Job creation and investment in imperfect financial and labor markets

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Abstract

Purpose – This paper aims to weigh the restrictions to job creation imposed by labor market imperfections with respect to financial market imperfections. The authors want to see which restriction is more severe, and thus assess which is more powerful in creating permanent employment if it were removed.

Design/methodology/approach – A structural estimation is performed. The policy rules of the dynamic programming model are integrated into a simulated maximum likelihood procedure by which the model parameters are recovered. Data come from the CBBE (Balance Sheet data from the Bank of Spain). Identification of key parameters comes mainly from the observation of debt variation and sluggish adjustment to permanent labor.

Findings – Long-run permanent employment increases up to 69% when financial constraints are removed, whereas permanent employment only increases up to 54% when employment protection or firing costs are eliminated. The main finding of this paper is that the long-run expansion of permanent employment is larger when financial imperfections are removed than when firing costs are removed, even when there are important wage increases that moderate these employment expansions.

Social implications – The removal of firing costs has been suggested by several economists as a result of the analysis of labor market imperfections. These policies, however, face the strong opposition of labor unions. This paper shows that the goals of permanent job creation can be accomplished without removing employment protection but by means of enhancing financial access to firms.

Originality/value – The connection between financial constraints and employment has been studied in recent years, motivated by the Great Recession. However, there is no assessment of how financial and labor market imperfections compare with each other to restrict permanent job creation. This comparison is crucial for policy analysis. This study is an attempt to fill out this gap in the economic literature. No previous research has attempted to perform this very important comparison.

Keywords Job creation, Employment, Investment, Adjustment costs, Firing costs, Financial constraints, Structural estimation

Paper type Research paper

JEL classification – J23, J32, E22, G31

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1. Introduction

When payroll variations are costly and financial constraints are tight, firms are strongly discouraged from hiring workers. Both financial and labor market imperfections restrict employment expansion. Which of these imperfections is more restrictive to employment expansion? The answer to this question will determine the job creation potential of relaxation of financial constraints compared to the removal of labor market frictions.

The theoretical framework of this article is a neoclassical dynamic model of investment on the lines of Jorgenson (1963), with adjustment costs to capital as in Lucas and Prescott (1971), extended to allow for liquidity constraints and bankruptcy, as well as labor hiring and firing decisions. This framework is suitable for evaluating the dynamics of capital, debt and two types of labor under the elimination of firing costs and the elimination of financial constraints.

The main finding of this article is that financial constraints are a bigger obstacle for job creation than labor market imperfections. While removing the labor market costly adjustment helps firms to create jobs and increase capital accumulation by releasing internal resources for investment, binding financing constraints hinder job creation. The main implication of this finding is that the elimination of financial constraints can play a very important role in designing employment policies as it can create more jobs than just removing firing costs.

Weighing the employment impact of financial imperfections with respect to labor market imperfections is a contribution of the present article. Most research on the labor market impacts of financial restrictions evidenced job losses produced by financial shocks or by productivity shocks amplified in imperfect financial markets. No research so far has shown the relative strength of each of these imperfections, which is very important to outline policy interventions that face obvious political constraints. Eliminating or reducing firing costs, a policy that is often derived from analyzes that remark the severity of labor market imperfections is a very sensitive issue in countries with strong labor unions as is the case in Western Europe, and thus may not be politically feasible. Accordingly, to enhance policy designs to consider financial imperfections together with labor market imperfections, it is crucial to have a clear understanding of the job creation potentials of these two binding restrictions.

The literature on the interaction between financial and labor market imperfections is broad and rapidly growing. Several empirical studies, as surveyed by Hubbard (1998) and Bernanke *et al.* (1999), established that a firm's financial structure influences its investment decisions, thus rejecting the Modigliani and Miller (1958) proposition. Because external funds are more expensive than internal funds, the ability of a firm to adjust its capital is indeed sensitive to its internal collaterizable resources. On the other hand, investment also exhibits inaction and infrequent spikes, which are indicative of non-convex adjustment costs to capital (Caballero, 1999; Abel and Eberly, 1994; Cooper and Ejarque, 2004; Cooper and Haltiwanger, 2006). Similar research was conducted about labor adjustment costs, particularly hiring and firing costs, which were shown to reduce permanent employment, a particularly important topic in European countries (Bentolila and Bertola, 1990; Bentolila and Saint-Paul, 1992; Hopenhayn and Rogerson, 1993; Cabrales and Hopenhayn, 1997; Aguirregabiria and Alonso-Borrego, 2014).

The economic literature on the interaction of finance and labor markets grew substantially at the beginning of the 2000s and expanded to consider search and matching frictions besides firing costs. The common denominator of this research was to show both theoretically and empirically relatively large employment impacts of financial shocks and from the amplification of productivity shocks by financial constraints (Cantor, 1990; Sharpe, 1994; Nickell and Nicolitsas, 1999; Smolny and Winker, 1999; Yashiv, 2000; Pica, 2001; Acemoglu, 2001; Wasmer and Weil, 2004; Barlevy, 2003; Benito and Hernando, 2008; Caggese and Cuñat, 2008; Benmelech *et al.*, 2011; Bakke and Whited, 2012; Petrosky-Nadeau and Wasmer, 2013; Caggese *et al.*, 2019). Then, the Great Recession of 2007–2008 triggered a further expansion of this research, which corroborated that liquidity constraints are a powerful amplification mechanism of financial shocks with a large impact on labor demand. Following the Lehman crisis, banks were affected by huge losses that forced them to tighten lending to firms, which had to downsize their workforce. Firms with larger credit market frictions, expressed in more dependency on external finance or associated with less healthy lenders, were observed to experience larger employment drops (Chugh, 2013; Chodorow-Reich, 2014; Duygan-Bump *et al.*, 2015; Yashiv, 2016; Giroud and Mueller, 2017). Calibrated and estimated full-blown dynamic models that allowed for interactions between financing and search, matching or nonconvex labor adjustment costs also show that a credit crunch causes larger reductions in employment (Buera *et al.*, 2015; Michaels *et al.*, 2019; Elsby *et al.*, 2019).

