How Does Employment Protection Legislation Affect Firm Investment? The European Case *

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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 a negative correlation between EPL levels and investments. Firms facing negative shocks see their financial constraints worsening in countries with greater labour market rigidities. The presence of stricter EPL is a disincentive towards the use of internal funds for financing new projects: i.e., if capital is largely sunk and the legal environment favours ex-post profit appropriation by workers, firms may use internal funds for any ends alternative to fixed investment. Our results support the effort put forward by European institutions in recent years to reform both markets.

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1 Introduction

This paper aims at analyzing the impact of Employment Protection Legislation (EPL) on firms' investment decisions in the presence of financial imperfections. To our knowledge, 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), who shows 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 can impact on 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.

Traditionally, the impact of financial and labour market imperfections on investment has been analyzed separately. Parallely, policy design concerning the economic impact of each single market has not fully taken into consideration the functioning of the other market. We think that 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.

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 problems, and agency problems (Bernanke and Gertler, 1989), make the cost of internal finance lower than that of external finance. Thus, a hierarchy of financing structure arises (Bond and Meghir, 1994). The consequence of these types of imperfections is that investment decisions become sensitive to the availability of internal funds, if firms are financially constrained (Fazzari Hubbard and Petersen, 1988; Whited, 1992; Hubbard, 1998). Empirically, the sensitivity of investment to internal funds was originally tested by controlling for the firms' availability of cash flow in q-type models. More recently, a debate has developed about the correct way of interpreting the size of the cash-flow coefficient (Fazzari et al., 2000 and 1988; Kaplan and Zingales, 1997 and 2000). Specifically, Kaplan and Zingales claim that a higher cost premium for external finance may actually be associated with lower sensitivity of investment to cash flow. Bond and Van Reenen (2003) provide a useful review of this debate. Mizen and Vermeulen (2005) analyze possible causes of the differences in the sensitivity of investment to cash flow across countries. Further, Calcagnini and Saltari (2003) suggest substituting the cash flow variable with a more general variable of firms' liquidity conditions, calculated as the sum of the available free liquid assets and cash flow.

As for the role of labour market imperfections on investment, the economic literature and evidence are scanty (Nickell and Layard, 1999; Nickell, 2003; Young, 2003). One possible way of measuring labour market imperfections is to look at Employment Protection Legislation (EPL) indexes (OECD, 1999 and 2004).[1] Higher EPL values mean a more rigid labour market, i.e. firms find it costlier to adjust labour input, and then they are more limited in the kind of policies they can undertake in the presence of shocks. Indeed, as pointed out by Alesina *et al.* (2005), regulation can increase the cost the firm faces by expanding its productive capacity, and limits its capacity to respond to changes in fundamentals. Therefore, a higher EPL should result in a negative impact on investment, by increasing firm's adjustment costs over time. On the other hand, higher employment protection legislation values also mean higher firing costs and, therefore,

[1] Calcagnini and Saltari (2003) use strikes as an indirect measure of the functioning of the labour markets.

higher labour costs. The latter implies a substitution effect of labour with capital, with the likely consequence of higher capital accumulation growth rates. The simultaneous presence of these two effects often leaves the researcher with an unclear sign of the final impact of EPL on investment.

In a different perspective, the impact of labour market institutions on investment has been analyzed by Acemoglu (2003) who shows that the incentives for firms to invest in new technologies is positively affected by the degree of wage compression in the presence of labour market rents for firms. Pischke (2005) argues that, in the presence of credit constrained workers and of a minimum wage scheme, the incentive for firms to invest in training increases as a consequence of a skill biased technical change.

This paper improves on Calcagnini and Saltari (2003) in two ways. First, we specify a simple neoclassical model that incorporates financial constraints and investment adjustment costs as a function of investment and the level of labour market regulation. The latter hypothesis formalizes the idea that employment protection plays a role in firms' capital accumulation that is not just through the mechanism highlighted by Blanchard (1997, 2000) and Blanchard and Wolfers (2000) (i.e.: institutional change, labour supply adverse shock, lower profits, and subsequently less investment), but also through an additional channel. Second, we directly estimate, by means of GMM system techniques, the Euler equation for investment obtained from the complete model by making use of a large dataset of individual manufacturing companies located in ten European countries. Moreover, our results reflect both time and country variability and, therefore, are more general than Rendon's, obtained by data of only Spanish companies.

As expected, our empirical findings show that investment is positively correlated to measures of availability of internal funds and negatively to the (current) level of national labour market regulation. Moreover, the latter is stronger wherever financial markets are less efficient. 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. In other words, firms with better liquidity conditions are in a position to determine their optimal investment policy, even in the presence of stringent employment protection regulations, than those facing financial constraints.

The negative impact of market imperfections on investment is also stronger when firms contract the size of their capital stock (and likely their employee numbers), given that firing costs, severance payments, and notice period costs are more severe than correspondent costs borne during periods of positive investment and (likely) increase in the number of their employees. Finally, we find that small enterprises are less affected by the degree of labour market regulation than larger ones. Indeed, in all countries, 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 presence has been widely referred as one of the most important causes for the wide presence of small businesses within the Italian economy (Garibaldi *et al.*, 2003, Schivardi and Torrini, 2004).

The nature of our analysis is typically of partial equilibrium, therefore key elements, such as the insurance role of EPL (Pissarides, 2001), are left out of the model. Keeping in mind this limitation, our results support the effort put forward by European institutions to reform both markets in recent years.

Future research should focus at least on one main aspect. From a theoretical point of view, and given the peculiar role of EPL, a model capable of accounting for general equilibrium aspects should be studied.

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

2 The Model

This section presents a simple investment model that incorporates both financial and labour market imperfections. We assume that firms face costs of adjusting their capital stock that are a convex function of investment.[2] Moreover, we assume that the exact shape of the adjustment cost function also depends on the degree of labour market regulations, specifically on the Employment Protection Legislation (EPL). EPL increases the cost that firms face 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.[3]

EPL may influence investment decisions through another channel, that is firms' optimal labour demand (Bentolila and Bertola, 1990; Bertola, 1999). Indeed, higher EPL levels should make capital readily accessible by increasing the cost of labour relatively to the user cost of capital, favour a substitution of labour with capital and, finally, increase investment (Caballero and Hammour, 1998). Which of the two effects of EPL on investment dominates depends upon the parameter values of the model.

In this paper we will concentrate our attention on the first of the two channels, namely, the impact of EPL on investment through the capital adjustment cost function.

The simultaneous presence of imperfect credit and labour markets gives rise to a question concerning the effects of their interaction, and the nature of their impact on investment is the other aspect considered in this section.

[2]For a critical survey on theoretical and empirical models of investment with financial constraints see Hubbard (1998), Whited (1992), Saltari (2004).

[3]Alesina *et al.,* (2005) analyze the impact of product market regulation in a similar framework.

2.1 Model Specification

We consider a model in which a generic risk-neutral firm maximizes the flow of the expected present value of dividends D_{t+i}

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

where $\beta = 1/(1+r)$ 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 that uses capital and labour. The firm's output is

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

where K is the capital input and L is the labour input, and F(.) is a neoclassical production function.[4]

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

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

and

$$L_{t+1} = (1-\nu)L_t + E_t \tag{4}$$

where I_t denotes gross investment and E_t newly employed workers. Moreover, we assume a constant rate of depreciation of capital, δ, and voluntary quitting by workers, ν.

