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Does Employment Protection Legislation Affect Firm Investment? The European Case

Giorgio Calcagnini *and Germana Giombini †

Abstract

This paper aims at analyzing the impact of Employment Protection Legislation (EPL) on firms' investment policies in the presence of financial imperfections. Our results show that investment is positively correlated to measures of internal funds available to firms and negatively to the level of national labour market regulation. Moreover, the latter is stronger wherever financial market imperfections are larger: firms with better access to financial markets are in a position to determine their optimal investment policy, even in the presence of stringent Employment Protection Laws, than those facing financial constraints. Our results support the effort put forward by European institutions in recent years to reform both markets.

Keywords: Employment Protection Legislation, Financial Constraints, Investments.
JEL Classification: J30, D92, C23.

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1 Introduction

This paper aims at analyzing the impact of Employment Protection Legislation (EPL) on firms' investment decisions in the contemporaneous presence of financial imperfections. Traditionally, the impact on investment of financial market imperfections has been analyzed separately from that of labour market imperfections. Consequently, policy design focused on each single market and did not fully take into consideration the functioning of the other market. Analyzing how investment reacts to conditions prevailing in both the financial and labour markets may provide a better description of firms' fixed capital accumulation strategies and a more realistic set-up within which more efficient economic policies may be designed and implemented.

There are not many papers that investigate the joint influence of imperfect financial and labour markets on investment. The impact of credit and labour market imperfections on investment has been theoretically analyzed in Rendon (2004), where it was shown that job creation is limited by financing constraints even in the presence of a flexible labour market, and in Wasmer and Weil (2002). The latter, by proposing a macroeconomic model and treating credit and labour market imperfection symmetrically, find that credit market conditions may impact labour market equilibrium. Belke and Fehn (2000) present a macro model in which capital market imperfections exacerbate structural unemployment caused by labour market rigidities. On the empirical side, Calcagnini and Saltari (2003) analyze a reduced form investment model with financing constraints and labour market rigidities.

Of the two strands of the economic literature that study how imperfections affect investment, the one related to financial markets is likely the best known, debated and empirically tested. Briefly stated, in the presence of imperfect financial markets the Modigliani and Miller propositions (Modigliani and Miller, 1958, 1963) fail to hold. Asymmetric information and agency problems make the cost of internal finance lower than that of external finance. Thus, as a hierarchy of financing structures arises, firms are

more likely to be financially constrained, and investment decisions become sensitive to the availability of internal funds (Fazzari Hubbard and Petersen, 1988; Whited, 1992).[1]

As for the influence of labour market imperfections on investment, theoretical and empirical contributions are scantier.[2] They may be divided into two separate strands: a more traditional one that emphasizes the impact of labour market regulations on firms' costs and profits, and consequently on investment (Nickell and Layard, 1999; Nickell, 2003; Blanchard, 1997 and 2000; Blanchard and Wolfers, 2000); and a second one according to which, in the presence of labour market institutions, firms are more limited in the kind of policies they can undertake to face shocks (Denny and Nickell, 1992).[3] However, more "institutional rigidities" do not necessarily result in a negative impact on investment. Indeed, on one hand, labour market institutions are expected to reduce current investment by increasing firm adjustment costs over time but, on the other, they may positively influence investment decisions through firms' optimal labour demand (Bentolila and Bertola, 1990; Bertola, 1999). If "institutional rigidities" make capital readily accessible by increasing the cost of labour relative to the user cost of capital, they will favour the substitution of labour with capital (Caballero and Hammour, 1998). Which of the two effects on investment dominates will depend upon the parameter values of the model utilized to describe firm decisions.

Labour market institutions are difficult to measure and, therefore, there is no a general consensus among scholars on which indicator is the most appropriate one to utilize in empirical analyses. However, it is now an internationally widespread custom to measure labour market institutions by means of the Employment Protection Legislation (EPL) index (OECD, 1999 and 2004): higher EPL values mean more rigid labour markets. Recently, Nickell (2006) reviewed the main labour market indicators for the OECD

[1] For a critical survey on theoretical and empirical models of investment with financial constraints see Hubbard (1998), Saltari (2004).

[2] A review of the existing literature is found in Young (2003).

[3] As pointed out by Alesina *et al.* (2005), who analyze the impact of product market regulation on investment, regulation can increase the cost the firm faces by expanding its productive capacity, and limits its capacity to respond to changes in fundamentals.

countries (EPL, Union Density and Coverage, Bargaining Coordination and Centralization, among others). Alternatively, information can also be found on the Fondazione Rodolfo DEBENEDETTI web site, that provides detailed data on labour market laws for some European countries, but does not include a concise index.

This paper improves on existing empirical literature in two ways. First, we specify a simple neoclassical model that incorporates financial constraints and an adjustment cost function that depends on the investment rate and the level of labour market regulation. We assume that investment adjustment costs are a convex function of the investment rate and of Employment Protection Legislation. EPL increases the cost that firms bear when expanding or reducing their productive capacity due to the presence of hiring and firing costs and, therefore, limits their ability to respond to changes in fundamentals. Second, we estimate, by means of GMM system techniques, an empirical investment equation that summarizes the relationships among variables in our theoretical model by making use of a large dataset of individual manufacturing companies located in ten European countries.

As in Denny and Nickell (1992), who analyze whether unions influence investment directly, the idea here is that EPL not only influences investment via wages, and complementarities and substitutabilities with the labour factor, but it also does so more directly. Indeed, "*the installation of new machinery often requires changes in work practices if the new capital is to be operative at peak efficiency. The presence of [EPL] may inhibit these changes, thereby adding the effective cost of installation.*" (Denny and Nickell, 1992, p. 874). Eventually, the authors find that the impact of current and expected future union power is negative.

By solving our model we were able to write down a decision making rule for investment as a function of the marginal q and of financial and labour market variables. This rule clearly shows that both financial and labour market imperfections hinder investment and that, as might be expected, the contemporaneous presence of both imperfections makes investing more difficult.

Our approach has attractive properties.

First, it provides us with an equation suitable for empirical analysis, after that simplifying assumptions are made.

Second, it clearly signs the impact of EPL on investment.

Third, the results we reached at the firm level can be extended to the macroeconomic level since investment q models with quadratic adjustment costs and a representative agent predict smooth investment both at the microeconomic and at the macroeconomic level.