Research conducted in Spain on labor and financial imperfections has arrived at similar conclusions as this literature. Spanish firms are shown to face significant financial constraints, so that financial variables have an important effect on firms' investment, particularly on small firms (Alonso-Borrego and Bentolila, 1994; Estrada and Vallés, 1995). This research is also consensual that labor adjustment costs are large and exert a negative impact on employment (Bentolila and Saint-Paul, 1992; Bover *et al.*, 2002; Aguirregabiria and Alonso-Borrego, 2014) and that tight liquidity constraint strongly limit the expansion of investment and permanent employment in Spain (Hernando and Tribó, 1999; Benito and Hernando, 2007, 2008; Barceló, 2007; Hernando and Martínez-Carrascal, 2008). In recent years, Bentolila *et al.* (2018) have found that during the Great Recession in Spain there were larger job losses at firms attached to fewer solvent banks than at firms related to stronger banks [1].

This article performs a joint analysis of financial and real imperfections that affect both investment and hiring and firing decisions. This is formalized by a dynamic model in which firms decide on investment, labor and debt under financial constraints, bankruptcy conditions and adjustment costs to capital and labor. There are also two types of workers: One type is permanent, subject to firing costs and is more productive and the other type is temporary, hired under fixed-term contracts, which can be fired frictionlessly. These two types of labor are imperfect substitutes, but firms do generally prefer permanent and more productive workers. Temporary labor contracts allow firms to avoid hiring permanent workers who are costly to fire as needed, and thus serve as a relaxation of financial constraints, releasing resources to increase investment, reduce borrowing and hedge against adverse shocks. As firms accumulate capital, they also manage to build their team of permanent workers, substitute temporary workers and reduce their debt. Unlike debt, which can be reduced to zero, large firms do not totally substitute temporary workers for permanent workers because of their imperfect substitutability.

The data for this estimation comes from the Central de Balances del Banco de España (CBBE) (Balance Sheet data from the Bank of Spain) and includes financial variables, as well as information on permanent and temporary employment, from 1983 to 1996 [2]. This is a unique data set, particularly well suited to analyze the joint effects of credit constraints, firing costs and temporary employment on job creation. Several researchers also used it to analyze capital market imperfections, as well as labor market issues (Dolado and Bentolila, 1992; Bentolila and Dolado, 1993; Gómez and Dolado, 1995; Aguirregabiria and Alonso-Borrego, 2014).

The estimation consists of a simulated maximum likelihood procedure based on the policy rules of the theoretical model. The estimated model exhibits a good replication of the data. With the structural parameters, two counterfactual scenarios are evaluated. The first counterfactual scenario – the elimination of firing costs – initially reduces permanent employment substantially followed by a significant recovery, as well as capital increases and debt decreases. The second experiment – relaxing financial constraints – generates a sustained increase of permanent employment and capital together with a sharper decrease in firms' debt. Noticeably, the level of permanent employment produced by a relaxation of financial constraints is considerably higher in the long-run (69%) than the one produced by the elimination of labor market imperfections (54%). Wage increases resulting from an expanded labor demand diminish these increases in permanent employment, yet in the long-run, the expansion of permanent employment is always larger when financial imperfections are removed than when firing costs are removed. These quantitative results may be probably seen as very large, yet they convey an important message for policy analysis: Instead of emphasizing the removal of firing costs, which may face strong social resistance, particularly by labor unions, relaxing financial constraints may be politically feasible and at the same time an effective way of addressing firing costs and expand permanent employment. Recent research corroborates the crucial connection between financial tightening and increasing unemployment. Furthermore, the recent financial crises, the Great Recession and even the recent pandemic illustrate that actual policies by central banks and governments recognize the importance of firms' finance for job creation. Counter-cyclical policies to maintain and expand employment rely heavily on financial easing and expanding credit to firms rather than aiming at reducing firing costs.

The remainder of the article is organized as follows. Section 2 explains the model and characterizes the optimal solution. Section 3 discusses the estimation procedure and the sources of identification. Section 4 describes the data used in the estimation and documents their basic trends. Section 5 presents the results of the estimation and an assessment of how well the model fits the data. Section 6 evaluates the regime changes mentioned above. The main conclusions of this article are summarized in Section 7.

2. Model

Firms maximize the expected discounted value of their stream of dividends $\sum_{t=0}^{\infty} \frac{E_t D_t}{(1+\rho)^t}$, by choosing a sequence of investment I, permanent labor H, temporary labor L and debt B, at a discount rate ρ [3] Dividends are defined as:

$$D = \theta K^{\alpha}(H^{\gamma} + \lambda L^{\gamma})^{\frac{\beta}{\gamma}} - I - c^k\left(K, K'\right) - c^h(H_{-1}, H) - w_H H - w_L L - (1+r)B + B',$$

that is revenues from products that depend on capital K and on two types of labor, permanent labor H and temporary labor L, net of investment, adjustment costs to capital and to permanent labor, both labor costs and net debt variation. The firm's risky environment is contained in a random total factor productivity θ that follows a Markov process $P\left(\theta' | \theta\right)$, parameterized as an AR(1) process: $\ln\theta' \sim N\left(\mu + \phi \ln\theta,\ \sigma^2\right)$. Production technology is a Cobb–Douglas production function in capital and efficiency units of labor, with parameters α and β, respectively. Permanent and temporary labor is transformed into efficiency units of labor by a constant elasticity of substitution (CES) technology with parameters γ and λ, which reflect worker types' different productivities. Flexible or temporary workers are unskilled and rigid or permanent workers are skilled; between them, there are no promotions or transitions.

Investment involves a quadratic adjustment cost $c^k(K,K') = \frac{a}{2}\frac{I^2}{K}$, where $I = K' - (1-\delta_k)K$ and δ_k is the depreciation rate of capital. Wage rates for permanent and temporary labor are w_H and w_L, respectively. Firms do not have any way to alter these wages; they are wage-takers, which is motivated by a fully elastic labor supply or regulated wages [4]. The firm can hire and fire temporary workers and hire permanent workers at no cost, but their firing is costly: $c^h(H_{-1},H) = F\max[(1-\delta_h)H_{-1} - H, 0]$, where F is the firing cost in terms of unit variations in permanent labor. Workers quit their jobs at an exogenous rate δ_h without producing any cost to firms [5].