Because of Employment Protection Legislation, both the process of firing and the process of hiring are costly. We assume that this labour adjustment cost is represented

[4] A neoclassical production function satisfies:

- $Q'_K > 0$ and $Q''_K < 0$;
- $Q'_L > 0$ and $Q''_L < 0$;
- Inada conditions: $Q'(0) = \infty$; $Q'(\infty) = 0$; $Q(0) = 0$.

by a strictly convex and continuous function: $H(E_t)$.[5] The firm also bears continuous, strictly convex, and twice differentiable, investment adjustment costs of the following form

$$C(I_t) = \frac{b}{2}(I_t + \theta EPL_t)^2 \tag{5}$$

where $0 < b < 1$, and θ is a parameter whose value depends on Employment Protection Legislation at time t, and the capital accumulation strategy followed by the firm.

We assume that EPL costs, θEPL_t, are incurred at each point in time when investment is nonzero.

When investment is nonzero, $EPL_t = 0$ is the value corresponding to a flexible labour market. In the presence of employment protection, $EPL_t > 0$ and θ behaves as follows:

1. $\theta > 0$ if $I > 0$, i.e. the right-hand partial derivative $C_I(I)^+ > 0$;
2. $\theta < 0$ if $I < 0$, i.e. the left-hand partial derivative $C_I(I)^- < 0$;
3. $|C_I(I)^+| < |C_I(I)^-|$ for any given level of $|I|$ and EPL.

Higher EPL is associated with stricter Employment Protection Legislation, and, from (1) and (2), it implies higher adjustment costs for a given level of $|I|$. Moreover, from (3), we assume that Employment Protection affects investment adjustment costs to a greater extent if the firm disinvests.

Dividends are defined on the basis of the sources equal uses constraint. Sources are given by operating profits, π_t, and net borrowing, $B_{t+i} - B_t$. Uses are given by interest payments, rB_t,[6] investment in capital goods, I_t, and dividends

$$D_t = \pi_t - C(I_t) - p_t I_t + B_{t+1} - (1+r)B_t \tag{6}$$

[5] As it will be shown this function is not essential to our investigation, therefore we do not need to give it a specific functional form.

[6] The assumption of risk neutral firm implies that the firm's nominal required rate of return between periods t and $t+1$, r_t, is equal to the interest rate on default free bonds and is given exogenously to the firm.

where operating profits are given by

$$\pi_t = F(K_t, L_t) - w_t L_t - H(E_t) \tag{7}$$

We assume that the firm takes the price of output (normalized to one), of labour (w_t), and of investment (p_t) as given. We also assume a free tax environment.

As for the financial market, we assume that firms are financially constrained because of asymmetric information and transaction costs. Indeed, financing constraints are introduced in two ways:

1. we assume that a firm cannot finance its investment by issuing new shares because of the associated high transaction costs. Such a hypothesis is formally defined by a nonnegative constraint on dividends

$$D_t \geq 0. \tag{8}$$

   Therefore, the acquisition of a new capital good can be financed only by issuing new debt and by retaining profits;

2. moreover, we assume that the firm's debt capacity is limited. We formalize that assumption by means of an upward threshold, B^*_{t+1}, on debt

$$B_{t+1} \leq B^*_{t+1}. \tag{9}$$

The Bellman equation corresponding to the maximization problem (1) is

$$V(K_t, L_t, B_t) = \max_{I_{t+s}, B_{t+s}, E_{t+s}} [D_t(1 + \lambda_t) + \beta E_t V(K_{t+1}, L_{t+1}, B_{t+1})]. \tag{10}$$

where λ_t is the Lagrange multiplier associated with constraint (8).

The first order condition for investment is

$$(p_t + C_{I_t})(1 + \lambda_t) = \beta E_t(V_{K_{t+1}}) \tag{11}$$

where $C_{I_t} = \partial C / \partial I_t$ and $V_{K_{t+1}} = \partial V / \partial K_{t+1}$.

The left hand side (hereinafter LHS) of equation (11) is the marginal cost associated with an additional unit of capital, whereas the right hand side (hereinafter RHS) represents the marginal benefit of such an increase 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 envelope theorem with respect to K_t yields

$$\begin{aligned} V_{K_t} &= (1+\lambda_t)(\pi_{K_t}) + \beta E_t V_{K_{t+1}}(1-\delta) \\ &= (1+\lambda_t)[D_{K_t} + (p_t + C_{I_t})(1-\delta)] \end{aligned} \quad (12)$$

where $D_{K_t} = \partial\pi/\partial K_t$ is the marginal increase in dividends due to an additional unit of capital.

By combining equation (11) with equation (12), the Euler equation for investment is

$$(p_t + C_{I_t})(1+\lambda_t) = \beta E_t\{(1+\lambda_{t+1})[D_{K_{t+1}} + (1-\delta)(p_{t+1} + C_{I_{t+1}})]\}. \quad (13)$$

The LHS of equation (13) is the total cost associated with investment today. The RHS is the cost associated with the decision of not investing today, but tomorrow.

The first order condition for B_{t+1} turns out to be

$$1 + \lambda_t + \beta E_t(V_{B_{t+1}}) - \gamma_t = 0 \quad (14)$$

where γ_t is the Lagrange multiplier associated with constraint (9).[7] The envelope condition for debt is

$$V_{B_t} = -(1+\lambda_t)(1+r) \quad (15)$$

Therefore, combining equation (14) with equation (15), the first order condition for debt can be written as

$$\lambda_t = E_t(\lambda_{t+1}) + \gamma_t \quad (16)$$

and, substituting this result into the Euler equation for investment, (13), we get the following specification

$$(p_t + C_{I_t}) = \beta E_t\{\frac{1+\lambda_{t+1}}{1+\gamma_t + E_t\lambda_{t+1}}[F_{K_{t+1}} + (1-\delta)(p_{t+1} + C_{I_{t+1}})]\}. \quad (17)$$

[7] $B_{t+1} = (1+r)B_t + N_t$ where B_t is inherited from period t and N_t is the stock of debt acquired from time t to time $t+1$. Maximization with respect to B_{t+1} is the same as maximization with respect to N_t.

The LHS of equation (17) is the marginal cost of investing in new capital in the current period t. It is given by the price of new capital (p_t) plus the marginal installation cost (C_{I_t}). The RHS represents the cost of postponing investment until next period $t+1$. $D_{K_{t+1}} = \frac{\partial \pi_{t+1}}{\partial K_{t+1}} = \frac{\partial F_{t+1}}{\partial K_{t+1}} = F_{K_{t+1}}$, and $F_{K_{t+1}}$ represents the foregone marginal change in production due to the decision of not investing in period t, but in period $t+1$. Therefore, the cost of postponing investment is given by the foregone marginal change in production ($F_{K_{t+1}}$), and by the expected discounted value of the marginal purchasing and installation costs of investing tomorrow ($(1-\delta)(p_{t+1} + C_{I_{t+1}})$).

Let's define

$$\alpha_t = \frac{1 + \lambda_{t+1}}{1 + \gamma_t + E_t \lambda_{t+1}}$$

with $0 < \alpha_t < 1$. In the presence of binding nonnegative dividend and debt constraints (conditions (8) and (9) respectively), i.e. λ and γ different from zero, the opportunity cost of investing tomorrow is weighted by the relative shadow cost of internal funds, represented by α_t. Indeed, when a firm faces borrowing constraints, it incurs higher values of γ_t and hence higher marginal costs of investing today versus delaying it until tomorrow. Along the optimal path the two alternatives must be equivalent.