Our empirical findings show that investment is positively correlated to measures of firm availability of internal funds and negatively to the level of national labour market regulation. Moreover, the latter is stronger wherever financial market imperfections are larger. Indeed, when a negative shock occurs, firms may face the following trade-off: keep losing money on unproductive workers, or fire them and pay the dismissal costs (Rendon, 2004; Saint-Paul, 2002). Indifferently from the type of shocks (temporary or permanent), firms will need to generate either additional internal funds or cut (or delay) their investment plans if they are unable to access external funds or find the cost of this decision excessive. In other words, firms with better access to financial markets are in a position to determine their optimal investment policy, even in the presence of stringent Employment Protection Laws, than those facing financial constraints.

Second, we find that small enterprises are less affected by the degree of labour market regulation than larger ones. Indeed, EPL mostly applies to companies that exceed a legally determined number of employees. In Italy, for instance, such a threshold has been set at 15 employees and its existence has been analyzed as one of the causes for the wide presence of small businesses within the Italian economy. Both Garibaldi *et al.* (2003) and Schivardi and Torrini (2004) find that these threshold effects are significant and robust, but quantitatively small.

Notwithstanding our effort to analyze investment decisions in a more general framework than the traditional one, the nature of our analysis is still one of partial equilibrium,

where key elements, such as the insurance role of EPL (Pissarides, 2001), or the interaction between product and labour market regulation (Nickell, 1999; Blanchard and Giavazzi, 2003; Amable and Gatti, 2004; Fiori *et al.*, 2007) are left out of the model. Keeping in mind this limitation, our results support the effort put forward by the European institutions in recent years to reform both the financial and labour markets. Indeed, European financial policies increased the access to finance for a larger number of companies and reduced its cost. For instance, the introduction of a single unit of account has standardized the expression of prices of financial products and simplified financial transactions. This standardization yielded important economies in transactions costs because it made financial markets more transparent (Giavazzi *et al.*, 2000). At the same time, the loosening of labour market institutional rigidities favoured an increase of the investment share devoted to capacity expansion (Calcagnini *et al.*, 2006).

The rest of the paper is organized as follows. Section 2 describes the theoretical model, while Section 3 describes our dataset and the way variables are constructed, presents and discusses our empirical results. Finally, Section 4 concludes.

2 Optimal investment in the presence of financial and labour market imperfections

We consider a model in which a risk-neutral firm maximizes the value of its equity V_t

$$V_t = E_t\{\sum_{i=0}^{\infty} \beta^i (D_{t+i} - N_{t+i})\} \tag{1}$$

where D_t are dividends paid in period t, N_t is the value of new equity issued in period t, $\beta = 1/(1+r)$ is a constant discount factor, E_t is the expectations operator conditional on information available at time t, and it is taken over future input and output prices and technologies.

The firm produces in a competitive environment with a constant return to scale

technology of the form

$$Y_t = AF(K_t, L_t) \tag{2}$$

where K is capital, L is labour, and A is constant technical progress.[4]

The firm faces the following laws of motion for capital and labour

$$K_{t+1} = (1-\delta)K_t + I_t \tag{3}$$

and

$$L_{t+1} = (1-\gamma)L_t + H_t \tag{4}$$

where I_t denotes gross investment and H_t denotes hiring (if $H_t > 0$) or firing (if $H_t < 0$).[5] Moreover, we assume a constant and exogenous rate of depreciation of capital, δ, and a constant and exogenous rate of voluntary quitting by workers, γ. Given the time notation, both investment and hiring at time t do not contribute to productive capital and labour, respectively, until period $t+1$. Therefore, K_t and L_t depend only on past investment and hiring decisions.

The firm bears continuous and convex adjustment costs in terms of foregone production, assumed to be additively separable in gross investment and in job turnover as follows

$$C(I_t, H_t, K_t, L_t, EPL_t) = \theta_1^{EPL_t}[\frac{a}{2}(\frac{I_t}{K_t})^2 K_t] + \theta_2^{EPL_t}[\frac{b}{2}(\frac{H_t}{L_t})^2 L_t] \tag{5}$$

where the parameters a $(0 < a < 1)$ and b $(0 < b < 1)$ denote the importance of investment and labour adjustment costs, respectively. The parameters θ_1 $(\theta_1 > 1)$ and

[4]Imperfect competition can be allowed for by assuming that firm faces an isoelastic demand function of the form

$$P_t = Y_t^{\frac{1-\eta}{\eta}}$$

where η $(\eta \geq 1)$ is a markup parameter that takes the value equal 1 under perfect competition. In this setting, the difference between the price maker's profits and the price taker's profits is $\xi P_t F(K_t, L_t)$, where $\xi = \frac{\eta}{1-\eta}$ is the inverse of demand elasticity for the firm's output (Hayashi, 1982). In the presence of imperfect competition, the interaction between labour and product market regulations may generate different outcomes, according to their being complement or substitute policies (Fiori *et al.*, 2007).

[5]Without loss of generality, we assume that the firm in each period either hires or fires.

θ_2 ($\theta_2 > 1$) make the adjustment costs of investment and labour higher as long as some level of Employment Protection is present ($EPL_t > 0$).[6]

In general, $\theta_1 \lesseqgtr \theta_2$ so that the impact of EPL_t on investment adjustment costs may be different from that on labour adjustment costs. For instance, if $\theta_1 < \theta_2$, it is likely that a decrease in EPL_t may, *ceteris paribus*, favour labour demand relatively more than investment demand and, consequently, determine a change in the economy capital-labour ratio.[7]

As for the financial market, we assume that issuing new equity is the only source of external finance and that the firm may be financially constrained because of asymmetric information and transaction costs. Specifically, the firm bears a fixed cost premium of external finance as follows (Bond and Söderbon, 2006)

$$\Phi(N_t) = \phi N_t \tag{6}$$

where ϕ is a parameter that reflects the size of the cost premium for external finance.

The sources-equal-uses constraint is

$$D_t - N_t = \Pi_t - \Phi_t \tag{7}$$

where the net revenue function Π_t is given by

$$\Pi_t = P_t[Y_t - C(I_t, H_t, K_t, L_t, EPL_t)] - P_t^K I_t - W_t L_t \tag{8}$$

where P_t is the output price, P_t^K is the price of capital and W_t is the salary. Under the assumption of perfect competition, prices are given.

The firm maximizes V_t subject to the laws of motion of K and L, to the non negative constraint on dividend and new equity issues with shadow values λ_t^D and λ_t^N, respectively

[6]We assume quadratic adjustment costs of employment that depend on gross hiring and firing. However, turnover adjustment costs could depend on hiring and firing, but not on voluntary quitting, and could be asymmetric; e.g.: Nilsen, Salvanes and Schiantarelli (2007) develop a q model of labor demand, allowing for the presence of fixed, linear and quadratic components of adjustment costs.