Besides a labor market imperfection reflected in firing costs, there is a credit market imperfection that consists of an exogenous constraint on financing, formalized as a non-positive lower bound on dividends, $D \geq -\overline{D}$. This constraint reflects that firms can use their own funds costlessly. Once these funds are exhausted, privately held or owner-operated firms do not have access to any external funds, while publicly-traded firms face an infinite cost of equity issuance [6].

In the current period, the firm pays debt B at interest rate r, determined both in the past period and contracts next period's debt B' at the interest rate r'. The firm does not lend money in any way; that is, it is constrained to have a nonnegative level of debt: $B' \geq 0$.

The timing of events is as follows: the firm enters a period with a level of capital K, debt $(1+r)B$ and permanent labor H_{-1}, productivity θ is realized and the firm stays in business if its value is at least the value of an outside option and exits otherwise; the surviving firm chooses investment, new debt and the two types of labor; the exiting firm shuts down forever and defaults on the entirety of its debt [7].

The value of the firm is expressed in the following Bellman equation:

$$\begin{aligned} V\left(K, H_{-1}, (1+r)B, \theta\right) = \max_{K',H,L,B'} \Big\{ & \theta K^{\alpha}(H^{\gamma} + \lambda L^{\gamma})^{\frac{\beta}{\gamma}} + (1-\delta_k)K - K' - c^k\left(K,K'\right) \\ & - c^h(H_{-1},H) - w_H H - w_L L - (1+r)B + B' \\ & + \frac{1}{1+\rho} E \max\left[V\left(K', H, (1+r')B', \theta'\right), \Omega(\theta')\right] \Big\} \\ & \text{subject to } D \geq -\overline{D} \text{ and } B' \geq 0, \end{aligned}$$

where $\Omega(\theta)$ represents the value of the outside option, which is defined as the value of starting a firm at that idiosyncratic productivity with zero capital, zero permanent workers and zero debt: $\Omega(\theta) = V\left(0^+, 0, 0, \theta\right)$. In this environment, the value of the firm is increasing in capital and productivity, non-increasing in lagged permanent labor and decreasing in total debt payments, i.e. $V_K > 0$, $V_\theta > 0$, $V_{H_{-1}} \leq 0$, $V_{(1+r)B} < 0$.

Let the reservation productivity, the lowest productivity that allows the firm to stay in business, be $\underline{\theta}\left(K, H_{-1}, (1+r)B\right) \equiv \left\{\theta \middle| V\left(K, H_{-1}, (1+r)B, \theta\right) = \Omega(\theta)\right\}$. Then the firm keeps operating if $\theta \geq \underline{\theta}$, so that the probability of survival in the next period is $\Pr\left(\theta' > \underline{\theta}' | \theta\right) = 1 - \Phi\left(\sigma^{-1}\left(\ln\underline{\theta}' - \gamma\ln\theta - \mu\right)\right)$, where $\Phi(\cdot)$ is the normal cumulative distribution function. By the implicit function theorem applied to the definition of $\underline{\theta}$, we obtain the following derivatives: $\underline{\theta}_{K'} < 0$, $\underline{\theta}'_H \geq 0$, $\underline{\theta}'_{(1+r')B'} > 0$, which imply that the survival probability is increasing in the capital, non-increasing in permanent labor and decreasing in debt and the interest rate.

Firms and lenders establish a firm-specific debt contract by which lenders earn zero expected profits. Assuming that competitive lenders face an elastic supply of funds at the risk-free rate ρ, the interest rate r' charged on debt B' is determined by the condition:

$$G(r') = \Pr\left(\theta' > \underline{\theta}'|\theta\right)(1+r')B' - (1+\rho)B' = 0.$$

The first term represents the expected return to the lender; that is, the probability of survival times the return on borrowing; the second term is the opportunity cost of the funds. This equation pins down the firm-specific interest rate as a supply function: $r'(K', H, B', \theta) = \{r'|G(r') = 0\}$. The interest rate is decreasing in the capital, increasing in debt and ambiguous in permanent labor; more precisely, $r'_{K'} < 0, r'_{B'} > 0, r'_H \geq 0, r'_\theta < 0$. The interest rate ranges between ρ if survival were guaranteed and infinity if the firm exists the industry with certainty, in which case $B = 0$, lenders deny any credit to that firm so that a Ponzi scheme is ruled out. The interested reader will find more details on the solution of the model and on the interest rate function in Appendix 3 [8].

As investment and permanent labor adjustments are limited by internal funds, the firm alleviates financial constraints using temporary workers and reducing debt. As the firm increases capital and builds a team of permanent workers, temporary employment and debt go down. Once the firm attains its desired level of capital and permanent workers, these two variables are no longer sensitive to the firm's financial position.

Figure 1 illustrates the optimal solution for H as a function of H_{-1}. In models of adjustment costs under unconstrained financial markets, firms with a level of permanent labor lower than H_0 immediately adjust to H_0, whereas firms with a level of permanent labor higher than H_1 immediately adjust to H_1. However, under financial constraints, small firms do not adjust their permanent labor to H_0, as they want to avoid costly firing in future periods of low productivity. Even in the absence of hiring costs, financial constraints make firms hire permanent workers slowly and rely relatively more on temporary workers. In their turn, firms with an excessive number of permanent workers have to keep them because financial constraints impede them in paying the firing cost associated with payroll downsizing. These firms can only afford to make slow reductions of permanent employment, that is, to a level above H_1.

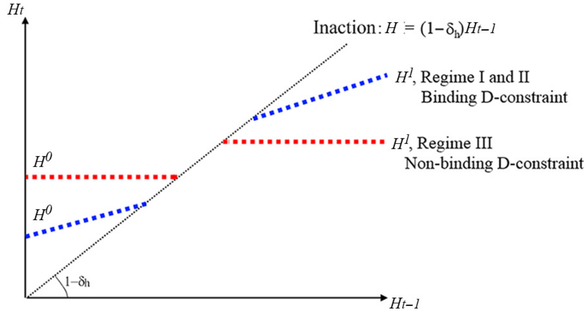

Figure 1.
Permanent employment H_t as a function H_{t-1}

Too few or too many permanent workers are both a liability and a sign that the firm's net worth is low. Hence, firing costs paid currently or in the future, constrain persistently the level of permanent workers to the financial position of the firm.

3. Estimation

The estimation method uses the policy rules of the dynamic model to construct a likelihood function at each parameter iteration (Hajivassiliou and Ruud, 1986; Keane and Wolpin, 1994). The estimated model's parameters are the maximizers of this simulated likelihood function.