Let's start by assuming perfect capital markets.[8] Combining equation (5) with equation (17) we can write

$$(p_t + bI_t + b\theta EPL_t) = \beta E_t[F_{K_{t+1}} + (1-\delta)(p_{t+1} + bI_{t+1} + b\theta EPL_{t+1})]. \qquad (18)$$

Equation (18) is not an investment equation, but an equilibrium relationship. It says that *along the optimal path* the marginal cost of investing must be constant. Since the LHS is known at time t, we can rewrite equation (18) as

$$E_t\{(p_t + bI_t + b\theta EPL_t) - \beta[F_{K_{t+1}} + (1-\delta)(p_{t+1} + bI_{t+1} + b\theta EPL_{t+1})]\} = 0. \qquad (19)$$

Under the hypothesis of rational expectation we can substitute expected value with

[8] i.e.: $\lambda_{t+1} = 0 = \gamma_t$

actual values plus a forecast error z_{t+1},[9] and normalizing for I_{t+1}, we obtain the following expression

$$I_{t+1} = \frac{p_t}{b\beta(1-\delta)} - \frac{p_{t+1}}{b} + \frac{1}{\beta(1-\delta)} I_t - \frac{F_{K_{t+1}}}{b(1-\delta)} + \frac{\theta EPL_t}{\beta(1-\delta)} - \theta EPL_{t+1} + z_{t+1}. \quad (20)$$

Equation (20) shows structural relationships between the model variables. Future investment depends on the variation of its installation cost, on current investment, on the marginal contribution of capital to production, and on the variation of costs associated with EPL.

2.2 EPL and Investment

Along the optimal path the relationship between EPL and investment can be analyzed from both a static and a dynamic point of view.

Statically, from equation (20), we obtain that investment is negatively affected by the level of Employment Protection for the same period; i.e. future investment is negatively affected by the level of EPL in period $t+1$.

Dynamically, i.e. looking at the impact of current and future EPL levels on future investment, three cases might occur:

1. Employment Protection Legislation does not change from period t to period $t+1$. The impact of EPL on future investment depends solely on the discount factor, the depreciation rate, and θ

   $$EPL[\frac{\theta}{\beta(1-\delta)} - \theta];$$

   in this case the cost associated with EPL is such that, along the equilibrium path, the firm prefers to postpone investment to period $t+1$;

2. Employment Protection Legislation in period $t+1$ becomes tighter than in period t. Such a policy is formalized by a higher EPL in period $t+1$. In this case we

[9] The forecast error z_{t+1} is assumed to be uncorrelated with any information available at time t. Moreover it is assumed to have: $E_t(z_{t+1}) = 0$; $V_t(z_{t+1}) = \sigma_t^2$.

have that

$$\frac{\theta EPL_t}{\beta(1-\delta)} - \theta EPL_{t+1} \qquad is \qquad smaller$$

than in case (1). Therefore, an expected stricter EPL in period $t+1$ is detrimental for future investment, and the incentive to postpone investment from period t to period $t+1$ is lower than in case (1);

3. Employment Protection Legislation loosens, so that the EPL_{t+1} is lower than the EPL_t, and we have

$$\frac{\theta EPL_t}{\beta(1-\delta)} - \theta EPL_{t+1} \qquad is \qquad larger$$

than in case (1), so that an expected lower EPL is positive for future investment, and the incentive to postpone investment from period t to period $t+1$ is higher than in case (1).

Therefore, we can say that a loosening of Employment Protection policy has, per se, a positive impact on future investment: along the optimal path, if a reduction of EPL is expected in $t+1$, the firm will decide to postpone its investment to the next period.

2.3 EPL, Financing Constraints, and Investment

How does EPL interact with financing constraints? The Euler equation in presence of financing constraints is

$$(p_t + b_t I_t + b\theta EPL_t) = \beta E_t\{\alpha_t[F_{K_{t+1}} + (1-\delta)(p_{t+1} + bI_{t+1} + b\theta EPL_{t+1})]\} \qquad (21)$$

When financing constraints are binding, the opportunity cost of investing tomorrow is weighted by the relative shadow value of tomorrow's dividends versus today's. The cost of investing today is higher, and financing constraints have the same effect as a higher discount rate. Therefore, financing constraints create an incentive to postpone investment to the next period. In terms of realized values, and normalizing for I_t, for the period in which financing constraints are binding, we get

$$\begin{aligned} I_t &= -\frac{p_t}{b} - \theta EPL_t + \frac{\alpha_t \beta F_{K_{t+1}}}{b} + \frac{\beta\alpha_t(1-\delta)p_{t+1}}{b} + \beta\alpha_t(1-\delta)I_{t+1} \\ &+ \beta\alpha_t(1-\delta)\theta EPL_{t+1} + z_{t+1}. \end{aligned} \tag{22}$$

In equation (22) we have added the strong assumption that the conditional covariance between α_t and other variables dated $t+1$ is constant. The latter is a reasonable assumption under the null hypothesis of perfect capital markets, when α_t should be equal to one. However, in the presence of financing constraints, the assumption may fail (Hubbar, Kashyap, and Whited, 1993). Therefore, from an econometric point of view, equation (22) can be rejected because of the failure of the perfect capital markets or because of the failure of the strong assumption on the conditional variance of α_t.

The interaction between financing constraints and EPL is detrimental for investment at time t. Indeed, the incentive to invest today instead of tomorrow, represented by the cost of EPL at $t+1$, is lower than in the case of no financing constraints. Formally

$$\beta\alpha_t(1-\delta)\theta EPL_{t+1} < \beta(1-\delta)\theta EPL_{t+1}$$

Therefore, it appears that the interaction of imperfect credit and labour markets is detrimental for investment. As long as capital market imperfections arise, the joint impact of financial constraints and Employment Protection is negative on investment, ceteris paribus.[10]

3 Data Description and Model Estimation

3.1 Data Description and Variable Construction

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 7 million

[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.

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 use the "7 million" database, but we base our analysis on only 10 European Countries.

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

Information on EPL are taken from the OECD (1999), and we use the EPL index for total workers, Version 1.

Legal origin information is taken from La Porta *et al.*(1999).

Data have been filtered in many ways.[11]

First of all, to avoid double counting, we have considered only unconsolidated accounts.

Second, we have controlled for outliers with respect to the median on original variables: intangible fixed assets (FIAS), tangible fixed assets (K), Depreciation (DEPR), Cash Flow (CF), Sales (TURN), Non Current Liabilities (NCLI), Cash and Cash Equivalent (CASH), Operating Profits (OPPL), Added Value (AV), Current Ratio (CURR), Liquidity Ratio (LIQR), Cost of Materials (MATE), Cost of Employees (STAFF), Cost of Good Sold (COST).

Third, since the data set did not provide data on Tangible Fixed Assets for Austria

[11] We are grateful to Davide Castellani for help and advice on this part.

and Germany, we have 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 have run regressions with and without these two countries, and the estimates did not change significantly.[12]

Finally, we have restricted our data set to firms for which we had at least five years of observations in the above cited variables. This step has allowed us to identify the reduced form parameters of the model, and to use the overidentified restrictions to test the model's instruments.[13]

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

Eventually, we constructed the variables for our regressions as follows:

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

$roir_t = OPPL_t/K_{t-1}$

$LIQ_t = CF_t + CASH_t$

p_t=Investment Deflator / Output Deflator;

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

All variables are in real terms. Price deflators of gross value added for 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.

Table 1 shows summary statistics by Country.

