	0.0000
Paper	823.0242	0.0000
Chemicals	1024.4170	0.0000
Glass	865.6775	0.0000
Metals	898.0333	0.0000
Machinery	988.6763	0.0000
N. of obs. = 243 N. of params = 16		
Hausman: χ^2_{21}= 47.07 p = 0.0000		

Finally, in Table 10 we report the correlation coefficients between predicted and actual (demeaned) values of the *gdp* share for each sector using the four models considered. The correlation coefficients are always positive.

Tab 10: Correlation between predicted and actual values

	Reg. (1)	**Reg. (2)**	**Reg. (3)**	**Reg. (4)**
Eq.	ϱ	ϱ	ϱ	ϱ
Food	0.4570	0.7538	0.4292	0.7536
Apparel	0.6700	0.9407	0.4308	0.9212
Paper	0.3271	0.6553	0.2791	0.6108
Chemic.	0.6709	0.8281	0.5298	0.8197
Glass	0.5628	0.8164	0.6009	0.8094
Metals	0.6134	0.7958	0.6333	0.7952
Machin.	0.4728	0.8396	0.5381	0.8276

4.3 Sensitivity analysis

In this subsection we present the results of a simple sensitivity analysis[16] and implement some control checks to face the complex issue of institutional interaction.

First, we test the robustness of our conclusions by introducing the total *gdp* per capita as an additional explanatory variable. Indeed, on the one hand, it may be argued that the union density rate can be a proxy for the total *gdp* per capita as poorer countries are more likely to have a lower union participa-

[16] Through the sensitivity analysis we want to examine whether our previous results are robust or fragile to: (*i*) changes in the conditioning information set (*i.e.* results are not altered if we include in the regression other explicative variables that might affect the specialization structure) and (*ii*) changes in the proxies chosen for the institutional variables, also allowing for interactions among different institutions.

tion. On the other, including this variable into our model is informative in order to control for possible domestic demand effects on the specialization structure. We obtained that the main conclusions derived in paragraph 4.2 remain almost unchanged even once the *gdp* effect is controlled for. In particular, the coefficients of the labor market institutions show the same sign and significance as, respectively, in Tables 6 and 7 (results are available upon request). This is interpreted as evidence for the robustness of our results.

In the remaining part of this paragraph, we deal with the issue of institutional interactions. As we have already noticed, the effects of each labor market institution in a certain country depend on the overall institutional framework considered and on the different relations of either complementarity or substitutability that may exist among the relevant variables. In particular, unionization patterns can be strongly affected by other variables that change the economic incentives to join a trade union (see for instance Checchi and Lucifora, 2002). Therefore, alternative institutional scenarios are likely to modify the nature of the mechanisms that we are investigating.

First, we allow for the possibility that the union density and the degree of bargaining coordination affect each other. To shed light on this issue, we regress the union density on the degree of bargaining coordination using a panel estimation with country fixed effect. We find a coefficient equal to -0.6884 (with $t = -2.81$). This result suggests a substitutability relation between the two variables[17]. To take account of this finding, we re-estimate our model using the difference between the union density and the bargaining coordination rate (that we call net union power or *nup*) rather than the two variables separately considered. We find that the coefficients on *nup* are negative and significant in the Apparel and Paper sectors, and positive and significant in the Metals and Machinery categories; no significant effect is found elsewhere. This result confirms our previous conclusions summarized in Table 6.

Second, we include into regression (3) other institutional variables in addition to the union density and the bargaining coordination rate. The aim is to control for possible interaction effects and to verify the sensitivity of the results to the institutional measures chosen in the previous regressions. Three variables that are usually considered relevant to the definition of the institutional climate that characterizes the

[17] The most evident examples of this phenomenon are France, Germany and Japan where the union density rate is below and the degree of bargaining coordination is above the OECD average.