The estimation recovers the model's parameters by minimizing the distance between observed and simulated trajectories of four observables: capital, debt, permanent employment and temporary employment. The simulation starts with the first observation after the year 1983 of these four variables and the first productivity level, which is recovered thereof. It is an estimation of a transitional process from one regime without temporary labor – in 1983 and 1984 – to one with temporary labor, established by an unanticipated change in 1985. Using the parameters of the productivity AR(1) process, for each firm, 100 simulated productivity sequences are generated. As it is unlikely that each of these simulations matches the observations exactly, it is assumed that observed values are measured with error.

Wage rates for permanent and temporary labor, w_H and w_L, are fixed, respectively, at the average and minimum wages per annum in Spain during the sample period: 2.58 for permanent labor and 0.89 for temporary labor [9]. Similarly, the annual risk-free interest rate ρ is set at 3.7% and the depreciation of capital δ_h at 15.6% per annum.

There are 11 estimated parameters of the model, which are identified from the four policy rules for the observable variables, characterized by nine possible regimes of permanent labor adjustment and possibly binding dividend and debt constraints [10].

The firing cost F is identified from the larger reductions in permanent labor, reductions in capital and the associated increases in debt, while the quit rate for permanent labor δ_h is identified from the lowest drops in permanent labor, understood by the model as inaction in labor adjustment. Similarly, the quadratic adjustment cost parameter a is identified from observed investment conditional on observed current capital. The financial constraint $\overline{D}$ is identified from the amount of debt, as this constraint is binding when debt is positive, while when debt is zero, capital and permanent labor are insensitive to debt. Cobb–Douglas production function parameters, α and β, are mainly pinned down by the observed capital-labor ratios by firm size, while CES parameters for the two types of labor, γ, λ, are mainly determined by the observed mix of the two types of labor by firm size [11]. Finally, the parameters of stochastic productivity, ϕ, μ, σ, are determined by the observed comovements of observed capital, the two types of labor and debt.

The estimated set of parameters is $\Theta = \{\alpha, \beta, \gamma, \lambda, \delta_h, F, a, \phi, \mu, \sigma, \overline{D}, \sigma_K, \sigma_H, \sigma_L, \sigma_B\}$; that is, the model's parameters and the standard deviations of the measurement errors. The computation of the likelihood function exploits the discretization of the variables performed to solve the theoretical model (Appendix 5). The likelihood function is maximized using the Powell algorithm (Press *et al.*, 1992).

4. Data

The data come from balance sheet records kept at the Bank of Spain (CBBE). This data set contains 94,192 observations for more than 200 variables about the financial structure and employment of 19,473 firms from 1983 until 1996. The selection of the data leaves in the sample manufacturing private firms that do not change activity, do not merge or split and have more than five consecutive observations. The final sample consists of 1,217 firms with 10,787 observations. The data for capital and debt are given in millions of pesetas of 1987, computed using the industrial price index as a deflator. The employment information is given in terms of permanent and temporary workers, which in each category is the annual average number of workers hired by the firm. A further description of the selection of the data, the definition of the variables and the structure of the panel is provided in Appendix 2.

Table 1 presents descriptive statistics for the main variables in original amounts, ratios and variations. This table shows the values of the variables by size, measured as thirds in the distribution of capital and by period: before the labor market reform (1983-1984), up to five years after the reform (1984-1989) and 1990-1996. This period is characterized by an important growth of capital, 3.3% by year, is the growth rate higher between 1985 and 1989 and a decline of debt [12]. Notice that in relative terms, debt by the worker is higher for medium-sized firms, whereas the debt-capital ratio is monotonically decreasing in firms' size. As predicted by the model, firms with a high level of capital rely less on debt for their financial needs than small firms, which may be thirsty for financial resources.

In this same period, temporary labor substitutes permanent labor and, moreover, experiences a very high expansion, which is responsible for most of the expansion in total labor in the 1980s and 1990s. This is in line with Bentolila and Saint-Paul (1992) and Boeri and Garibaldi (2007), who documents an overshooting of employment or transitional

Table 1.
Descriptive statistics by period and firm size

	1983–1984			1985–1989			1990–1996		
Variable	Small	Med.	Large	Small	Med.	Large	Small	Med.	Large
Obs.	250	346	411	1,910	1,778	1,654	1,437	1,471	1,530
Capital K									
Average	36	171	1179	32	164	1127	33	160	1211
SD	(21)	(65)	(918)	(20)	(64)	(902)	(21)	(65)	(969)
$\Delta K/K\%$	−5.6	−9.2	−4.9	3.4	5.5	4.7	−1.4	2.3	3.3
$K/(H+L)$	0.7	1.7	3.4	0.8	1.9	3.5	1.1	2.4	4.0
Debt B									
$\text{Average}\|_{B>0}$	66	172	503	61	172	475	60	143	467
$\text{SD}_{B>0}$	(74)	(179)	(362)	(74)	(178)	(352)	(99)	(165)	(371)
$\Delta B/B\%\|_{B>0}$	18.1	22.5	5.9	2.8	3.1	2.2	0.6	1.7	−0.6
$B/K\|_{B>0}$	1.9	1.1	0.4	1.9	1.0	0.4	1.8	0.9	0.4
$\%\text{Obs.}\|_{B=0}$	20.8	15.3	8.8	23.1	14.8	10.1	28.0	11.2	5.1
Permanent labor H									
Average	51	92	319	34	75	281	24	51	247
SD	(42)	(67)	(282)	(29)	(63)	(259)	(24)	(51)	(247)
$\Delta H/H\%$	−1.8	0.2	−1.2	0.5	0.6	0.7	−2.5	−0.4	−0.3
Temporary labor L									
$\text{Average}\|_{L>0}$	11	16	33	9	19	58	9	18	65
$\text{SD}\|_{L>0}$	(25)	(32)	(87)	(12)	(29)	(108)	(9)	(23)	(108)
$\Delta L/L\%\ \|_{L>0}$	26.7	0.9	14.3	7.8	12.6	16.3	−1.1	−1.3	−3.6
$\%\text{Obs.}\|_{L=0}$	61.6	54.3	45.7	47.9	36.5	28.5	28.0	19.8	16.3
$L/(H+L)\%$	9.2	7.5	5.9	11.2	13.3	12.9	20.1	21.6	17.8

Notes: Data on capital and debt are given in million pesetas of 1987; large, medium-sized and small firms are, respectively, in the upper, medium and lower third of the capital distribution "honeymoon" in the initial period after the regime change. Further evidence and discussion of these trends are provided in the next section.