[12]Estimates available on request.

[13]To identify the autoregressive parameter we needed at least three time series observations of investment (Bond, 2002). Given that we lose a time period observation 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 instruments' validity.

Table 1: Summary Statistics

	Observations	Mean	Median	Standard Deviation
Austria				
I/K	69	0.138	0.081	0.218
CF/K	68	0.332	0.273	0.236
LIQ/K	68	0.596	0.422	0.505
F_K	69	1.115	0.757	0.993
$roir$	68	0.269	0.145	0.323
p	86	1.030	1.040	0.017
$Workers$	51	802	706	390.420
EPL		2.2	2.2	0
Legal origin	German			
Belgium				
I/K	659	0.310	0.226	0.363
CF/K	658	0.732	0.553	0.631
LIQ/K	658	1.540	0.878	2.366
F_K	652	8.257	2.294	32.345
$roir$	653	0.756	0.388	1.304
p	816	1.100	1.110	0.027
$Workers$	815	209	111	315.855
EPL		2.628	2.2	0.495
Legal origin	French			
Germany				
I/K	285	0.134	0.072	0.236
CF/K	285	0.285	0.027	0.321
LIQ/K	285	0.562	0.416	0.689
F_K	279	1.588	0.829	3.194
$roir$	280	0.279	0.206	0.275
p	350	1.003	1	0.019
$Workers$	318	1471	833	1790.918
EPL		2.753	2.5	0.292
Legal origin	German			
Finland				
I/K	297	0.131	0.066	0.234
CF/K	297	0.635	0.321	1.690
LIQ/K	297	1.426	0.513	5.044
F_K	296	1.908	1.009	5.714
$roir$	296	0.837	0.346	2.256
p	370	1.095	1.105	0.021
$Workers$	322	617	190	1651.799
EPL		2.12	2.1	0.032
Legal origin	Scandinavian			
France				
I/K	2808	0.328	0.231	0.442
CF/K	2804	1.257	0.659	3.552
LIQ/K	2790	3.335	1.245	10.11
F_K	2734	4.453	1.963	10.771
$roir$	2759	1.902	0.673	10.286
p	3438	0.995	0.992	0.018
$Workers$	2872	437	183	1019.152
EPL		3	3	0
Legal origin	French			

Summary Statistics. Continued.

	Observations	Mean	Median	Standard Deviation
Great Britain				
I/K	703	0.207	0.163	0.230
CF/K	703	0.433	0.271	0.651
LIQ/K	702	0.741	0.396	1.201
F_K	545	1.519	0.797	2.293
$roir$	687	0.473	0.244	0.883
p	858	0.769	0.720	0.114
$Workers$	870	717	249	1847.053
EPL		0.611	0.6	0.028
Legal origin	English			
Italy				
I/K	4510	0.347	0.240	0.441
CF/K	4506	0.997	0.392	9.159
LIQ/K	4495	1.794	0.653	9.947
F_K	4497	6.606	1.730	37.180
$roir$	4498	1.264	0.388	9.319
$Workers$	5426	242	120	694.800
p	5593	0.912	0.901	0.030
EPL		3.15	3.26	0.437
Legal origin	French			
Netherlands				
I/K	52	0.253	0.165	0.347
CF/K	52	1.023	0.500	1.027
LIQ/K	52	3.301	1.142	5.163
F_K	35	2.209	1.770	2.159
$roir$	51	1.161	0.478	1.318
p	64	1.019	1.020	0.009
$Workers$	64	1070	269	2693.638
EPL		2.529	2.7	0.272
Legal origin	French			
Portugal				
I/K	32	0.176	0.067	0.283
CF/K	32	0.246	0.192	0.150
LIQ/K	32	0.366	0.211	0.384
F_K	32	0.585	0.494	0.320
$roir$	32	0.170	0.098	0.161
p	40	1.077	1.079	0.029
$Workers$	37	364	291	252.158
EPL		3.743	3.7	0.068
Legal origin	French			
Spain				
I/K	1577	0.259	0.191	0.341
CF/K	1578	0.842	0.449	2.385
LIQ/K	1577	1.726	0.736	5.959
F_K	1527	3.139	1.274	8.287
$roir$	1577	0.980	0.397	3.703
p	1968	1.008	1.019	0.028
$Workers$	1607	248	136	894.279
EPL		2.99	2.9	0.104
Legal origin	French			
Total				
I/K	10992	0.304	0.213	0.406
CF/K	10983	0.954	0.449	6.217
LIQ/K	10956	2.048	0.752	8.582
F_K	10666	5.069	1.611	26.293
$roir$	10900	1.257	0.419	8.068
p	13583	0.958	0.973	0.085
$Workers$	12382	367	150	1024.223
EPL		2.845	3	0.703

3.2 Model Estimation

The model presented in the last section permitted us to obtain a Euler equation for investment with and without financing constraints in the presence of EPL. The natural empirical procedure, therefore, should be to proceed with the estimation of equation (20), that should hold in the presence of perfect capital markets.[14]

However, a first aspect has to be mentioned. As Lucke and Gaggermeier (1999) argue, the data used to estimate the Euler equation are the solution to the complete set of first order conditions of the problem, while the the Euler equation alone represents a subset of the restrictions of the optimal path. Moreover, in terms of deep parameters, the solution to the complete set of first order conditions is not nested in the functional form of the Euler equation alone except for specific initial conditions. Consequently the estimates of the deep parameters may be severely biased.

A second aspect is linked to the necessity to control for variable heteroskedasticity. Differently from the Euler equation (20), we decided to work with the investment ratio, $(I/K)_{i,t}$, that denotes the ratio between gross investment of firm i in period t, and the beginning of period capital stock. The consequence of this normalization is that the estimated coefficient will no longer be directly comparable with those of the Euler equation (20). Nevertheless, the qualitative information is maintained.

The reduced form equation corresponding to the Euler equation (20) is the following

$$\begin{aligned} (I/K)_{i,t} &= \beta_0 + \beta_1 (I/K)_{i,t-1} + \beta_2 p_{j,t} + \beta_3 p_{j,t-1} + \\ \beta_4 F_{K_{i,t}} &+ \beta_5 EPL_{j,t} + \beta_6 EPL_{j,t-1} + d_t + \eta_i + \varphi_j + v_{it} \end{aligned} \tag{23}$$

where the subscript i refers to the company, t to the time period, and j to the country. We expect that estimated coefficients will be signed as follows: β_2, β_4, and β_5 should be

[14] Indeed, one of the advantages of Euler approach is that even in situations where it is not possible to obtain a closed form solution, the equilibrium relationship can be used to estimated the structural parameters. In practice, however, empirical implementation is complex, and a few problems arise in presence of nonlinear equations. In fact, in presence of measurement error for investment it is not possible to recover consistent estimates of the parameters, and estimates are often systematically biased (Attanasio and Low, 2004). These problems amplify in presence of small samples.

negative; β_1, β_3, and β_6 should be positively signed.

The algebric sum $\{\beta_2 p_{j,t} + \beta_3 p_{j,t-1}\}$ represents the user cost of capital. Given that price indexes are defined at the country level, whereas we deal with firm level data, we make the assumption that the variation in the user cost of capital among firms can be controlled for by using additive year-specific effects, d_t, and firm-specific effects, η_i (Bond and Meghir, 1994). Firm-specific effects are also justified by the variation of depreciation rates across firms.

$F_{K_{i,t}}$ is the marginal product of capital. In the Euler equation (20), it represents the foregone marginal change in production due to the decision to postpone investment from period $t-1$ to period t.

