Financial Reforms in Economies with Firing Costs[*]

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Abstract

Emerging economies are characterized as having underdeveloped financial markets. Furthermore, many of these economies have employment protection laws that make it costly for firms to fire workers. Understanding the interaction between these features is key for evaluating financial and labor policy reforms since they have a direct impact on the allocation of resources and aggregate productivity. This paper quantifies the effect on aggregate productivity of an improvement in financial development in economies with firing costs. I develop a small open economy model with heterogeneous firms that face collateral constraints and have to pay firing costs. I calibrate the model using census plant-level data from the manufacturing sector in Chile. I find that aggregate productivity increases by 2.5 percent following a financial reform that makes Chile's level of financial development comparable to that of the United Kingdom. Ignoring firing costs underestimates the impact of the reform, predicting an increase in productivity of 0.3 percent. Acknowledging firing costs introduces two reasons why the financial reform has a stronger impact. On the one hand, firms with high past employment hoard labor and, as a result, demand more capital, which makes them more likely to be financially constrained. On the other hand, an increase in wages following the reform increases the effective firing cost and hence discourages firms with low past employment from hiring. As a result, these firms demand less capital than they would if there were no firing costs and are less likely to be financially constrained.

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1 Introduction

Emerging economies are characterized as having underdeveloped financial markets. Moreover, many of these economies have employment protection laws that make it costly for firms to fire workers. These features hamper the allocation of resources across firms which in turn affects the total factor productivity (TFP) of an economy. Therefore, it is important to consider the full extent of their impact when evaluating financial or labor policy reforms. To accomplish this, it is key to understand the interaction between the level of financial development and labor protection legislation in a given economy.

This paper quantifies the effect of a financial reform on TFP in an economy with firing costs. To do this, I develop a quantitative model of heterogeneous firms owned by entrepreneurs that face collateral constraints and have to pay firing costs. I then calibrate the economy using detailed census plant level data from the manufacturing sector in Chile, a country where firing costs are relatively high and a financial market that was not fully developed during 1995 to 2007, the period analyzed. Next, I carry out a counterfactual policy experiment where collateral constraints are relaxed to achieve the level of financial development of external credit-to-output ratio of the United Kingdom.[1] I find that after the reform TFP increases by 2.5%. Importantly, if firing costs are excluded from the analysis, the increase in TFP after the reform is only 0.3%. Finally, I study the interaction of these two frictions for a range of plausible values of firing costs and financial frictions and find that the general equilibrium effects are quantitatively relevant.

This study brings together two strands of literature - that on financial friction as a source of low TFP in developing economies and that on the effects of firing costs on allocative efficiency and TFP - by studying the interaction of these sources of frictions on productivity. In general, previous literature that study financial frictions assume frictionless labor markets

[1]Following the literature that studies the effect of financial frictions on TFP, I use external credit-to-output as a measure of financial development. The average credit to output ratio in the Chilean manufacturing sector during the period analyzed is 0.33. The same measure for the United Kingdom is 1.10.

and do not incorporate the effect of labor policy into their analysis.[2] Similarly, the literature studying the effects of firing costs on misallocation and productivity frequently abstracts from incorporating capital decisions into their analysis, or assumes capital markets with no frictions.[3] I incorporate both of these frictions into my analysis and find that studying them jointly is important to quantify the effect of both financial and labor market policies.

To study the effect of a financial reform in an economy with firing costs, I develop a general equilibrium small open economy model where entrepreneurs own firms that are heterogeneous in their productivity shock. Entrepreneurs have consumption and saving decisions, rent capital from international lenders and hire labor to produce. Capital is subject to a collateral constraint, hence entrepreneurs can rent it up to a multiple of their net worth. Moreover, they must pay firing costs proportional to wages when adjusting their level of labor downwards. As a result, firms are endogenously heterogeneous in their net worth and the level of past employment. To close the model, homogeneous workers supply labor inelastically and receive firing costs back as a transfer from the government. The calibrated model is able to reproduce cross sectional moments in the micro data as well as aggregate moments related to the two frictions analyzed.