5. Results

Table 2 reports the maximum likelihood parameter estimates and their asymptotic standard errors. The capital coefficient is estimated at around 0.26, whereas the labor coefficient is around 0.65. These Cobb–Douglas parameters display decreasing returns to scale to capital and labor, as they add up to less than one. The value of 0.84 for γ, greater than β, indicates that substitutability between the two types of labor is predominant, however, imperfect. The estimate for λ shows that one unit of temporary labor is roughly around 20% as productive as one unit of permanent labor. In terms of profits, firms have a clear incentive to hire permanent workers, but, as seen below, their wages and especially their firing costs are relatively high.

The rate of quits of permanent labor of 0.2% is below its usual measures in job survey data. This value suggests that reductions in permanent labor result mainly from firms' decisions. Firing costs are estimated to be 5.19, which doubles the annual wage. These firing costs do not just include observed severance payments, but all possible costs associated with the process of firing a worker, including the cost for the firm that workers appeal firing decisions and continue working. Capital adjustment costs are 2.39, which are relatively high, corresponding to slow adjustments in the capital.

The persistence parameter of the production process is 0.88, with a mean of 0.12 and a standard deviation of 0.28. The lower threshold on dividends is estimated at around 100 million pesetas of 1987, which may apparently indicate relatively loose liquidity constraints; however, it is important to bear in mind that adjustment costs both for apital and labor are relatively high, so these constraints are very likely to be binding [13]. Standard deviations of measurement errors are around the values of the standard deviations of the four variables explained in the descriptive section and are particularly low for capital and permanent labor. As we will see graphically and numerically, the model is able to fit the data fairly well.

Figure 2 reports the paths for actual and predicted average capital, debt and permanent and temporary labor by year. As explained above, the predicted variables in the first two

Parameters		Estimates	Standard errors
Capital Cobb–Douglas parameter	α	0.25650	0.0782
Labor Cobb–Douglas parameter	β	0.64533	0.0996
CES parameter for temporary and permanent labor	γ	0.83571	0.0229
Efficiency of temporary labor	λ	0.19495	0.0110
Quit rate for permanent workers	δ_h	0.00235	0.0013
Firing cost	F	5.18602	0.3325
Capital adjustment cost	a	2.39328	0.1938
Productivity persistence	ϕ	0.88259	0.0098
Productivity growth	μ	0.12290	0.0219
Volatility of productivity	σ	0.28380	0.0403
Borrowing constraint	$\overline{D}$	100.1	4.2
Measurement error, capital	σ_K	795.2	52.9
Measurement error, borrowing	σ_B	389.2	19.4
Measurement error, permanent labor	σ_H	106.5	44.8
Measurement error, temporary labor	σ_L	170.5	22.2

Table 2. Parameter estimates

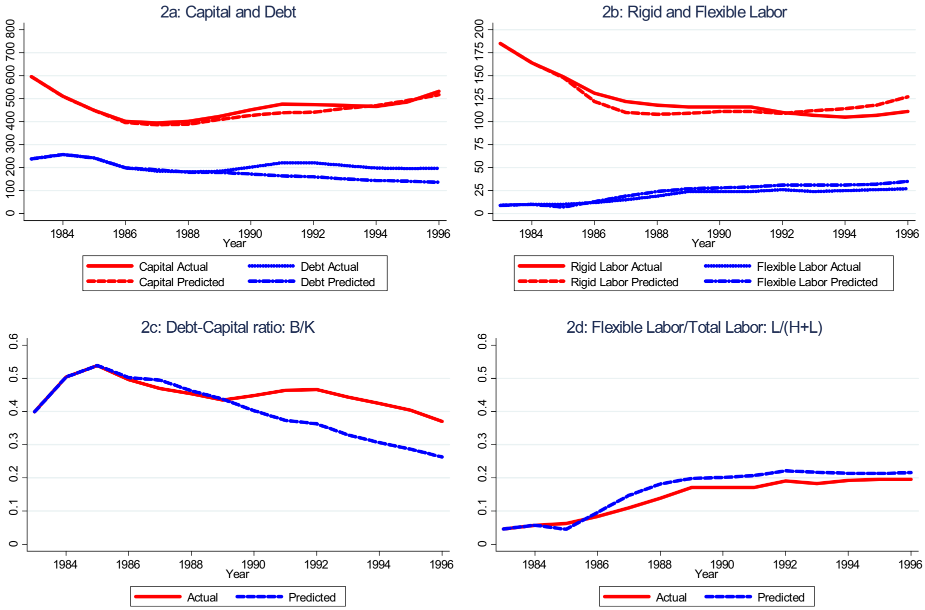

Figure 2.
Actual and predicted variables

years coincide with the actual because the estimation is made conditional on these observations coming from a regime without temporary labor. The model displays good replication of the data. The predicted path for debt fluctuates around the actual one, with some underprediction in later years, which looks clearer in Figure 2(c) which shows the debt-capital ratio over time. There is an increase in this ratio from 1983 until 1985 and from then onward a decrease. The predicted path for the two types of labor is also close to the actual path, with some overprediction for both types of labor in the past years. This trend is also clear in Figure 2(d) showing the actual and predicted percentage of temporary labor over the total labor force. These graphs illustrate the model is fairly successful in replicating the data.

Table 3 also shows that the model fit is fairly good, especially for capital and permanent and temporary labor. The sample standard deviations of the predicted errors of each variable are reported in the last row of each table; they are substantially lower than the estimated standard deviations of the measurement errors.

6. No labor and no financial imperfections

Having recovered the underlying parameters of the model and assessed their success in replicating the data, we can evaluate the impact on employment of two counterfactual scenarios:

(1) removing labor imperfections; and

(2) eliminating financial constraints.