To allow for possible imperfect competition we define the marginal product of capital as (Calcagnini and Iacobucci, 2004; Gilchrist and Himmelberg, 1998):

$$F_{K_{i,t}} = \gamma_{i,t} * oprek_{i,t}$$

where:

$\gamma = (1 + \xi^{-1}) * \alpha_k$;

ξ = price elasticity of demand;

α_k = capital share on output.

Price elasticity has been calculated from the markup on variable costs, defined as the sum of the cost of materials and of employees. Capital share on output has been defined as the ratio $\alpha_{k,i,t} = (AV_{i,t} - STAF_{i,t})/AV_{i,t}$. $oprek_{i,t}$ is the sales to capital ratio.

The impact of Employment Protection Legislation is captured by the $EPL_{j,t}$ and $EPL_{j,t-1}$ regressors, that are country specific.

Finally, the model includes country dummies, φ_j. Indeed, given the country specific nature of the EPL index, it could also be the case that, in the absence of country dummies, the EPL index captures other aspects, different from the tightness of employment protection, such as the heterogeneous environment in which firms operate.

We deal with an unbalanced panel data of firms, and, given the dynamic structure of equation (23), we use the system GMM estimator approach as Bond *et al.* (2004), 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.

Instruments' validity is tested by using a Hansen J test for overidentified restrictions, that, differently from the Sargan test, is robust to autocorrelation or heteroskedasticity. We use the one-step variant of the system GMM.

3.3 Discussion of Results

We begin by reporting the results of the basic investment equation (23) in Table 2.

Column (1) represents the simplest model. All estimated coefficients are statistically significant at conventional levels, except the coefficient of the marginal product of capital. As expected, investment shows a persistent autoregressive dynamic ($\beta_1 = 0.413$); both the coefficient on current and the coefficient on past installation costs are statistically significant and present the right signs ($\beta_2 = -0.716$ and $\beta_3 = 0.788$, respectively). As expected, the coefficient of current EPL is negative and statistically significant, whereas the coefficient of past employment protection is positive and statistically significant. The theoretical intuition that states an opposite impact of current and past EPL on investment, appears to be satisfied.

We run an F test of the overall impact of EPL, with the following null hypothesis

$$\beta_5 + \beta_6 = 0 \tag{24}$$

We can reject the null, i.e. overall EPL appears to have a negative impact on investment.[15] This finding, however, contrasts with the theoretical prediction: empirically, the negative effect given by current EPL, $EPL_{j,t}$, overwhelms the positive effect given by past EPL, $EPL_{j,t-1}$.

Given that the coefficient on $F_{K_{i,t}}$ is wrongly signed and not significant, and given the overall negative effect of EPL on investment, we conclude that Euler equation (20) fails to hold, and we investigate possible causes.

In column (2) the ratio of cash flow to the beginning of period capital stock, $(CF/K)_{i,t}$, is included to investigate whether financial variables have explanatory power for investment.We should expect a coefficient not statistically different from zero if the firm is not financially constrained, and a positive coefficient if the firm is financially constrained.[16] We find a positive and significant cash flow coefficient and we attribute this result to the possible presence of financial constraints, i.e. due to binding financing constraints, internal funds have a positive impact on investment.[17]

However, the coefficient of $F_{K_{i,t}}$ is still not significant.

In column (3) we control for possible interactions between imperfect capital and labour markets by adding the term $(CF/K)_{i,t} * EPL_{j,t}$. The investment equation becomes:

$$\begin{aligned}(I/K)_{i,t} &= \beta_0 + \beta_1 (I/K)_{i,t-1} + \beta_2 p_{j,t} + \beta_3 p_{j,t-1} + \beta_4 F_{K_{i,t-1}} + \beta_5 EPL_{j,t} + \\ \beta_6 EPL_{j,t-1} &+ \beta_7 (CF/K)_{i,t} + \beta_8 (CF/K)_{i,t} * EPL_{j,t} + d_t + \eta_i + \varphi_j + v_{it}. \qquad (25)\end{aligned}$$

From the theoretical implications of our model (equation 21), we should expect a negative coefficient on both the $EPL_{j,t}$ and the interaction term $(CF/K)_{i,t} * EPL_{j,t}$; i.e. both employment protection and the interaction between imperfect labour and financial

[15] Once controlled for country dummies, the inclusion of other dummies, to capture sectorial variation or legal origin, does not change the results. Moreover the impact of past cash flow and of past EPL is not statistically significant. Estimates available on request.

[16] See Bond *et al.* (2004) for a discussion about measurement errors and the explanatory power of cash flow.

[17] As already seen, this interpretation can be subject to a number of objections. Indeed, cash flow could be proxying expectations of future demand.

markets have a negative impact on investment.

The coefficient on the interaction between EPL and cash flow, that should capture the effect of the contemporaneous presence of financial and labour market imperfections, is negative and highly significant ($\beta_8 = -0.02$).

We run an F test of the null that the overall impact of EPL is zero

$$\beta_5 + \beta_6 + \beta_8 * \overline{CF/K} = 0 \tag{26}$$

where $\overline{CF/K}$ is the mean value of the cash flow ratio in the sample. The test rejects the null, and the overall impact continues to be negative.

To analyze the overall impact of cash flow we run an F test of the null

$$\beta_7 + \beta_8 * \overline{EPL} = 0 \tag{27}$$

where $\overline{EPL}$ is the mean value of EPL within the sample. We find that cash flow is statistically different from zero, and that the overall effect of this variable is positive.

In columns (4) and (5) we decided to use an alternative measures of internal funds. In fact, 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. Therefore, columns (4) and (5) consider an alternative possible regressor to capture internal funds, $LIQ/K_{i,t}$, a liquidity index based on total cash in hand available to the firm. The ratio is significant in both columns. Moreover, the coefficient of the interaction term $LIQ/K_{i,t} * EPL_{j,t}$ is negative and significant (column 5). As for the case of the overall impact of cash flow, we still have an overall positive and statistically significant impact of the liquidity index.

In Table 3 we have substituted the marginal product of capital, $F_{K_{i,t}}$, with the real return on investment, $roir_{i,t}$. We motivate this alternative choice with the difficulties linked to the measures of the marginal product of capital, as a possible cause of the null impact of the $F_{K_{i,t}}$ regressor in the investment equation.

We have followed the same steps as above. The main difference with respect to Table 2 is the failure to reject the null of no significant coefficient of current installation cost in all specifications.

The coefficient of the real return on investment displays the right sign, once we control for the availability of internal funds, in columns (2), (3), and (5). However, the coefficient is continually not statistically significant with the exceptions of column (2), and column (1). Moreover, in the latter case, the coefficient, being positive, displays the wrong sign.

Firms' investment policies turn out to be positively affected by the presence of internal funds. Indeed, in column (2) and in column (4), both the cash flow coefficient and the liquidity index coefficient are positive and statistically significant. However, in column (3), the inclusion of the regressor $CF/K_{i,t} * EPL_{j,t}$ makes the impact of cash flow not statistically different from zero. The latter fact appears to be due to problems of correlation between the two variables: cash flow and roir.

As in the Euler equation (20), the impact of $EPL_{j,t-1}$ is always positive and statistically significant, whereas the coefficient of $EPL_{j,t}$ is negative and significant in all specifications. The F test of the total impact of EPL always rejects the null of no significance of the regressors, and the total effect turns out to be negative. Moreover, the coefficient on the interaction between liquidity and EPL is negative and significant. This last result supports the finding of our theoretical model about a negative impact on investment of imperfect financial and labour markets.