In the model collateral constraints and firing costs interact as follows. Consider first an economy with only firing costs. In such economy, the allocation of labor is distorted. Firms with high past employment who receive bad productivity shocks do not fire workers since it is costly to do so. Firms with low past employment who receive good shocks do not hire as many workers, since they expect that their productivity might be low in the future and do not want to be stuck with a high level of past employment. In this economy, firms' net worth is irrelevant for their decisions since it is now used as collateral. Alternatively, consider an economy where only collateral constraints are present. Given a level of net

[2]Examples of this literature are Buera et al. (2011), and Gopinath et al. (2017). Buera and Shin (2013) analyze the effects of financial frictions and incorporate a reduce form friction that affects labor choices of firms. However, they do not study the effects of specific labor policies in their analysis.

[3] Hopenhayn and Rogerson (1993), Veracierto (2001), Petrin and Sivadasan (2011), Da-Rocha et al. (2016)

worth, in this economy firms who receive good productivity shocks are more likely to be financially constrained than firms who receive bad shocks. Past employment is irrelevant for firms' decisions in this setting since there are no firing costs. Finally, consider an economy where both collateral constraints and firing costs are present. In this case, both the level of net worth and of past employment will have an impact on firms decisions. Given a level of net worth there can be four types of firms. Two types of firms were also present in the previous economy with only financial frictions. These are firms with low past employment who receive bad shocks, and firms with high level of past employment who receive good shocks. The former will demand little labor and capital and as a result, are not likely to be financially constrained. The latter will demand a large amount of capital and labor, and therefore are likely to be financially constrained. However, there are two types of firms that only arise in this economy. Firms with high past employment who receive bad shocks will not fire workers, and since labor and capital are complements, will demand a large amount of capital. Hence, there will be some firms with bad shocks who will be financially constrained because they have hoarded too much labor and therefore demand more capital than in the economy with just financial frictions. Furthermore, there will be firms with low levels of past employment who receive good shocks that hire less workers than they would in the absence of firing costs. As a result, they will demand less capital and hence will be less likely to be financially constrained. This interaction will drive the results of the quantitative evaluation.

To carry out the quantitative analysis I calibrate the model using the ENIA (Encuesta Nacional Industrial Anual), a plant level manufacturing census from Chile that covers all establishments with more than 10 employees. The data set is an unbalanced panel that contains information on wage bill, severance payments, employment, fixed assets, gross revenue, intermediate inputs, and four digit ISIC industry classification, among other variables. The richness of the data makes it possible to estimate firms' production functions using Wooldridge (2009) method, a refinement to Levinsohn and Petrin (2003) and Olley and Pakes (1996). Thus, productivity and technology parameters are estimated directly from the micro data. The period I analyze is 1995-2007. During this period, there were no labor reforms and the financial market remained relatively stable.[4] This is important since in the calibration I will assume the economy is in a steady state.

Using the model described above calibrated to the Chilean economy, I study the effect of a financial reform that increases Chile's external credit-to-output ratio to the level of the United Kingdom. I find that, in the long run, the reform generates an increases in TFP of 2.5%. This is driven by a sharp improvement in the allocation of capital, which is achieved through a direct and an indirect channel. Directly, through the relaxation of the collateral constraint, which implies that firms require less net worth to be financially unconstrained. Indirectly, since the reform induces an increase in wages which leads to an increase in the effective cost of firing and hence firms with high productivity shocks hire less labor and demand less capital.[5] The increase in wages also worsens the allocation of labor, as measured by an increase in the dispersion of the marginal product of labor, but this effect is not strong enough to offset the gains from a better allocation of capital.

To study the importance of incorporating firing costs into the analysis, I recalibrate the model to Chile ignoring firing costs and perform the same policy counterfactual. In this economy, TFP increases by only 0.3% after the reform. The difference stems from the type of firms that are constrained and the fact that the indirect effect is not present in this economy.