As both regime changes increase the labor demand for the two types of labor, in the absence of labor supply data, we can also assess how their impact variates with a 10% wage increase and a 20% wage increase. The first scenario is attained by solving the dynamic programming problem using the estimated parameters, with the exception of firing costs, which are set to zero: $F = 0$ and increasing permanent and temporary workers' wages, w_H and w_L, respectively, in the given percentages. The elimination of the

Year	Capital Act.	Capital Pred.	Debt Act.	Debt Pred.	Permanent labor Act.	Permanent labor Pred.	Temporary labor Act.	Temporary labor Pred.
1983	596	596	238	238	185	185	9	9
1984	510	510	257	257	164	164	10	10
1985	449	449	242	242	149	148	10	7
1986	401	396	199	199	131	122	12	13
1987	394	386	185	191	122	110	15	19
1988	401	389	182	180	118	108	19	24
1989	423	409	184	179	116	109	24	27
1990	451	427	202	172	116	111	24	28
1991	476	439	221	164	116	111	24	29
1992	474	441	221	160	110	109	26	31
1993	471	458	209	151	107	112	24	31
1994	466	470	198	144	105	114	25	31
1995	485	492	196	141	107	118	26	32
1996	532	517	197	136	111	127	27	35
$\sqrt{n^{-1}\Sigma e^2}$	126.13		262.38		41.18		35.99	

Table 3. Actual and predicted variables

dividend constraint is accomplished numerically setting $\overline{D}$ at a very high absolute value while allowing wages of both workers to increase in the same percentages as in the previous scenario.

The predicted paths of the four variables are generated in a similar fashion as in the estimation, by a simulation of the sequence of productivities starting off with the true observed values of 1983 and 1984 and use the model's policy rules of each counterfactual regime. The sequences of new predictions are reported in Table 4 and depicted in Figure 3 for removing labor market imperfections and Figure 4 for removing financial constraints, for 0%, 10% and 20% increases in wages.

The removal of firing costs reveals that firms have too many permanent workers, which they would like to eliminate, but cannot because of the high firing costs that this would represent. After its initial reduction, permanent labor increases again, as capital grows and debt decreases slowly to a positive level. When there are no wage increases, firms clearly

Variable	Year	Benchmark case Level	Counterfactuals: (%) variation zero firing cost Wage increases: 0%	10%	20%	No dividend constraint Wage increases: 0%	10%	20%
Capital	1986	396	0.8	−0.5	−3.5	6.3	5.8	3.3
	1990	427	15.2	15.9	11.9	24.1	21.3	10.3
	1996	517	30.8	33.3	32.3	30.9	28.0	16.1
Debt	1986	199	0.0	5.5	1.0	−81.9	−81.9	−81.9
	1990	172	−72.1	−69.2	−69.2	−91.3	−91.3	−91.3
	1996	136	−87.5	−85.3	−81.6	−100.0	−100.0	−100.0
Permanent workers	1986	122	−10.7	−24.6	−36.9	7.4	−1.6	−16.4
	1990	111	38.7	21.6	9.9	45.0	27.9	9.0
	1996	127	54.3	40.2	28.3	69.3	49.6	29.9
Temporary workers	1986	13	7.7	−15.4	−38.5	7.7	−23.1	−38.5
	1990	28	42.9	10.7	−17.9	57.1	14.3	−17.9
	1996	35	85.7	42.9	14.3	91.4	42.9	8.6

Table 4. Regime changes: Removal of the labor market and financial imperfections

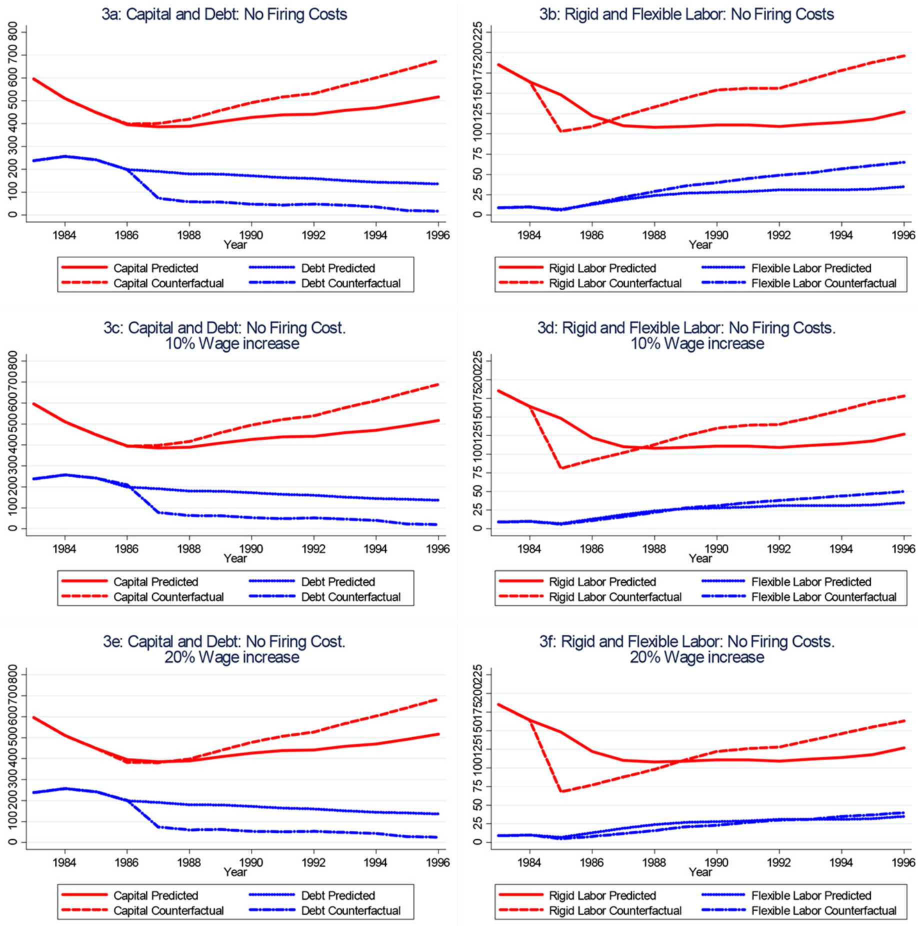

Figure 3.
Capital, debt and labor after regime changes: No firing cost

substitute permanent labor for temporary labor, without much increase in capital or decrease in debt. While wage increases imply lower levels of permanent and temporary labor and lower drops of debt at all years, the response of capital is non-monotonic: Wage increases from 0% to 10% boost capital levels, suggesting a stronger substitution effect, but wages increase from 10% to 20% decrease capital levels suggesting that the scale effect dominates over the substitution effect.