Table 2: Fixed Investment Models I

	(1)	(2)	(3)	(4)	(5)
$(I/K)_{i,t-1}$	0.413***	0.609***	0.615***	0.393**	0.516***
	0.157	*0.195*	*0.173*	*0.171*	*0.143*
$p_{j,t}$	-0.716**	-0.659**	-0.688**	-0.700**	-0.703**
	0.287	*0.321*	*0.326*	*0.282*	*0.303*
$p_{j,t-1}$	0.788***	0.752***	0.839***	0.760***	0.862***
	0.191	*0.206*	*0.236*	*0.185*	*0.232*
$F_{K_{i,t}}$	0.003	0.001	0.001	0.001	0.001
	0.002	*0.001*	*0.001*	*0.001*	*0.001*
$EPL_{j,t}$	-0.241***	-0.286***	-0.257***	-0.236***	-0.203***
	0.057	*0.065*	*0.065*	*0.059*	*0.060*
$EPL_{j,t-1}$	0.071**	0.073*	0.071*	0.065**	0.065**
	0.033	*0.037*	*0.037*	*0.033*	*0.035*
$(CF/K)_{i,t}$		0.007***	0.062***		
		0.001	*0.020*		
$(CF/K)_{i,t} * EPL_{j,t}$			-0.020***		
			0.007		
$(LIQ/K)_{i,t}$				0.005***	0.078***
				0.001	*0.014*
$(LIQ/K)_{i,t} * EPL_{j,t}$					-0.026***
					0.005
time dummies	✓	✓	✓	✓	✓
country dummies	✓	✓	✓	✓	✓
constant	✓	✓	✓	✓	✓
Hansen J (p-value)	0.89	0.37	0.47	0.72	0.59
AR(1)(p-value)	0.00	0.00	0.00	0.00	0.00
AR(2)(p-value)	0.80	0.70	0.50	0.90	0.38
Cash Flow (p-value)	–	–	0.00	–	–
Liquidity (p value)	–	–	–	–	0.00
EPL (p-value)	0.00	0.00	0.00	0.00	0.00
Observations	8051	8041	8041	8021	8021
Firms	2623	2623	2623	2623	2623

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 8.2 SE package one-step results; full set of time dummy included; '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; Cash Flow, Liquidity, EPL are F Tests of the joint significance of the cash flow, liquidity, and EPL terms, respectively.

Table 3: Fixed Investment Models II

	(1)	(2)	(3)	(4)	(5)
$(I/K)_{i,t-1}$	0.775***	0.580***	0.747***	0.624***	0.590***
	0.121	*0.104*	*0.074*	*0.096*	*0.085*
$p_{j,t}$	-0.436	-0.460	-0.403	-0.455	-0.488
	0.333	*0.296*	*0.333*	*0.306*	*0.299*
$p_{j,t-1}$	0.750***	0.707***	0.661**	0.722***	0.816***
	0.231	*0.205*	*0.266*	*0.210*	*0.236*
$roir_{i,t}$	0.001***	-0.003**	-0.005	0.000	-0.001
	0.000	*0.001*	*0.005*	*0.002*	*0.002*
$EPL_{j,t}$	-0.341***	-0.294***	-0.349***	-0.307***	-0.233***
	0.061	*0.055*	*0.080*	*0.054*	*0.057*
$EPL_{j,t-1}$	0.091**	0.079**	0.082**	0.082**	0.077**
	0.041	*0.036*	*0.039*	*0.037*	*0.036*
$(CF/K)_{i,t}$		0.010***	-0.017		
		0.001	*0.088*		
$(CF/K)_{i,t} * EPL_{j,t}$			0.010		
			0.034		
$(LIQ/K)_{i,t}$				0.006***	0.081***
				0.002	*0.018*
$(LIQ/K)_{i,t} * EPL_{j,t}$					-0.027***
					0.007
time dummies	✓	✓	✓	✓	✓
country dummies	✓	✓	✓	✓	✓
constant	✓	✓	✓	✓	✓
Hansen J (p-value)	0.47	0.34	0.10	0.27	0.43
AR(1)(p-value)	0.00	0.00	0.00	0.00	0.00
AR(2)(p-value)	0.43	0.88	0.74	0.65	0.40
Cash Flow (p-value)	–	–	0.00	–	–
Liquidity (p value)	–	–	–	–	0.00
EPL (p-value)	0.00	0.00	0.00	0.00	0.00
Observations	8217	8208	8208	8186	8186
Firms	2665	2665	2665	2665	2665

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 8.2 SE package one-step results; full set of time dummy included; '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; Cash Flow, Liquidity, EPL are F Test of the joint significance of the cash flow, liquidity, and EPL terms, respectively.

3.4 Investment and Firm Size

In this section we discuss how firm investment decisions are influenced by the interaction of firm size with imperfect financial and labour markets.

The interest on the interaction of firm size with Employment Protection Legislation and financing constraints is mainly motivated by two facts.

First of all, EPL usually applies differently to firms according to their size. Indeed, EPL is stricter when applied to firms with a higher number of workers employed (OECD, 2004).

Second, with respect to financing constraints, it is usually the case that smaller firms are more sensitive to internal funds than larger firms (Gertler and Gilchrist, 1994; Gilchrist and Himmelberg, 1995; Rajan and Zingales, 1994).

Instead of splitting the sample with *a priori* criteria,[18] we use three alternative dummy variables to capture firm size, and we allow them to interact with cash flow and EPL. We construct three definitions of firm size. The first two are defined with respect to the number of employees, whereas the third one is defined with respect to sales:

1. $Size_{i,t}$ is a dummy variable, which takes a value equal to 1 if firm i average employment is equal to or less than 100;

2. $Size_{i,t}$ is a dummy variable, which takes a value equal to 1 if firm i average employment is equal to or less than 20;

[18]Different a priori criteria might be used. Fazzari, Hubbard and Petersen (1998) propose the dividend payout ratio. Among other criteria we can list (cf. Lensink, Bo, and Sterken, 2001): age criterion, size criterion, and business conglomerate criterion. However, dividing firms into sub-samples using *a priori* criteria may have some drawbacks. First of all, more than one factor can determine whether a firm is financially constrained. Second, a time invariant criterion does not permit one to detect whether a firm that initially faced financing constraints becomes less constrained during the sample periods. Third, a problem of selection bias arises if the variable used as a selection criterion is correlated with investment. To solve or temper these problems an interactive approach has been proposed. Instead of selecting firms according to an *a priori* criterion, such an approach allows for interaction between the indicator of the availability of internal funds and a time-varying variable chosen as the relevant firm characteristic. Another solution is to use an endogenous switching model, where the switching function may depend on financial variables, firm size, year and industry dummy, etc..

3. $Size_{i,t}$ is a dummy variable, which takes a value equal to 1 if firm i average sales are equal to or less than average sales in the sample.