[7]On this topic see European Commission (2001), Graph 9, p.114: the second part of the Nineties, when most European countries carried out reforms that made their labour markets more flexible, is characterized by a lower increase in the capita-labour ratio than in the US where EPL levels are the lowest among industrialized economies.

$$
\begin{aligned}
V(K_t, L_t) &= \max_{I_{t+s}, H_{t+s}, N_{t+s}} \{\Pi_t - \Phi(N_t) + \lambda_t^D[\Pi + N_t - \Phi(N_t)] + \lambda_t^N N_t \\
&+ \beta E_t[V_{t+1}((1-\delta)K_t + I_t, (1-\gamma)L_t + H_t)]\}. \qquad (9)
\end{aligned}
$$

The first order conditions (FOCs) for the maximization problem (9) are as follows.[8]

The first order condition for investment is

$$
-\Pi_{I_t}(1 + \lambda_t^D) = \beta E_t(V_{K_{t+1}}) \qquad (10)
$$

that yields

$$
-\Pi_{I_t} = \frac{\lambda_t^K}{1 + \lambda_t^D} \qquad (11)
$$

where $\Pi_{I_t} = \partial \Pi_t / \partial I_t$, $V_{K_{t+1}} = \partial V_{t+1} / \partial K_{t+1}$ is the shadow value of capital, and $\lambda_t^K = \beta E_t(V_{K_{t+1}})$ is the shadow value of investment. The left hand side of equation (10) is the marginal cost associated with an additional unit of capital, whereas the right hand side is its marginal benefit in terms of the present expected marginal value of the firm. At the optimum the marginal cost has to be equal to the marginal benefit.

The evolution of the shadow value of capital along the optimal path is

$$
V_{K_t} = (1 + \lambda_t^D)(\Pi_{K_t}) + \beta E_t V_{K_{t+1}}(1 - \delta) \qquad (12)
$$

where $\Pi_{K_t} = \partial \Pi / \partial K_t$ is the marginal increase in the net revenue due to an additional unit of capital.

Similarly, the first order condition for hiring (firing) is

$$
-\Pi_{H_t}(1 + \lambda_t^D) = \beta E_t(V_{L_{t+1}}) \qquad (13)
$$

that yields

$$
-\Pi_{H_t} = \frac{\lambda_t^L}{1 + \lambda_t^D} \qquad (14)
$$

where $\Pi_{H_t} = \partial \Pi_t / \partial H_t$, $V_{L_{t+1}} = \partial V_{t+1} / \partial L_{t+1}$ is the shadow value of labour, and $\lambda_t^L = \beta E_t(V_{L_{t+1}})$ is the shadow value of hiring.

[8] In the presence of additively separable adjustment costs, FOCs for capital are independent of labour decisions, and viceversa.

The evolution of the shadow value of labour along the optimal path is

$$V_{L_t} = (1 + \lambda_t^D)(\Pi_{L_t}) + \beta E_t V_{L_{t+1}}(1 - \gamma). \tag{15}$$

The first order condition for new shares is

$$-\Phi_{N_t} - \lambda_t^D \Phi_{N_t} + \lambda_t^D + \lambda_t^N = 0 \tag{16}$$

that yields the shadow value of dividends as

$$\lambda_t^D = \frac{\Phi_N - \lambda_t^N}{1 - \Phi_N}. \tag{17}$$

If new shares are issued ($\lambda_t^N = 0$) equation (17) becomes

$$\lambda_t^D = \frac{\Phi_N}{1 - \Phi_N} \tag{18}$$

which, by using equation (6) may be written as

$$\frac{1}{1 + \lambda_t^D} = 1 - \phi. \tag{19}$$

Substituting the definitions of net revenue (8) and the equation (19) in the investment first order condition (11) we obtain

$$(P_t^K + P_t C_{I_t}) = \frac{\lambda_t^K}{1 + \lambda_t^D} = \lambda_t^K (1 - \phi). \tag{20}$$

Now, if we substitute the first derivative of the adjustment costs function (5) into the above equation (20) and solve for I_t/K_t , the investment ratio turns out to be a function of the ratio of the shadow value of an additional unit of capital to its purchase cost, or marginal q ($q = \lambda_t^K / P_t^K$), and it is negatively affected by the cost of external finance ϕ, and by the level of Employment Protection $\theta_1^{EPL_t}$

$$(\frac{I}{K})_t = \frac{1}{\theta_1^{EPL_t}} \frac{1}{a} [q_t(1 - \phi) - 1] \frac{P_t^K}{P_t}. \tag{21}$$

Equation (21) shows that the optimal investment rate is lower than in the standard q model both because of financial market and labour market imperfections.[9,10,11]

3 Data Description and Model Estimation

3.1 Data Description

The data used in this paper come from several sources.

Annual firm-level observations over the period 1994-2000 are taken from AMADEUS, a comprehensive, pan-European database containing financial information on public and private companies in 38 European countries. The data set covers all sectors, with the exception of the financial sector. It is produced by Bureau van Dijk (BvD), whose local providers collect balance sheet information, sectors of operation, and number of employees from the national Chambers of Commerce. To allow for comparability, BvD has developed a uniform format, composed by 23 balance sheet items, 25 profit and loss account items, and 26 standard ratios. Additional information, such as industry and activity codes, the incorporation year of the firm in the register, and the quoted/unquoted indicator, complete the dataset. There are several versions of AMADEUS, depending on the number of firms included in the dataset. In this paper we focus our analysis on 10 European countries.

To generate real variables we use national price deflators available from the Annual Macroeconomic (AMECO) database provided by the European Commission's Directorate General for Economic and Financial Affairs (DG ECFIN).

[9] As for financing constraints, Bond and Söderbon (2006) show that three different financial regimes for firms may be detected: unconstrained ($D > 0$ and $N = 0$), constrained ($D = 0$ and $N = 0$), and external finance regime ($D = 0$ and $N > 0$). Investment displays excess sensitivity to cash flow fluctuations if the firm is in the constrained regime or moves from the external finance regime to either one of the other regimes because of cash flow shocks. As expected, marginal q is not a sufficient statistic for investment rates in the model with an increasing cost premium for external funds.

[10] Rendon (2004) reaches similar results by using a dynamic model of labour demand under liquidity constraints. Indeed, by means of computer simulation, he shows that firm's investment increases when labour market rigidities or financial constraints are made easier.

[11] Symmetrically, we can obtain a similar hiring (firing) rule for the labour input.