The removal of the dividend constraints generates a large increase in capital with an immediate reduction of debt to zero. This is associated with increases both in permanent and temporary employment. That is, in this counterfactual scenario, firms do not downsize their permanent workforce suddenly as in the previous scenario. What clearly prevails is the complementary between capital and labor and between the two types of labor. These variations are particularly large if wages are fixed. Wage increases of 10% and 20% reduce this growth of capital and of both types of labor, especially of temporary labor, suggesting a clear dominance of the scale effect.

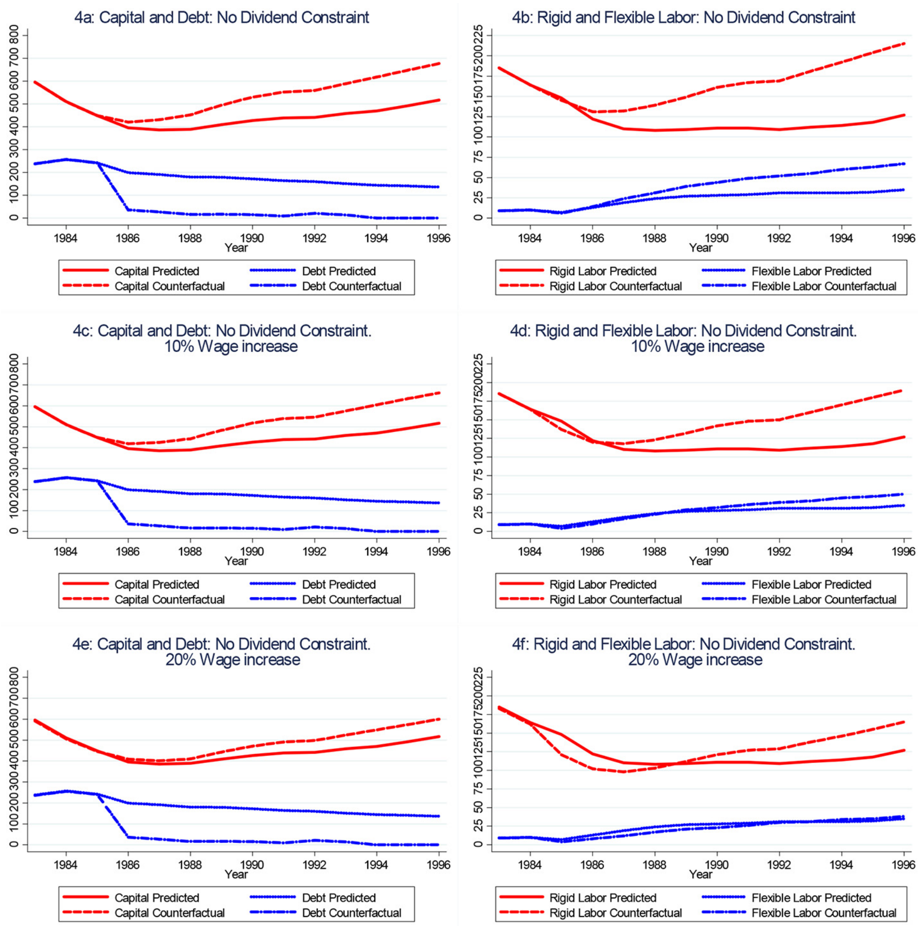

Figure 4.
Capital, debt and labor after regime changes: No financial constraint

Table 4 reports specific values of the four variables predicted in these scenarios for three selected years. Removing financial imperfections clearly implies larger increases of permanent labor in 1996 than for removing firing costs, particularly when there are no wage increases: 54% increase of permanent labor for removing firing costs and 69% permanent labor increase for removing the dividend constraint. The long-run expansion of temporary employment is also larger for removing the dividend constraint, 91%, than for removing firing costs, 86%. Interestingly, increases in capital are in both cases 30%, while debt understandably disappears for removing dividend constraints, while it is reduced by 88% for removing firing costs.

Wage increases, particularly large increases, of 20%, erode the expansion of permanent employment substantially when the dividend constraint is removed, to 30% in 1996, which is still above the corresponding expansion of permanent employment of 28% when firing costs are removed. Removing the dividend constraint with wage increases of 20% imply much smaller long-run increases in capital and in temporary labor: only 16% for capital and only 9% for temporary labor in 1996, in contrast with 30% for capital and 14% for temporary labor when firing costs are removed. At any rate, even when accounting for increases in wages resulting from an increased labor demand, the long-run expansion of permanent employment is always larger when financial imperfections are removed than when firing costs are removed. There is no sudden large permanent employment drop when financial constraints are totally removed as it occurs when firing costs are totally removed.

This shows that removing financial constraints can create more permanent employment than removing firing costs. Access to external finance can activate imperfect labor markets without actually removing firing costs. Conversely, a financial tightening in the presence of large firing costs, as experienced in recent years, implies potentially large contractions in permanent employment.

7. Conclusions

The present article has analyzed the interaction between financial and labor market imperfections by means of a tractable estimated dynamic model of investment and labor demand. Capital accumulation and permanent job creation are restricted by a limited ability to use external finance and by the costly firing of permanent workers. Firms have to improve their internal financial position to increase their capital and adjust their number of permanent workers.

A comparative evaluation of two counterfactual scenarios reveals that relaxing financial constraints increases long-run permanent employment by 69% while removing firing costs increases long-run permanent employment by up to 54%. As these two scenarios imply both displacements of the labor demand, an upward-sloping labor supply will imply higher wages and, thus lower increases in permanent employment. Even when this effect is accounted for, increases in permanent employment are still larger under the removal of financial constraints than under the elimination of firing costs. With large wage increases of 20%, long-run permanent employment increases by 30% when financial constraints are removed and by 28% when firing costs are removed.

The present comparative assessment of the severity of financial constraints *vis-à-vis* the severity of labor imperfections has been carried out in a framework that is abstracted from features such as costly equity issuance, equilibrium interest rates, wage bargaining, search or matching frictions or promotions from temporary to permanent contracts. However, existing research in enhanced setups that formally incorporate the mentioned features unanimously underscores the negative effect of financial constraints on job creation, and thus the robustness of the main result of the present article on the job creation potential of removing financial constraints.