The empirical investment equation becomes

$$\begin{aligned} (I/K)_{i,t} &= \beta_0 + \beta_1 (I/K)_{i,t-1} + \beta_2 p_{j,t} + \beta_3 p_{j,t-1} + \beta_4 F_{K_{i,t}} + \beta_5 EPL_{j,t} + \\ \beta_6 EPL_{j,t-1} &+ \beta_7 (LIQ/K)_{i,t} + \beta_8 (LIQ/K)_{i,t} * EPL_{j,t} + \beta_9 Size_{i,t} + \\ \beta_{10} Size_{i,t} &* EPL_{j,t} + \beta_{11} Size_{i,t} * (LIQ/K)_{i,t} + d_t + \eta_i + \varphi_j + v_{it} \end{aligned} \tag{28}$$

Table (4) reports the estimates. Columns (1), (2), and (3) for marginal product, and (4), (5), and (6) for the real return on investment, correspond to the three alternative dummy variables defined above, respectively.[19]

We should expect a positive interaction between firm size and EPL for small firms defined according to the number of employees. Indeed, EPL should have less overall negative impact on firms with a lower number of employees; therefore, the negative impact of the $EPL_{j,t}$ regressor should be counterbalanced by a positive sign of the coefficient of the $Size_{i,t} * EPL_{j,t}$ variable. Small firms defined according to average sales should present a positive sign in the interaction between the size dummy and the liquidity index, $Size_{i,t} * (LIQ/K)_{i,t}$, because, as stated above, these firms are usually more subject to financial constraints; therefore, their investments should be more sensitive to the availability of internal funds.

Estimates of the empirical equations that discriminate between firms according to the number of employees confirm our expectations (column 1 and 2). Both past investment and the liquidity index display positive and statistically significant coefficients. As expected, the coefficient of the current installation cost is negative and statistically significant, whereas the coefficient of the past installation cost is positive and statistically significant.

[19] In principle, we could have added a fourth dummy variable to the regression equation, i.e. the interaction of size with the EPL and the liquidity regressor. However, this fourth dummy variable has been excluded from the regression equation because highly correlated with the $Size_{i,t} * EPL_{j,t}$ variable.

In both specifications, the coefficient of current employment protection is negative and significant, whereas the coefficient of past EPL is positive and statistically significant.

The coefficient of the interaction between EPL and internal funds is negative and statistically significant.

$Size_{i,t}$ is negative in both specifications, but statistically significant only when we consider firms with a number of workers equal to or less than 20. Then, it seems that firms with less than 20 employees invest less.

As for the interaction between firm size and EPL, $Size_{i,t} * EPL_{j,t}$, the coefficient turns out to be positive in both specifications, but statistically significant only when we consider firms with a number of workers equal to or less than 20 (column 2). In this latter case the negative effect of $EPL_{j,t}$ appears to be counterbalanced by the positive effect provided by the interaction between Size and EPL. Therefore, we test the hypothesis of no significance of overall EPL for small firms by an F Test

$$\beta_5 + \beta_6 + \beta_8 * \overline{LIQ/K} + \beta_{10} = 0 \tag{29}$$

and we fail to reject the null. According to the test, EPL does not play a role in investment decisions when firms have a number of employees equal to or less than 20. Such a finding supports our idea of EPL as a component of the investment adjustment costs, given that EPL usually applies mildly to firms with a low number of workers.

We test the significance of the overall impact of EPL for large firms by running the following F test

$$\beta_5 + \beta_6 + \beta_8 * \overline{LIQ/K} = 0 \tag{30}$$

We reject the null in both specifications, and we find that the overall impact is negative.

The coefficient of the interaction of firm size and cash flow is not statistically significant in either of the specifications. Moreover, it is wrongly signed when we consider firms with a number of workers equal to or less than 100 (column 1). However, in this latter case, we find that, once we control for small firms, the overall impact of the liquidity is not statistically significant. Indeed, in column (1), we cannot reject the null

$$\beta_7 + \beta_8 * \overline{EPL} = 0 \tag{31}$$

Therefore, the impact of the liquidity index appears to be not statistically different from zero for large firms.

When we control for small firms with respect to average sales (column 3), there is no evidence of a significantly positive interaction between the liquidity index and size.

Columns (4) to (6) add the impact of firm size, and the interaction of firm size with employment protection and financing constraints, to the specification (3) of Table 3.

In this case we find that firms with a number of workers equal to or less than 100 invest less, and appear to be less sensitive to EPL than larger firms (column 4). However, EPL continues to have an overall negative impact on investment. Once we control for firm size, we find that the overall impact of the liquidity on firm investment decisions is not statistically different from zero.

When we consider firms with less than 20 workers, we find that the total effect of EPL, tested by (30) and by (29) is negative and significant for large firms, but not statistically different from zero for small firms, respectively. Therefore, it appears that EPL does not play a role in the investment decisions of firms with less than 20 workers.

When we control for small firms according to average sales (column 6), we find that neither the coefficient on $Size_{i,t}$ nor the coefficient of the interaction between size and cash flow are statistically different from zero. However, we fail to reject the null of test (31), i.e. large firms are not significantly affected by internal funds. Finally, we find that EPL has an overall negative impact on investment.

Table 4: Investments and Firm Size

	(1) $emp \leq 100$	(2) $emp \leq 20$	(3) $turn \leq average$	(4) $emp \leq 100$	(5) $emp \leq 20$	(6) $turn \leq average$
$(I/K)_{i,t-1}$	0.582***	0.525***	0.563***	0.607***	0.587***	0.609***
	0.118	*0.125*	*0.125*	*0.087*	*0.079*	*0.089*
$p_{j,t}$	-0.719**	-0.725**	-0.694**	-0.492	-0.515*	-0.483
	0.315	*0.307*	*0.311*	*0.303*	*0.303*	*0.304*
$p_{j,t-1}$	0.852***	0.898***	0.859***	0.802***	0.862***	0.815***
	0.231	*0.256*	*0.232*	*0.232*	*0.264*	*0.236*
$F_{K_{i,t}}$	0.000	0.001	0.001			
	0.001	*0.001*	*0.001*			
$roir_{i,t}$				-0.001	-0.002	0.000
				0.001	*0.001*	*0.003*
$EPL_{j,t}$	-0.241***	-0.188***	-0.216***	-0.258***	-0.205***	-0.241***
	0.057	*0.062*	*0.057*	*0.056*	*0.064*	*0.057*
$EPL_{j,t-1}$	0.067*	0.064*	0.067*	0.078**	0.075**	0.078**
	0.036	*0.035*	*0.036*	*0.037*	*0.036*	*0.037*
$(LIQ/K)_{i,t}$	0.076***	0.101***	0.071***	0.074***	0.116***	0.071***
	0.020	*0.030*	*0.020*	*0.020*	*0.031*	*0.027*
$(LIQ/K)_{i,t} * EPL_{j,t}$	-0.024***	-0.035***	-0.024***	-0.025***	-0.040***	-0.024***
	0.006	*0.011*	*0.006*	*0.007*	*0.011*	*0.008*
$Size_{i,t}$	-0.094	-0.680**	0.029	-0.109*	-0.638***	0.025
	0.068	*0.282*	*0.032*	*0.066*	*0.265*	*0.028*
$Size_{i,t} * EPL_{j,t}$	0.042	0.237**	-0.006	0.046*	0.230**	-0.006
	0.026	*0.100*	*0.013*	*0.025*	*0.099*	*0.012*
$Size_{i,t} * (LIQ/K)_{i,t}$	-0.005	0.004	0.001	0.001	0.006	0.002
	0.010	*0.003*	*0.004*	*0.010*	*0.004*	*0.008*
time dummies	✓	✓	✓	✓	✓	✓
country dummies	✓	✓	✓	✓	✓	✓
constant	✓	✓	✓	✓	✓	✓
Hansen J (p-value)	0.56	0.62	0.68	0.49	0.55	0.40
AR(1) (p-value)	0.00	0.00	0.00	0.00	0.00	0.00
AR(2) (p-value)	0.37	0.33	0.36	0.42	0.33	0.39
LIQ Large (p-value)	0.19	0.00	0.12	0.45	0.00	0.53
EPL Large (p-value)	0.00	0.00	0.00	0.00	0.00	0.00
EPL Small (p-value)	–	0.56	–	0.00	0.87	–
Observations	8021	8021	8021	8186	8186	8186
Firms	2623	2623	2623	2665	2665	2665

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 8.2 SE package one-step results; full set of time dummy included; '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; LIQ Large and EPL Large are F Tests of the joint significance of the liquidity and EPL terms, respectively, when $size = 0$; EPL Small is a F test of the joint significance of EPL terms when $size = 1$.