Table 1 shows summary statistics by Country.[12] Our final sample contains 2669 firms of which only 82 are listed.[13] We have a total of more than 10,000 observations for each variable of interest, and the observation period used in the estimates runs from 1994 to 2000. However, the panel data is unbalanced with gaps and the average stay of the firms in the sample is 3 years.

Tables 2 and 3 show detailed investment rate statistics. The former shows the percentile distribution by country, while the latter shows the distribution of investment rates according to different threshold values. These statistics show significant cross-country variability in investment rates and in their range of values for the whole sample. Specifically, the sample contains 1483 episodes of negative investment, and more than 5000 episodes of positive spikes.[14]

Different measures of Employment Protection are available to scholars. Table 4 shows descriptive statistics for the EPL indicators used in this paper.

We present estimates obtained by using the latest OECD EPL index (OECD, 2004), Version 1, that accounts for regular and temporary workers. EPL for regular workers mainly concerns the costs for employers of firing workers with regular contracts and it is measured according to the strictness in the regulations for regular procedural inconvenience, notice and severance pay for no-fault individual dismissals, and difficulty of dismissals. The strictness of EPL for temporary workers mainly concerns hiring practices such as type of contracts considered acceptable or number of successive contracts or renewals. The index is measured both for the fixed-term contracts and for temporary agency workers. The overall EPL index ranges theoretically from 0 to 6. In our sample the EPL ranges from 0.6 to 3.7. However, the OECD index shows little time variation (especially over the period up to 2000 that is the period for which we have available the AMADEUS dataset) and it may present some limitations (Bertola *et al.*, 2000; Del

[12]Data Appendix discusses the sample selection procedure.

[13]The 82 listed firms are 1 Austrian, 2 Belgian, 2 British, 10 Finnish, 25 French, 22 German, 11 Italian, 9 Spanish.

[14]The papers by Cooper, Haltiwanger and Power (1999), Cooper and Haltiwanger (2006) define spikes to be cases where investment relative to the beginning of period capital is greater than 20 percent.

Conte *et al.*, 2004). Therefore, Section 3.4, also presents some robustness checks by using two other indicators. Specifically, we first use the index (EPL_BW) that was developed by Blanchard and Wolfers (2000) and updated by Nickell *et al.* (2001) and Gòmez-Salvador *et al.* (2004). The EPL_BW index is scaled from 0 to 6 as the OECD index, and in our sample ranges from 0.50 to 3.82. EPL_BW exhibits greater time variability than EPL_OECD, but, to a large extent, this variability is due to the interpolation of previous EPL measures as calculated by Lazear (1990) and the OECD.

Second, we develop a new index (EPL_fRDB) starting from information available on the Fondazione Rodolfo DEBENEDETTI web site (fRDB). The fRDB hosts a documentation centre on social policy reforms and the EU labour markets. We constructed our index by using information available in the Social Reforms database on social reforms in the EU15 countries (except Luxembourg) over the period 1987-2005. The Data Appendix describes the methodology we followed to construct the fRDB index.

Table 1: **Summary Statistics, 1994-2000**

Country		**I/K**	**CF/K**	**LIQ/K**	**Usercost**	**Workers**	**Rtas**	**Δ (VA/K)**	**EPL**
Austria	Obs.	69	68	68	80	49	78	52	80
	mean	.138	.331	.588	1.029	801.122	.075	.040	2.2
	median	.081	.273	.383	1.040	706	.061	.030	2.2
	sd	.218	.236	.485	.017	391.221	0.071	.545	0
Belgium	Obs.	655	654	653	816	809	809	493	816
	mean	.307	.729	1.548	1.100	210.143	.070	.195	2.417
	median	.226	.552	.890	1.110	112	.045	.124	2.2
	sd	.364	.618	2.445	.027	316.747	.080	1.774	.412
Finland	Obs.	294	294	294	294	270	293	222	294
	mean	.131	.640	1.353	1.102	671.256	.129	.214	2.1
	median	.063	.322	.518	1.113	196.5	.110	.065	2.1
	sd	.235	1.698	4.505	.016	1786.439	.149	1.857	0
France	Obs.	2767	2763	2747	3438	2828	3284	2102	3438
	mean	.323	1.305	3.364	.995	425.886	.105	.317	3
	median	.231	.664	1.265	.992	183	.089	.067	3
	sd	.412	3.505	9.993	.017	974.865	.082	24.651	0
Germany	Obs.	280	280	280	350	312	347	211	350
	mean	.129	.312	.589	1.003	1491.071	.098	.064	2.717
	median	.074	.270	.412	1	856	.092	.024	2.5
	sd	.206	.193	.643	.019	1802.019	.075	.572	.285
Great Britain	Obs.	687	687	687	858	850	853	516	858
	mean	.209	.449	.748	.769	697.789	.122	-.159	.613
	median	.163	.275	.407	.720	249.5	.101	-.081	.6
	sd	.230	.638	1.151	.114	1825.114	.104	.764	.030
Italy	Obs.	4501	4499	4480	5593	5415	5417	3420	5593
	mean	.347	.997	1.772	.912	242.111	.080	.002	3.081
	median	.240	.392	.649	.901	121	.055	-.001	3.26
	sd	.440	9.166	9.830	.030	695.468	0.082	5.878	.415
The Netherlands	Obs.	51	51	51	64	63	63	38	64
	mean	.256	1.037	3.329	1.019	1078.937	0.154	-.048	2.55
	median	.168	.510	1.058	1.019	265	0.138	.137	2.7
	sd	.349	1.033	5.019	.009	2714.256	0.099	1.198	.262
Portugal	Obs.	24	24	24	32	29	32	16	32
	mean	.171	.257	.376	1.069	371.276	0.023	.004	3.7
	median	.100	.219	.233	1.074	291	0.015	-.020	3.7
	sd	.260	.154	.393	.027	259.432	0.038	.372	0
Spain	Obs.	1576	1577	1577	1968	1606	1950	1186	1968
	mean	.258	.842	1.675	1.008	248.016	0.099	.148	2.962
	median	.191	.449	.740	1.019	136	0.075	.017	2.9
	sd	.341	2.385	5.512	.028	894.557	0.096	1.928	.096
Total	Obs.	10904	10897	10861	13493	12231	13126	8256	13493
	mean	.303	.969	2.037	.957	363.120	.093	.112	2.809
	median	.214	.451	.759	.973	150	.072	.010	3
	sd	.398	6.231	8.446	.084	1011.919	.089	13.034	.678