These relatively large quantitative outcomes are certainly the result of the drastic removal of liquidity constraints and firing costs. Real variations in finance tightness and firing costs may be less severe, so that observed outcomes may be actually more moderate. Yet, some policy implications emerge from the present analysis. The removal of firing costs or employment protections has been the cornerstone of labor policies in several Western European economies. Policy measures to reduce unemployment included reducing firing costs, lowering government intervention in wage determination and reducing unemployment transfers. In particular, most of the observed reforms did not attempt to reduce the costs of firing those already used, protected by strong unions, but to create a new type of contract that, once expired, allows firms to costlessly lay off newly hired workers. The result of these reforms was the emergence of dual labor markets consisting of permanent workers who are difficult to hire and especially difficult to fire and temporary workers, on probation for a fixed number of months, after which they are either promoted to be permanent or dismissed. Logically, these reforms created a strong incentive for firms to hire more temporary workers; however, the fact that firms in these economies not only operate in imperfect labor markets but also in imperfect financial markets, further limited the creation of permanent jobs to the extent of firms' financial resources.

The present article has shown that removing firing costs, politically unfeasible in most Western European economies, would imply a sharp initial reduction of permanent employment followed by important increases thereof. Certainly, this initial reduction of employment will make such regime change even less acceptable to permanent workers. On the contrary, relaxing financial constraints would produce long-run larger capital and permanent employment expansions than the previous change, but without the initial mass layoff of permanent workers. This analysis suggests that policies designed to increase job creation will benefit from not limiting themselves to labor market policy measures but also consider financial variables and investment. Focusing on relaxing financial constraints may seem to be an indirect policy; nonetheless, it may probably be a more politically feasible and at the same time effective way to address labor market imperfections.

The present estimation and evaluation were performed using data for times of economic expansion, with only minor downturns compared to the Great Recession or the recent pandemic crisis, for which there is very visible evidence that limited finance limits job creation and reinforces job loss. Yet, we can see that even in times of sustained economic expansion, financing constraints and labor imperfections were substantial in hindering larger permanent employment increases. On the other hand, in terms of policy implications, most counter-cyclical policies carried out during these recent stress periods, both the Great Recession and even the pandemic, consisted of expanding credit issuance to the economy, with the specific purpose that firms do not fire workers. No policy in the world attempted to alleviate the firm's financial position by reducing the cost of firing workers.

Notes

1. Close to the Spanish context, Fernandes and Ferreira (2017) find that in Portugal after the 2008–2009 crisis, firms in more financially constrained industries hired a larger proportion of fixed-term workers with respect to permanent workers, relative to less financially vulnerable firms.
2. Updating the "empirical analysis with a longer series that incorporates more recent data," in particular the downturn of the late 2000s, is a sensible extension of this research. Undoubtedly, the incorporation of this severely stress scenario is likely to further reinforce the sensitivity of employment to financial constraints. This valuable extension is left for future research.
3. In what follows, variables in the current period will not carry a subscript, variables in the next period will be denoted by "prime" and variables in the past period will have the subscript -1.
4. This assumption is based on the existence of relatively rigid wages in Spain, as in Western Europe generally, as a result of highly centralized wage bargaining (Appendix 1 for a description of the institutional background in Spain).

5. Adjustment costs to labor do not interact with adjustment costs to capital, as in Merz and Yashiv (2007), nor are they contingent on the financial situation of the firm.
6. A smoother version of this constraint is that after its internal funds are exhausted, the firm can issue equity at an increasing cost for existing shareholders (as in Gomes *et al.*, 2006) or Whited, 2006).
7. Unlike other models in which a firm defaults and continues operating, in this model, default is a terminal action of the firm.
8. This model is solved by a numerical solution for assigned parameter values by discretizing all possible combinations of K, H and $(1+r)B$, into grids of points. This is explained in Appendix 4.
9. The CBBE data include the total wage bill for both permanent and temporary workers. In previous versions of this research wages rates were also estimated, resulting in values that are around average wages and minimum wages. Calibrating and fixing these two wage rates, however, strenghtens identification and saves some computational time.
10. A detailed discussion on parameter identification in this kind of model, though without labor, is exposed in Pratap and Rendon (2003) and in Whited (2006), Hennessy and Whited (2007) and Bakke and Whited (2012).
11. The estimation can be disciplined by fixing or calibrating some parameters such as the technology parameters. Actually those calibrated values were taken as initial parameters in the estimation process. As this data set is not representative of the Spanish economy, but only of Spanish manufacture, usual calibrations are notoriously outperformed by the estimated parameter values.
12. The years thereafter are a period of economic expansion, followed by a slowdown, notoriously during the Great Recession of the mid and late 2000s, which is characterized by tighter of credit to firms and a consequent increased unemployment. Incorporating in the estimation more recent data that contain this stressed period would most likely increase the sensitivity of employment to finance, thus reinforcing the results of the present article. We leave this extension for future research.
13. In this same data set, Benito and Hernando (2007, 2008) and Hernando and Martínez-Carrascal (2008) also find relatively tight liquidity constraints, which strongly limit the expansion of investment and permanent employment.
14. Short term debt is the kind of debt that we have in the theoretical model. It is more variable than long term debt, which can be captured by the model in the parameter for the tightness of the financial constraint.
15. This feature is exploited by performing a sequential solution, whereby the dynamic problem is first solved for capital and debt conditional on rigid labor and then it is solved for the optimal level of rigid labor, see Appendix 5. This solution approach relates this dynamic problem to the usual models of capital accumulation and debt without labor.
16. For K, B, $\tilde{B}(i)$, H and L the gridsize is the segment between the upper and lower bound divided by the number of gridpoints minus one. Ordinals from one to N are assigned to the gridpoints, while the ordinal zero is reserved to express $K(0) = B(0) = \tilde{B}(0) = H(0) = L(0) = 0$.
17. To simplify the argument assume that all loops executed in the numerical solution have the same size N, an integer. Then, the sequential maximization (four states and one choice plus four states and one choice) is clearly faster is than the simultaneous one (four states and two choices), as $N^5 + N^5 < N^6$, if $N > 2$.

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Appendix

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