To further explore how these two frictions interact, I analyze different economies within a plausible range of levels of both collateral constraints and firing costs. I perform two different policy counterfactual for a se of economies. First, I explore the effects of relaxing the collateral constraint for economies with different levels of firing costs. Second, I study how economies with different levels of financial development are affected by an increase in firing costs.

[4] Between 1991 and 1998 there was a 30% unremunerated reserve requirement imposed in Chile for all new credit. Empirical evidence suggests that it had small effects on the real exchange rate. See Andreasen et al. (2018)

[5] Since firing costs are proportional to wages, an increase in the wage increases the effective cost of firing.

Regarding the first counterfactual, I find that there is a non-monotonic relationship between the increase on TFP following a financial reform and the level of the firing cost in the economy. There are two reasons for this. First, in economies with low firing costs, wages are more elastic to a relaxation of the collateral constraints and as a result, the effective cost of firing a worker increases more than in economies with higher firing costs. Thus, the distortion of the allocation of labor offsets some of the gains from the improvement in the allocation of capital. Furthermore, if the firing cost is too high, there is little reallocation of labor and hence little reallocation of capital. Second, the type fo firms that are constrained prior to the reform is different for different levels of firing costs. In economies with low firing costs, firms do no hoard labor since it is relatively cheap to adjust it. In economies where the firing cost is too high, firms are discouraged from growing and thus will not have large levels of past employment. In these two types of economies, financially constrained firms will be mostly firms who receive high productivity shocks. As a result, the impact on TFP of relaxing the collateral constraint will be lower relative to economies with moderate levels of firing costs. In such economies, firms will hoard labor and demand more capital and therefor are more likely to be financially constrained even if they receive bad shocks.

When studying how an increase in firing costs affects economies with different levels of financial development, I find that economies with more developed financial markets suffer a smaller drop on TFP. There are two effects driving this result. First, in economies where the level of financial development is higher, firms use less internal resources to rent capital, relative to economies with tighter collateral constraints. As a result, firms can use some of their profits to pay for the firing cost and have a better allocation of labor. Moreover, when collateral constraints are loose, firms that hoard labor can demand more capital, and as a result capital is better allocated in such economies. Second, given an increase in firing costs, the allocation of capital is worsened, driven by firms who hoard too much labor and thus demand too much capital. This negative effect is ameliorated in economies where financial constraints are loose.

Increasing firing costs has direct implications with the capital-labor ratio of the economy. Interestingly, the model replicates the findings of the empirical literature that studies the effect of firing costs on firm investment that find that the relationship between the capital-labor ratio and firing costs is hump-shaped. In my analysis, there is a slight increase in capital-labor ratio following an increase in firing costs in economies with a low level of firing costs.This is consistent with the findings of Autor et al. (2007) who study the implications on firm investment of the adoption of wrongfully discharged protection by state courts in the United States. Moreover, in economies with relatively high levels of financial development and firing costs, and increase in firing costs generates a decrease in the capital-labor ratio. This is in line with the findings of Calcagnini et al. (2009) and Cingano et al. (2014) who find a negative relation between firing costs and capital-labor ratio in European economies.

The remainder of the paper is organized as follows. Section two describes the papers relation and contribution to the literature. In section three I develop the model that will be used through out the analysis. Section four describes the data, calibration and the fit of the model. I present the results of the financial reform in section five. Section six analyzes economies with a plausible range of both firing costs and collateral constraints. I conclude in section seven.

2 Literature Review

This paper contributes mainly to two strands of literature by bringing them together, that one that studies financial frictions as a source of low TFP in developing countries, and that studying the effect of firing costs on the allocation of resources and productivity.

Regarding the first one, Midrigan and Xu (2014) find that financial frictions have little impact on productivity through capital misallocation. They study an environment with frictionless labor markets and find that most of the effect of the financial frictions on TFP comes from distorting the decisions of firms to upgrade technology. Similarly, Buera et al.

(2011) also find that the most important channel is the extensive one, in an environment with no labor frictions. I focus on the impact of financial frictions on the allocation of resources and incorporate a relevant labor market policy that affects the way these resources are allocated.