Table 2: **Investment Rates: percentiles by Country, 1994-2000**

Country	**p10**	**p25**	**p50**	**p75**	**p90**
Austria	-.122	-.000	.081	.267	.498
Belgium	-.033	.074	.226	.467	.710
Finland	-.080	-.017	.063	.209	.422
France	-.002	.095	.231	.423	.709
Germany	-.068	-.015	.074	.236	.406
Great Britain	.000	.062	.163	.302	.476
Italy	-.014	.085	.240	.457	.793
The Netherlands	-.033	.021	.168	.388	.632
Portugal	-.086	-.016	.100	.247	.496
Spain	-.041	.041	.191	.372	.619
Total	-.023	.069	.214	.412	.704

Table 3: **Distribution of Investment Rates, 1994-2000**

I/K	**Observations**	**Percentiles**
$I/K < 0$	1483	13.6
$I/K = 0$	5	0.0
$0 < I/K < 0.02$	331	3.0
$0.02 \leq I/K < 0.08$	1125	10.3
$0.08 \leq I/K < 0.12$	792	7.3
$0.12 \leq I/K < 0.2$	1476	13.6
$0.2 \leq I/K < 0.3$	1653	15.1
$I/K > 0.3$	4039	37.0
Total	10904	100

Table 4: **EPL Indicators. Summary Statistics, 1994-2000**

	EPL_OECD	**EPL_BW**	**EPL_fRDB**
mean	2.81	2.96	0.82
max	3.70	3.82	1.11
min	0.60	0.50	0.10
sd	0.68	0.74	0.22

3.2 Model Estimation

To make equation (21) suitable to estimation, taking into account information contained in our dataset, some changes concerning the variables and the equation specification were needed.

First, as explained in the Section 3.1, most of the firms for which we have balance-sheet data are not listed. Therefore, for these firms, we were unable to construct any measure of individual marginal or average q, as would be the case for listed companies. We decided to substitute the marginal q with a profitability variable, namely the return on total assets ($RTAS_{i,t}$).

For the purpose of checking result robustness, we also estimated equation (21) by substituting the profitability variable with an accelerator-type variable, i.e. the change between two consecutive years of the value added - total fixed assets ratio ($\Delta(VA/K)_{i,t}$) in place of $RTAS_{i,t}$.

Second, financial market imperfections are embedded in equation (21) by means of the ϕ term. The larger financial market imperfections are, the higher ϕ is, the lower q and investment are. Here, to explicitly take into account financial market imperfections, we followed the nowadays traditional approach of adding a liquidity variable in the investment equation. Indeed, in the presence of financial constraints, investment becomes sensitive to the availability of internal sources of finance. The liquidity variable we used is total cash-in-hand available to the firm, $(LIQ/K)_{i,t}$, instead of the cash-flow variable.[15] Our choice concerning the liquidity variable is also supported by the fact that $(LIQ/K)_{i,t}$ is strongly and positively associated (the correlation coefficient is $r = 0.72$) with an index of financing obstacles obtained from the World Business Environment

[15] Among others, Calcagnini and Saltari (2003) argue that cash flow might not efficiently measure the extent to which investment depends on internally generated funds. A main concern, in addition to the Kaplan and Zingales critique (Fazzari, Hubbard and Petersen, 1988, 2000; Kaplan and Zingales, 1997, 2000; Cleary, Povel, and Raith, 2004), is the fact that cash flow depends on balance sheet policies, and therefore is more an accounting variable than an economic variable. Moreover, investment may also depend on the availability of other, less volatile, financial resources. See also Bond *et al.* (2004) for a discussion about measurement errors and the explanatory power of cash flow.

Survey (WBES), a cross-national survey conducted in developed and developing countries in 1999 by the World Bank and published in Beck et al. (2002), Table I, p.39. This correlation is only 0.37 between the WBES index and the cash-flow.

Third, the interaction between financial and labour market imperfections, represented by the last term of equation (21), is included in our empirical equation by the $(LIQ/K)_{i,t} * EPL_{j,t}$ variable.

Fourth, we added the previous period investment rate $(I/K)_{i,t-1}$, to equation (21) to take into account the likely presence of the autoregressive process in observed investment.

Fifth, the price ratio $P^K_{j,t}/P_{j,t}$, or user cost of capital, is calculated at the country level. Therefore, we assume that changes in the user cost of capital among firms can be controlled for by additive year-specific effects, d_t, and firm-specific effects, η_i. Firm-specific effects are also justified by the variability of capital depreciation rates across firms (Bond and Meghir, 1994).

Sixth, the model includes country dummies, φ_j that control for the heterogeneous environment in which firms operate. In the absence of country dummies, the EPL index may capture other aspects, different from the tightness of Employment Protection.

Finally, given the impossibility to estimate the original structural equation as a function of q, we opted for a version of equation (21) where investment is linearly dependent on explanatory variables.[16]

Therefore, our empirical specification of equation (21) is

$$\begin{aligned}(I/K)_{i,t} &= \beta_0 + \beta_1(I/K)_{i,t-1} + \beta_2 RTAS_{i,t} + \beta_3 P^K_{j,t}/P_{j,t} + \beta_4 EPL_{j,t} \\ &+ \beta_5(LIQ/K)_{i,t} + \beta_6(LIQ/K)_{i,t} * EPL_{j,t} + d_t + \eta_i + \varphi_j + v_{it} \qquad (22)\end{aligned}$$

where the subscript i refers to the single company, t to the time period, and j to the country.

[16] At first we thought of taking logs of equation (21), but because of the negative values in the investment rate series, as is also the case for the other two variables $RTAS$ and $\Delta(VA/K)$, we decided to work with the original variables.

As for the sign of the coefficients in equation (22), we expect a positive sign for β_1, β_2, β_5, and a negative sign for β_3, β_4, β_6.

To estimate our model we dealt with an unbalanced panel data of firms, and, given the dynamic structure of equation (22), we used the system GMM estimator approach as in Blundell, Bond, and Windmeijer (2000), and Blundell and Bond (1998). This method controls for the presence of the unobserved firm-specific effect and for the endogeneity of contemporaneous regressors. It uses equations in first-differences for which endogenous variables lagged two or more periods will be valid instruments, provided there is no serial correlation in the time varying component of the error term. This assumption is tested by performing tests for serial correlation in the first differences residuals. The equations in differences are combined with the equations in levels, for which lagged differences of the variables are used as instruments. AR(1) and AR(2) are the empirical realizations of the test statistics of first and second order residual autocorrelation. Significance means that the null hypothesis of no autocorrelation is rejected. The absence of AR(2) is the necessary condition for unbiased and efficient estimates.