3.5 Asymmetric Impact of EPL

Theoretically, we have assumed that EPL affects firms' investment adjustment costs. Moreover, we have assumed that the negative impact of EPL is higher when firms disinvest.

We test the hypothesis of asymmetric impact of EPL in Table 5.

For comparative purposes, we report the estimates of the basic Euler equation with country dummies in column (1), the estimates of the model enriched with cash flow and the interaction of EPL and cash flow in column (3), and the estimates of the model with the liquidity index and the interaction of the liquidity with EPL in column (5).

In columns (2), (4), and (6) we add the regressor $dkneg_{i,t} * EPL_{j,t}$, which represents the interaction of a dummy variable, $dkneg_{i,t}$, with EPL. $dkneg_{i,t}$ is such that it takes a value equal to one if firm i has a negative investment in period t.

The basic empirical investment equation becomes

$$\begin{aligned} (I/K)_{i,t} &= \beta_0 + \beta_1 (I/K)_{i,t-1} + \beta_2 p_{j,t} + \beta_3 p_{j,t-1} + \beta_4 F_{K_{i,t}} \\ +\beta_5 EPL_{j,t} &+ \beta_6 EPL_{j,t-1} + \psi dkneg_{i,t} * EPL_{j,t} + d_t + \eta_i + \varphi_j + v_{it}. \end{aligned} \tag{32}$$

If an asymmetric impact of EPL exists, ψ should be negative signed. Indeed, given that we theoretically assume a higher negative impact of EPL if the firm disinvests, the following empirical relationships should arise:

1. if investment is positive, the regressor $dkneg_{i,t} * EPL_{j,t}$ is equal to zero, and the impact of EPL is given by the coefficient β_5 alone, which we expect to be negative;

2. if investment is negative, $dkneg_{i,t} * EPL_{j,t}$ is different from zero, and the negative impact of EPL captured by the coefficient β_5 should be augmented by a negative ψ coefficient; i.e. the negative impact will be higher if the firm disinvests. In fact, we should obtain

$$|\beta_5| < |\beta_5 + \psi|.$$

The theoretical assumption of the asymmetric impact of EPL appears to be consistent with the empirical findings. Indeed, we find that the coefficient ψ is negative and statistically different from zero, both when we consider the basic empirical specification (23) and when we consider the alternative specifications that consider the impact of financial variables (25), i.e. in columns (2), (4), and (6), respectively.

Table 5: Asymmetric Impact of EPL

	(1)	(2)	(3)	(4)	(5)	(6)
$(I/K)_{i,t-1}$	0.413***	0.436***	0.615***	0.643***	0.517***	0.512***
	0.157	*0.150*	*0.173*	*0.165*	*0.143*	*0.134*
$p_{j,t}$	-0.716**	-0.061	-0.688**	-0.027	-0.703**	-0.034
	0.287	*0.235*	*0.326*	*0.278*	*0.303*	*0.245*
$p_{j,t-1}$	0.788***	0.328**	0.839***	0.375*	0.862***	0.395*
	0.191	*0.164*	*0.236*	*0.215*	*0.232*	*0.205*
$F_{K_{i,t}}$	0.003	0.002	0.001	0.000	0.001	0.000
	0.002	*0.002*	*0.001*	*0.000*	*0.001*	*0.001*
$EPL_{j,t}$	-0.241***	-0.115**	-0.257***	-0.127**	-0.203***	-0.066
	0.057	*0.048*	*0.065*	*0.058*	*0.060*	*0.052*
$EPL_{j,t-1}$	0.071**	0.074**	0.071*	0.074**	0.065*	0.068**
	0.033	*0.029*	*0.037*	*0.033*	*0.035*	*0.030*
$(CF/K)_{i,t}$			0.062***	0.067***		
			0.020	*0.019*		
$(CF/K)_{i,t} * EPL_{j,t}$			-0.020***	-0.022***		
			0.007	*0.007*		
$(LIQ/K)_{i,t}$					0.078***	0.082***
					0.014	*0.012*
$(LIQ/K)_{i,t} * EPL_{j,t}$					-0.026***	-0.028***
					0.005	*0.004*
$dkneg_{i,t} * EPL_{j,t}$		-0.146***		-0.150***		-0.148***
		0.004		*0.005*		*0.005*
time dummies	✓	✓	✓	✓	✓	✓
country dummies	✓	✓	✓	✓	✓	✓
constant	✓	✓	✓	✓	✓	✓
Hansen J (p-value)	0.89	0.54	0.47	0.38	0.72	0.54
AR(1)(p-value)	0.00	0.00	0.00	0.00	0.00	0.00
AR(2)(p-value)	0.80	0.59	0.50	0.39	0.38	0.22
Cash Flow (p-value)	–	–	0.00	0.00	–	–
Liquidity (p-value)	–	–	–	–	0.00	0.00
EPL (p-value)	0.00	0.00	0.00	0.00	0.00	0.00
Observations	8051	8051	8041	8041	8021	8021
Firms	2623	2623	2623	2623	2623	2623

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 8.2 SE package one-step results; full set of time dummy included; '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; Cash Flow, Liquidity is a F Test of the joint significance of the liquidity terms; EPL is a test of the joint significance of EPL terms.

4 Summary and Conclusions

This paper analyzes the link between investment, financing constraints and Employment Protection Legislation.

We propose a neoclassical investment model, with financing constraints, in which EPL enters as a component of the investment adjustment costs function of the firm. The idea is that regulation can increase the cost the firm faces when expanding or reducing its productive capacity, and limits its capacity to respond to changes in fundamentals. Moreover, we assume that EPL has an asymmetric impact on investment, with a higher negative impact when the firm disinvests.

By assuming that Employment Protection impacts not only labour costs but also investment adjustment costs, we find that current EPL has a negative impact on current investment, and the joint impact of EPL and financing constraints on investment is detrimental for investment.

In the empirical part of the work we estimate an empirical investment equation derived by the theoretical Euler equation of investment using GMM system techniques. Given that the Euler equation appears to be violated, we add regressors meant to capture the sensitivity of firms to internal funds.

We find that EPL had a negative and significant impact on investment, and that the joint impact of labour market rigidities and capital market imperfections is negative. The latter result shows that the two negative effects tend to exacerbate the negative impact on investment.

When we control for different firm sizes, we find that EPL does not play a role in investment decisions of firms with a number of workers equal to or less than 20. We believe that this result is consistent with the theoretical model proposed, given the fact that EPL usually does not apply to smaller firms.

Moreover, the empirical investigation confirms the hypothesis of asymmetric impact of EPL.

We believe that this paper contributes to current research at least in two ways. First, we suggest a model able to formalize the impact of financing constraints and EPL on investment. Second we validate the theoretical implications with empirical findings.

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