With respect to the second strand of literature, an early example is Hopenhayn and Rogerson (1993). This study abstracts from capital allocation and studies the effect of firing costs on firms decisions to operate and how labor is allocated across them. They find that firing costs reduce productivity, mainly from the extensive margin. Veracierto (2001) builds on the previous study and incorporates capital choice into the analysis. He finds that incorporating capital is not important for understanding the long run and welfare effects of firing taxes, but it does impact the short run implications of eliminating firing costs. Importantly, he assumes that the capital market is frictionless. I add collateral constraints into the analysis and find that the level of financial development is important to understand the long term consequences of imposing firing costs. Petrin and Sivadasan (2011) study the imact of firing costs in Chile after a labor reform in 1991 that increased the ceiling of severance payments from five monthly wages to eleven. They find that the allocation of labor worsened after the reform. Da-Rocha et al. (2016) study an environment where firing costs not only distort the allocation of resources but also affect the underlying distribution of firms' productivity. They find that this channel is important in explaining the impact of firing costs on aggregate productivity. There is no capital decision in the model. Overall the literature on financial frictions and development has ignored labor market policies and the literature on firing costs abstracts from distorted capital markets. To the best of my knowledge this is the first study to analyze these two frictions together and quantify the effect of their interaction on the allocation of resources and TFP.

This paper also contributes to the empirical literature studying the impact of the interaction between the level of financial development and firing costs in firm investment and productivity. Calcagnini et al. (2009) use firm level data from ten European countries and perform an estimation of a dynamic panel model. They find that financial frictions are positively correlated with firms' cash holdings and these are larger in countries with more strict employment protection legislation. Another study by Calcagnini et al. (2014) finds that investment is affected by the presence of both frictions and that the effect of labor market regulation is weaker in countries with more developed financial markets. I find qualitatively similar results. Cingano et al. (2014) estimate the impact of firing costs on capital deepening and productivity. They analyze a specific reform in Italy where firms with less than fifteen employees ceased to be exempt from paying firing costs. They find that firing costs induced an increase in th capital to labor ratio and a decline in TFP. Moreover, the firms most affected by the reform were firms with low levels of liquidity, their proxy for financial frictions. I contribute to this literature by developing and calibrating a structural model that allows to study counterfactual policies in the presence of both financial frictions and firing costs.

Finally, this study is also related to a large literature that studies the impact of financial frictions on labor outcomes. Buera et al. (2015) study how a credit crunch following the 2007-2008 financial crisis in the U.S. affected output, unemployment and net employment growth. Arellano et al. (2016) analyze how a tightening in financial conditions affected output and labor during the recession of 2007-2009. I contribute to this literature by analyzing the interaction of financial frictions with a specific labor market distortion, namely firing costs.

3 Model

This section provides a description of the theoretical model used for the analysis of a financial reform. The two key ingredients are collateral constraints faced by firms and labor adjustment costs that firms have to pay.

3.1 Setting

I consider a small open economy populated by two types of agents: entrepreneurs and workers. Time is discrete and infinite, and there is only one type of good in the economy. Capital is rented by entrepreneurs from international financial intermediaries.

3.2 Agents

Entrepreneurs There is a measure one of infinitely lived entrepreneurs. Every period, each entrepreneur receives an idiosyncratic productivity shock z_t which evolves according to an AR(1) process. They are heterogeneous in their productivity shock z_t, level of net worth a_t, and past employment ℓ_{t-1}. Each entrepreneur can only own one firm. They have preferences over consumption given by

$$\mathbb{E}_0 \sum_{t=0}^{\infty} \beta^t u\left(c_t\right),\ u\left(c\right) = \frac{c^{1-\sigma}}{1-\sigma}. \tag{1}$$

The firm owned by the entrepreneur uses capital k_t and current employment ℓ_t to produce

$$y_t = z_t \left(k_t^{\alpha} \ell_t^{1-\alpha}\right)^{\nu},$$

where z_t is the productivity shock, $\alpha \in (0,1)$ is the output elasticity of capital, and ν is the span of control parameter that controls the decreasing returns to scale.