We use the one-step variant of the system GMM and we require that the robust estimator of the covariance matrix of the parameter estimates be calculated. Therefore, the resulting standard error estimates are consistent in the presence of any pattern of heteroskedasticity and autocorrelation within the panel. Instruments' validity is tested by using the Hansen J test for overidentified restrictions, that, differently from the Sargan test, is robust to autocorrelation or heteroskedasticity.[17]

3.3 Discussion of Results

Estimation results for the investment equation (22) are shown in Table 5. The latter shows six different specifications of equation (22) that we will discuss in turn.

Column (1) shows the base model. All estimated coefficients, with the exception

[17]Indeed, Arellano and Bond (1991) find the one-step Sargan test over-rejects in the presence of heteroskedasticity. Moreover, we test the exogeneity of each instrument subset by difference-in-Sargan tests and we do not reject the null of exogeneity.

of the user cost of capital coefficient, β_3, are statistically significant at conventional probability levels. As expected, investment shows a persistent autoregressive dynamic ($\beta_1 = 0.568$). Moreover, the return on the total assets coefficient is positive and statistically significant, as well as the estimated liquidity index coefficient. The latter result supports the hypothesis that, on average, firms in our dataset show excess sensitivity to the availability of internal liquidity sources or, equivalently, that financial market imperfections do likely exist.[18]

The estimated coefficient of current EPL is negative and statistically significant, as well as the coefficient of the interaction variable between EPL and the liquidity index. Together, these two results show that labour market imperfections are detrimental for investment and that their effects are larger in the contemporaneous presence of financial market imperfections.[19]

The empirical model in column (2) of Table 5 takes into account the fact that EPL usually applies differently to firms according to their size. Indeed, EPL is often stricter when applied to firms with a number of employees larger than a legally determined threshold (OECD, 2004).[20]

Therefore, by means of information obtained from Bertola, Boeri and Cazes (1999) and from Bonin (2005), we defined a new dummy variable, $SIZE_{i,t}$ that takes value equal to 1 when the firm is exempted from EPL according to the number of employees. Overall, our sample contains 61 firms exempted from EPL of which 43 are Spanish, 3 are French, and 15 are Italian.

Therefore, our base equation (22) was changed by simply adding the new dummy

[18]Since β_6 is negative, to analyze the overall impact of liquidity on investment, we run the following F test

$$\beta_5 + \beta_6 * \overline{EPL} = 0$$

where $\overline{EPL}$ is the sample mean value of EPL. The F test result rejected the null in favour of a positive impact of (LIQ/K) on investment.

[19]Estimates in Table 5 do not significantly change if we add industry or legal origin dummy variables to equation (22). Estimates available upon request from authors.

[20]Boeri and Jimeno (2005) look for discontinuity in dismissals probability at the threshold defining the range exempted from EPL. Messina and Vallanti (2007) make inferences on the impact of EPL by exploiting the within country variation in the enforcement of EPL.

variable $SIZE_{i,t}$ to it

$$\begin{aligned}(I/K)_{i,t} &= \beta_0 + \beta_1(I/K)_{i,t-1} + \beta_2 RTAS_{i,t} + \beta_3 P^K_{j,t}/P_{j,t} + \beta_4 EPL_{j,t} + \beta_5(LIQ/K)_{i,t} \\ &+ \beta_6(LIQ/K)_{i,t} * EPL_{j,t} + \beta_7 SIZE_{i,t} + d_t + \eta_i + \varphi_j + v_{it} \qquad (23)\end{aligned}$$

We expect β_7 to be positive: *ceteris paribus*, small-sized firms should invest more than larger firms because their decision is not negatively affected by EPL.

Estimates of equation (23) are shown in column (2) of Table 5 and, when compared to the same coefficients of column (1), they do not show significant changes. Moreover, as expected, β_7 is positive and statistically significant.

To measure the overall impact of EPL for exempted firms on investment, we run the following test:

$$\beta_4 + \beta_6 * \overline{LIQ/K} + \beta_7 = 0$$

where $\overline{LIQ/K}$ is the mean value of our liquidity variable. Here the null is that the impact of EPL on investment for exempt firms is zero and our results show that we fail to reject the null (see the EPL-F test at the bottom of Table 5).

Columns (3) and (4) respectively show the estimates of equations (22) and (23), in which the profitability variable $RTAS_{i,t}$ has been replaced by the $\Delta(VA/K)_{i,t}$ variable. As may be expected, some changes occurred in the values of the estimated coefficients but, overall, results shown in columns (3) and (4) are equivalent to those in column (1) and (2) and confirm the negative role that market imperfections play on investment.

Finally, columns (5) and (6) show results for equation (22) when the four countries (Austria, Finland, France and Portugal) that during the period 1994-2000 experienced no changes in the OECD EPL index are dropped from our sample.[21] For the sake of space, we only show estimates that use $RTAS_{i,t}$ as explanatory variable instead of $\Delta(VA/K)_{i,t}$. Results, notwithstanding the partial loss of the EPL cross-country

[21] As for the other two EPL indexes used, Finland is the only country for which the EPL_FRDB index does not change in the period 1994-2000, while Austria and Great Britain are the two countries for which the EPL_BW does not change in the same period.

variability due to the reduced number of countries in the sample, are equivalent to those shown in the first four columns.