domestic labor market are: employment protection legislation (epl), unemployment benefit replacement rate (brr) and unemployment benefit durations (bd). Then we repeat the estimation results for model (3) adding alternatively one of these three additional control variables[18]. Starting with epl, we find that our previous results are quite robust and all the conclusions derived in paragraph 4.2 remain unchanged. Furthermore, the coefficients on employment protection legislation are always nonsignificant but in the Chemicals sector where we obtain a positive value. Turning to the second control variable (brr), we notice that the introduction of the benefit replacement rate alters somewhat the output of the regression. Indeed, the own-TFP effects become nonsignificant in the Food, Apparel and Paper industries and are always weaker even when they remain significant. Interestingly enough, the effect of the union density on the sector share changes in the Apparel sector, where the correspondent coefficient is now nonsignificant, and in the Metals category, where it becomes negative (however, it is still positive and significant in the Chemicals and Machinery industries). The parameters correspondent to the unemployment benefit rate have negative and statistically significant values in the Apparel and Chemicals sectors, while positive and significant in the Paper and Metals ones, and are nonsignificant elsewhere. Finally, the inclusion of the benefit durations (bd) does not modify the previous conclusions in an important way. The correspondent coefficients are always nonsignificant but in the Apparel category where the estimated value is negative.

Summarizing, the introduction of the mentioned control variables reveal that interactions within the institutional system are important and their effects differ from sector to sector. Although our previous conclusions are in general robust to the implemented control checks, further research on these interaction effects is suggested.

5 Conclusions

The main goal of this paper is to study the role of different determinants of comparative advantage in the OECD countries: factor endowments, technological levels, and institutions. The basic econometric framework is provided by Harrigan (1997a) that includes the first two but not the third component of comparative advantage. Therefore, the contribution of the paper is twofold. First, we replicate Harrigan's

[18] As instruments we adopt political variables that summarize the cumulative number of, respectively, left, central and right seats held by all government parties from 1946 to the year of observation. First stage regression results again confirm the relevance of all the instruments. Econometric output is available upon request.

results extending his original sample to include more countries and a larger period of time. Second, we make explicit the effects of labor institutions on comparative advantage. To the best of our knowledge this is the first study that pursues this aim from an empirical point of view. The implemented analysis suggests a number of interesting conclusions.

Consistently with Harrigan (1997a), we find that technological levels are a very important determinant of the relative sectorial performance. Indeed, the own-TFP effects are almost always significant at a high confidence level and positive. Furthermore, such a result is very robust across different specifications.

With regard to the effects of relative factor endowments on international specialization, our results are in general very consistent with the theory (relative land abundance affects positively *gdp* share in the Food sector, relative labor abundance affects *gdp* share positively in the Apparel sector and negatively in highly capitalised industries). However, since they differ somewhat from the ones obtained by Harrigan, it may be argued that the factor endowments' effects are not very robust, neither across samples nor across alternative specifications. This finding hints that there exist other decisive elements that bias the effects of relative factor abundance as they are predicted by standard trade models.

Therefore, we include institutional variables in our framework. We find that these institutions have important effects that vary across sectors. In particular, on the one hand, the union density is found to have a negative effect on comparative advantage in the labor-intensive sectors and a positive effect in the capital-intensive ones. On the other hand, the bargaining coordination rate's coefficients are positive and significant in the sectors where the union density has the most important (either positive or negative) effects, while are negative and significant in sectors where the union density does not enter in an important way. This result suggests that interactions between different institutions are very likely to exist and affect economic performance. Finally, we control for the introduction of *gdp* per capita and alternative measures of labor institutions. We conclude in favor of the robustness of our results.

This paper is relevant in two main respects. First, it gives a contribution to the theory of international trade including a further determinant of the cross-border exchange patterns that is usually not taken into account. Second, it has important policy implications, in particular with regard to labor reforms and the debate on single peaked versus diversified capitalism (Freeman, 2000). Accordingly, as an increasingly

integrated international economy can potentially limit the freedom of individual countries in choosing their own model of governance, it may be asked: "*Can institutional differences persist in a global economy or does competitiveness require that labour institutions converge to a single dominant form?*" (Freeman, 2000: 1). In the light of the above empirical evidence, we argue that institutional differences may turn out to be a source of comparative advantage for individual countries. As a consequence, domestic governments might do better to design their own labor market institutions and interventions rather than to converge to a single institutional model.

Our results represent only a first contribution to explore the relation between institutions and relative economic performance. Some further steps in this direction are suggested. First, the issue of complementarity versus substitutability of different labor market institutions seems worth to be addressed in a rigorous way to understand how alternative institutions work in alternative regimes. Second, the focus of the debate may be profitably extended to developing countries.