Workers There is a unit measure of homogeneous hand-to-mouth workers. Workers preferences are

$$\mathbb{E}_0 \sum_{t=0}^{\infty} \beta^t u\left(C_t^{\omega}\right),$$

where C_t^{ω} is the aggregate consumption of all workers and $u\left(c\right)$ is the same as defined above.

International lenders International lenders rent capital and receive deposits from entrepreneurs. The return on deposits is r_t. Lenders are competitive and the zero-profit condition implies that the rental cost of capital $R_t = r_t + \delta$. Capital is rented intraperiod, and the amount an entrepreneur can rent is subject to a collateral constraint. In particular, entrepreneurs can rent up to a multiple λ of their net worth, $k_t \leq \lambda a_t$. This captures the level of financial development in the economy.[6] All entrepreneurs are subject to the same collateral constraint.

3.3 Problem of the Entrepreneur

Entrepreneurs make consumption/savings decisions, hire labor in a competitive market at a wage w_t and rent capital from international lenders. There is a firing cost that is proportional to wages, $w_t g\left(\ell_{t-1}, \ell_t\right) = \tau \max\left\{0, \ell_{t-1} - \ell_t\right\}$.[7] The entrepreneur's budget constraint is

$$c_t + a_{t+1} = y_{it} - w_t \ell_t - R_t k_t - w g\left(\ell_{t-1}, \ell_t\right) + (1+r)\, a_t. \tag{2}$$

The problem of the entrepreneur can be written recursively. Let the individual state of a particular entrepreneur be her net worth a, past employment $\underline{\ell}$, and productivity shock z. The recursive problem is to maximize the value value function:

$$V\left(a, \underline{\ell}, z\right) = \max_{\{c,k,\ell,a'\}} u\left(c\right) + \beta \mathbb{E}_{z'|z} V\left(a', \ell, z'\right) \tag{3}$$

subject to

$$\begin{aligned} c + a' &= z\left(k^{\alpha} \ell^{1-\alpha}\right)^{\nu} - w\ell - \left(r + \delta\right) k - w g\left(\underline{\ell}, \ell\right) + (1+r)\, a \\ k &\leq \lambda a. \end{aligned}$$

[6] This type of constraint has been extensively used in the financial development literature. See for example Buera and Shin (2013) and Moll (2014).

[7] See Section 4 for details on the functional form choice.

3.4 Problem of the Worker

Workers supply labor inelastically and receive transfers from the government. These transfers are the sum of the firing costs paid by firms. Hence, given a wage w and transfers T, total consumption of workers is given by

$$C^{\omega} = w + T$$

3.5 Equilibrium

Given r, a stationary equilibrium is a wage w, an endogenous distribution of entrepreneur types μ, entrepreneurs' choices $c\left(a, \underline{\ell}, z, \mu\right)$, $k\left(a, \underline{\ell}, z, \mu\right)$, $\ell'\left(a, \underline{\ell}, z, \mu\right)$, $a'\left(a, \underline{\ell}, z, \mu\right)$, and workers' consumption C^{ω}, such that:

1. Given w and r, the policy functions for the firm, $c\left(a, \underline{\ell}, z, \mu\right)$, $a'\left(a, \underline{\ell}, z, \mu\right)$, $\ell\left(a, \underline{\ell}, z, \mu\right)$, and $k\left(a, \underline{\ell}, z, \mu\right)$, solve the entrepreneur's problem (3).