Table 5: Fixed Investment Models

Explanatory Variables	(1)	(2)	(3)	(4)	(5)	(6)
$(I/K)_{i,t-1}$	0.568***	0.497***	0.677***	0.606***	0.628***	0.534***
	[0.094]	[0.10]	[0.077]	[0.090]	[0.086]	[0.11]
$RTAS_{i,t}$	0.610**	0.689**			0.682**	0.479*
	[0.28]	[0.29]			[0.28]	[0.29]
$(\Delta VA/K)_{i,t}$			0.002***	0.002***		
			[0.000]	[0.000]		
$P^K_{j,t}/P_{j,t}$	-0.118	-0.124	-0.151	-0.164	0.0871	0.111
	[0.24]	[0.24]	[0.25]	[0.24]	[0.24]	[0.24]
$EPL_{j,t}$	-0.232***	-0.214***	-0.187***	-0.171***	-0.345***	-0.340***
	[0.047]	[0.047]	[0.043]	[0.043]	[0.062]	[0.063]
$(LIQ/K)_{i,t}$	0.052***	0.053***	0.043***	0.047***	0.049***	0.045***
	[0.007]	[0.009]	[0.009]	[0.010]	[0.004]	[0.005]
$(LIQ/K)_{i,t}$*$EPL_{j,t}$	-0.017***	-0.017***	-0.014***	-0.015***	-0.016***	-0.014***
	[0.003]	[0.003]	[0.003]	[0.004]	[0.001]	[0.002]
$SIZE_{i,t}$		0.716**		0.676*		0.503*
		[0.34]		[0.35]		[0.30]
Constant	0.218	0.213	0.275	0.284	0.131	0.151
	[0.18]	[0.18]	[0.18]	[0.18]	[0.18]	[0.18]
time dummies	✓	✓	✓	✓	✓	✓
country dummies	✓	✓	✓	✓	✓	✓
Observations	7893	7893	8197	8197	5655	5655
Number of firms	2665	2665	2665	2665	1898	1898
F test (*p value*)	0.000	0.000	0.000	0.000	0.000	0.000
Hansen J test (*p value*)	0.177	0.317	0.333	0.393	0.205	0.182
AR1 (*p value*)	0.000	0.000	0.000	0.000	0.000	0.000
AR2 (*p value*)	0.979	0.932	0.293	0.347	0.457	0.414
Liquidity F test (*p value*)	0.000	0.000	0.000	0.000	0.000	0.000
EPL F test (*p value*)	-	0.192	-	0.191	-	0.665

NOTES: Robust standard errors are reported in brackets below coefficients. *$p < 0.10$; **$p < 0.05$; ***$p < 0.01$ significance levels respectively. Estimation by GMM-SYSTEM using STATA 9.2 SE package one-step results; 'Hansen J' is test of the overidentified restrictions (p-value reported); AR(k) is the test statistic for the presence of k-th order serial correlation in the first-differenced residuals, distributed N(0,1) under the null; Liquidity and EPL are F Tests of the joint significance of the liquidity and EPL terms, respectively.

3.4 Robustness Checks

This Section shows additional estimates of equation (22) by using alternative EPL indexes to the OECD one. Indeed, as pointed out in Section (3.1), the OECD EPL index is often criticized for its poor time variation, especially over the time period analyzed in this paper.

We used two alternative indexes of the strictness of Employment Protection, labelled EPL_BW and EPL_fRDB, respectively. The former was first developed by Blanchard and Wolfers (2000) and updated by Nickell et al. (2001) and Gomez Salvador et al. (2004). The latter is an index that we constructed starting from information available on the Fondazione Rodolfo DEBENEDETTI web site (fRDB).

Table 6 shows the estimation results for the two equations (22) and (23) with the two new different EPL indexes. Columns (1)-(2) and columns (3)-(4) show estimates that use the EPL_BW index and the EPL_fRDB index, respectively.

As for the estimates that make use of the EPL_BW index, they confirm the previous results we found by using the OECD EPL index. Investment is negatively affected by the presence of positive EPL levels: the estimated coefficient of EPL_BW (β_4) is always negative and statistically significant. The liquidity-ratio coefficient (β_5) is positive and statistically significant, while the coefficient of the interaction variable between liquidity and EPL_BW, (β_6), is negative and statistically significant in the base equation, column (1), and when we control for firm size, column (2).

Finally, when we used the fRDB index, the coefficient of EPL_fRDB was always negative and statistically significant.[22] However, the estimated coefficients $(LIQ/K)_{i,t}$ and $(LIQ/K)_{i,t} * EPL_fRDB_{j,t}$ were never statistically significant.

Overall, these results strongly support the negative relationship between investment and EPL, while they are mixed with respect to the contemporaneous role of labour and financial market imperfections on investment. Instead, results produced no clear

[22]The size of the estimated coefficients of EPL_fRDB is larger than the size of the estimated coefficients of EPL_OECD and EPL_BW due to their different scales. See Data Appendix for details.

indications especially in the equation specification that makes use of the Fondazione Rodolfo DEBENEDETTI EPL variable that we constructed starting from disaggregated information. We do not exclude the possibility that this result may heavily depend on our decisions about the weights we assigned to the two components of labour market reforms by means of which we constructed the index.[23]

[23] As explained in the Appendix, we first assigned weights 1 and 2 to the marginal and structural components of labour market reforms, respectively. Tentatively, we changed these weights to 1 and 5, but results did not change.

Table 6: Robustness Checks

Explanatory Variables	(1)	(2)	(3)	(4)
$(I/K)_{i,t-1}$	0.456***	0.297*	0.564***	0.295**
	[0.13]	[0.18]	[0.12]	[0.15]
$RTAS_{i,t}$	0.702*	0.866**	0.574*	0.232
	[0.41]	[0.43]	[0.32]	[0.41]
$P^K_{j,t}/P_{j,t}$	-0.0405	-0.0726	-1.163***	-1.067***
	[0.23]	[0.22]	[0.37]	[0.35]
$(LIQ/K)_{i,t}$	0.036**	0.068***	0.002	-0.002
	[0.017]	[0.024]	[0.008]	[0.010]
$EPL_BW_{j,t}$	-0.191***	-0.146**		
	[0.064]	[0.066]		
$(LIQ/K)_{i,t} * EPL_BW_{j,t}$	-0.008*	-0.018***		
	[0.005]	[0.007]		
$SIZE_{i,t}$		0.733		0.860**
		[0.61]		[0.40]
$EPL_fRDB_{j,t}$			-12.02***	-10.23***
			[2.67]	[2.68]
$(LIQ/K)_{i,t} * EPL_fRDB_{j,t}$			0.003	0.008
			[0.0089]	[0.011]
Constant	0.124	0.111	2.279***	2.078***
	[0.17]	[0.17]	[0.50]	[0.50]
time dummies	✓	✓	✓	✓
country dummies	✓	✓	✓	✓
Observations	7893	7893	7893	7893
Number of firms	2665	2665	2665	2665
F test (*p value*)	0.000	0.000	0.000	0.000
Hansen J test (*p value*)	0.192	0.139	0.184	0.170
AR1 (*p value*)	0.000	0.000	0.000	0.000
AR2 (*p value*)	0.958	0.778	0.964	0.654
Liquidity F test (*p value*)	0.000	0.000	-	-
EPL F test (*p value*)	-	-	-	0.001

NOTES: Robust standard errors are reported below coefficients. $*p < 0.10$; $**p < 0.05$; $***p < 0.01$ significance levels respectively. Estimation by GMM-SYSTEM using STATA 9.2 SE package one-step results; 'Hansen J' is test of the overidentified restrictions (p-value reported); AR(k) is the test statistic for the presence of k-th order serial correlation in the first-differenced residuals, distributed N(0,1) under the null; Liquidity and EPL are F Tests of the joint significance of the liquidity, and EPL terms, respectively.