6 Appendix A: Data description

Total factor productivity computation (TFP). Industry-specific data used for the TFP computation are taken from the Industrial Sectoral Data Base - OECD Statistical Compendium 1999/2. All the data are expressed in real terms. Labor input, l, is total employment (ET)[19]; value added, y ($GDPD$), and gross fixed capital stock, k ($KTVD$), are at constant prices, 1990 purchasing power parity US dollars. Labor share, s, is compensation of employees ($WSSS$) at current prices in national currency over gross domestic product (GDP). Included sectors are: 1- Food, beverages and tobacco (FOD$-ISIC$ 31), 2- Textile, wearing apparel and leather industries (TEX$-ISIC$ 32), 3- Paper and paper products, printing and publishing (PAP$-ISIC$ 34), 4- Chemicals and chemical petroleum, coal, rubber and plastic (CHE$-ISIC$ 35), 5- Non-metallic mineral products except products of petroleum (MNM$-ISIC$ 36), 6- Basic metal industries (BMI$-ISIC$ 37), 7- Fabricated metal products, machinery and equipment (MEQ$-ISIC$ 38)[20].

Sector shares (S_{jc}). The share of sector j is value added of sector j (at constant prices, 1990

[19] Lowercase letters refer to our variables, while uppercase letters refer to variables as they are defined in the OECD database.

[20] Wood ($ISIC$ 33) and other manufacturing ($ISIC$ 39) are excluded due to data shortage.

purchasing power parity US dollars) $-GDPD_j-$ over value added of total manufacturing $-GDPD_{MAN}-$. The data source is Industrial Sectoral Data Base - OECD Statistical Compendium 1999/2.

GDP per capita (*gdp*). GDP per capita in US dollars at current prices and 1990 exchange rates. The source is OECD Statistical Compendium 1999/2, National Accounts I.

Factor endowments:

Capital input. Capital input is classified in two different kinds of capital that are producer durable goods (*prod durable*) and other nonresidential constructions (*nonres constr*). They are obtained from the Comparable Welfare State Dataset (assembled by Huber, Ragin, and Stephens, 1997) that includes extended series from the original dataset − Penny World Table 5.6 (Summers and Heston, 1991). Capital stocks are expressed per worker. Data (originally at 1985 international prices) are converted in 1990 international prices by author's calculation.

Labor input. Labor force is classified in: workers with low education (*low workers*) that is equal to (*no.ed.* + *pri.ed.)*×*lab.for./100* (where *no.ed.* and *pri.ed.* are respectively the percentages of "no schooling" and "primary school attained" in the total population above 25, and *lab.for.* is labor force); workers with medium education (*med workers*) that is equal to *sec.ed.*× *lab.for./100* (where *sec.ed.* is the percentage of "secondary school attained" in the total population above 25); workers with high education (*high workers*) that is equal to *high.ed.*×*lab.for./100* (where *high.ed.* is the percentage of "higher school attained" in the total population above 25). Data on school attainment are from Barro and Lee (2000), while data on labor force are obtained from the OECD Employment Outlook Labour Force Statistics (2003). Data are expressed in thousands of persons.

Land input (*arable land*). Arable land is in thousands of hectares. The data source is World Development Indicators Database (2004).

Labor market institutions:

Data on labor market institutions are obtained from the Labour Market Institutions Database (Nickell and Nunziata, 2001). We use the following variables:

Net union density (*union density*). It is constructed as the ratio of total reported union members to wage and salaried employees.

Bargaining coordination (*coordination*). It is an index within the range $(1-3)$ increasing with the degree of coordination in the bargaining process on the employers as well as on the unions side.

Employment protection legislation (*epl*). It is an index within the range $(1-2)$ increasing with the strictness of employment protection.

Benefit replacement rates (*brr*). The benefits are a percentage of average earnings before tax and refer to the first year of unemployment benefits, averaged over family types of recipients.

Benefit durations (*bd*). It is an index constructed as a weighted average of the unemployment benefit replacement rate received during the first five years of unemployment.

Political variables:

Political variables are obtained from the Comparable Welfare State Dataset (Huber, Ragin, and Stephens, 1997) and are listed below:

Cumulative percentage of left seats. It is the cumulative number of left seats held by all government parties from 1946 to the year of observation.

Cumulative percentage of right seats. It is the cumulative number of right seats held by all government parties from 1946 to the year of observation.

Cumulative percentage of center seats. It is the cumulative number of center seats held by all government parties from 1946 to the year of observation.

7 References

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