4 Conclusions

This paper analyzed the link between investment, financing constraints and the imperfections in the labour market as measured by the levels of the OECD Employment Protection Legislation index.

We presented and discussed a neoclassical investment model with financing constraints, in which EPL is inserted as a component of the investment adjustment costs function of the firm. The idea behind this modelling of the investment adjustment cost function is that regulation (a) increases the cost the firm faces when expanding or reducing its capital stock, and (b) limits its ability to respond to changes in fundamentals. One result of this type of investment adjustment cost function is that the firm's decision to invest clearly depends upon the presence of financial and labour market imperfections. Specifically, we showed that current EPL has a negative impact on current investment, and that the joint impact of EPL and financing constraints on investment is detrimental for investment.

These theoretical conclusions found empirical support in the estimation of a panel data model, by means of a large dataset containing information on companies from ten European countries and national Employment Protection Legislation systems.

Empirically, we also showed that investment decisions of small-sized firms (i.e., defined according to each national exemption threshold of EPL) are, as expected, not affected by labour market regulations.

The contribution of this paper is twofold. First, it suggests a simple way to incorporate labour market imperfections into the investment adjustment cost function that produces clearcut results on optimal investment. Second, it reports a set of empirical estimates that support both the theoretical model and the effort put forward by the E.U. to liberalize markets.

We leave to future research the extension of our work to the case with an increased number of markets that simultaneously affect firm investment decisions. Specifically, we

plan to study how the departure from perfect competition impacts investment in the contemporaneous presence of financial and labour market imperfections.

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Data Appendix

Sample and variable definition

Data have been treated as follows.

First of all, to avoid double counting, we have dropped from the initial sample firms for which we only had consolidated accounts.

Second, we controlled for outliers with respect to the median on original variables: tangible fixed assets (K), Depreciation (DEPR), Cash Flow (CF), Sales (TURN), Non Current Liabilities (NCLI), Cash and Cash Equivalent (CASH), Operating Profits

(OPPL), Value Added (VA), Liquidity Ratio (LIQR), Cost of Materials (MATE), Cost of Employees (STAFF), Cost of Good Sold (COST).

In particular we substituted observations that were below (33 percent) or above (100 percent)the median of the firm with the interpolated value. The average percentage of observations considered outliers by the filter is 8 percent of the initial sample.

Third, since the data set did not provide data on Tangible Fixed Assets for Austria and Germany, we replaced Tangible Fixed Assets with Total Fixed Assets. In this way we have not lost information on German and Austrian firms. To check whether this step influenced our estimates, we ran regressions with and without these two countries, and the estimates did not change significantly.[24]

Finally, we restricted our data set to firms for which we had observations lasting at least five years on the above mentioned original variables. This step allowed us to identify the reduced form parameters of the model, and to use the overidentified restrictions to test the model's instruments.[25]

Our final sample is composed of more than 10,000 observations.

Eventually, we constructed our regression variables as follows:

- $I_t = K_t - K_{t-1} + DEPR_t$;

- $RTAS_t = Pofit(Loss)BeforeTaxation/TotalAssets$

- $LIQ_t = CF_{t-1} + CASH_t$

- $\Delta(VA/K)_{i,t} = (VA_t/K_{t-1}) - (VA_{t-1}/K_{i,t-1})$

- $(P_K/P)_t$=Investment Deflator / Output Deflator;

- $oprek_t = TURN_t/K_{t-1}$;

[24]Estimates available upon request.

[25]To identify the autoregressive parameter we needed at least three time series observations of investment (Bond, 2002). Given that we lose one year to construct investment, with four time period observations we could exactly identify the model, whereas with five time period observations we can use the overidentified restrictions to test instrument validity.

Variables are in real terms. Price deflators of gross value added for the manufacturing industry are available for each country from Chapter 14 of the AMECO database provided by the European Commission DG ECFIN. Since we did not have price deflators for gross investment, we have constructed a price deflator for each country that is a weighted average of price deflators for gross fixed capital formation in three sectors: Equipment, Metal Products and Machinery, and Transport Equipment. Data have been taken from Chapter 4 of AMECO.

The Foundation RODOLFO DEBENEDETTI EPL index

The fRDB EPL index has been developed starting from information available on the the Fondazione Rodolfo DEBENEDETTI (fRDB) web site. The fRDB provides a documentation centre on social policy reforms and EU labour markets. Particularly, we used the Social Reforms Database that collects information about social reforms in the EU15 Countries (except Luxembourg) over the period 1987-2005. The database has been created by fRDB and it is constantly updated. It focuses on four areas of reforms: Employment Protection Legislation (EPL); Public Pension Systems; Non-Employment Benefits; Migration Policies.

The fRDB Social Reforms Database collects qualitative features of reforms. In fact, EPL reforms have been classified along two main lines

1. direction (*sign*): Do they make [EPL] more or less stringent? We have redefined this variable so that *sign* is equal to 1 if EPL becomes stricter, -1 if EPL loosens;

2. scope (*dim*): Are these reforms marginal or radical? In order to decide whether a reform is marginal or radical, fRDB implements a two step procedure: first, a qualitative assessment on the reforms is made; second, trends in selected time series are analyzed. The variable *dim* is equal to 1 if the reform is marginal; 2 if the reform is structural.

Finally, an index of coherence (*cohe*) among all the measures of the same reform has been assigned to each reform: it is computed as the ratio between the number of measures of "prevailing" sign over the total number of measures it involves.[26]

Therefore, the fRDB index has been obtained by implementing the following steps:

1. we used the OECD EPL index, Version 1, for the year 1985 (base year) and for all countries;

2. the EPL_fRDB indicator for the first year (1985) and for each country i was defined as

$$EPL_fRDB_{i,85} = ratio_{i,85} + \sum_j EPL_new_{i,85}$$

   where

   - $ratio_{i,85} = EPL_OECD_{i,1985}/EPL_OECD_{IT,1985} * 100$;
   - $\sum_j EPL_new_{i,j,85} = \sum_j sign_{i,j,85} * cohe_{i,j,85} * dim_epl_{i,j,85}$ where j's are the reforms taken in country i in year 1985;

3. the EPL_fRDB indicator for the following years was defined as

$$EPL_fRDB_{i,85+t} = EPL_fRDB_{i,85+t-1} + \sum_j EPL_new_{i,85+t}$$

Summary statistics for the three indicators are reported in Table 4.

[26]For further details www.frdb.org/documentazione.