2. The labor market clears:

$$1 = \int \ell\left(a, \underline{\ell}, z, \mu\right) d\mu\left(a, \underline{\ell}, z, \mu\right)$$

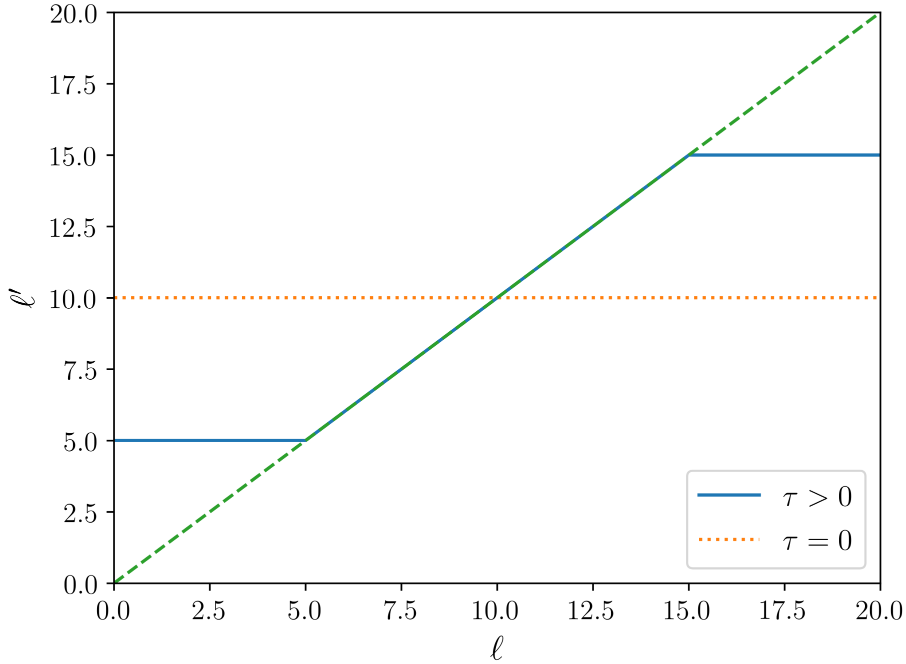
3. The good market clears:

$$\begin{aligned} C^{\omega} + \int c\left(a, \underline{\ell}, z, \mu\right) d\mu\left(a, \underline{\ell}, z, \mu\right) = & \int z\left(k\left(a, \underline{\ell}, z, \mu\right)^{\alpha} \ell\left(a, \underline{\ell}, z, \mu\right)^{1-\alpha}\right)^{\nu} d\mu\left(a, \underline{\ell}, z, \mu\right) \\ & - \delta \int k\left(a, \underline{\ell}, z, \mu\right) d\mu\left(a, \underline{\ell}, z, \mu\right) \\ & + r \int \left[k\left(a, \underline{\ell}, z, \mu\right) - a\right] d\mu\left(a, \underline{\ell}, z, \mu\right) \end{aligned}$$

3.6 Interaction Between Firing Costs and the Collateral Constraint

To understand why the firing cost and the collateral constraint interact, it is convenient to look at the policy function of labor with respect to past employment, given net worth a and current productivity shock z. This is shown in Figure 1. The solid line is the policy function when $\tau > 0$, the dotted line represents the policy function when $\tau = 0$, and the dashed line is the 45 degree line. The key aspect of the policy function when $\tau > 0$ is that there is an inaction zone in which the firm does not adjust labor. Moreover, the firm only hires if the level of past employment is very low (in this case, below 5) and only fires if past employment is too high (in this example, above 15). Note that if firing costs are 0, the labor choice does not depend on past employment. Hence, firms with high past employment who receive bad shocks may end up with more labor relative to the case when $\tau = 0$. Alternatively, firms who receive good shocks and have low past employment may hire less labor than they would in an economy with no firing costs. Since capital and labor are complements, these distortions in labor will translate into firms demanding too much or too little capital relative to the case when $\tau = 0$. On one hand, there will be firms with high past employment who receive bad shocks that will demand a large amount of capital, and will be more likely to be financially constrained relative to an economy with no firing costs. On the other hand, there will be firms with a low level of past employment who receive good shocks and demand less capital than in the economy with $\tau = 0$. These firms will be less likely to be financially constrained.

Figure 1: Labor Policy Function for a given a and z



4 Parametrization

In this section, I describe how I parameterize the model described above to match key features of the Chilean economy and its manufacturing sector. I choose parameters on preferences, technology and the stochastic process of firm specific productivity. One period is set to be a year.

I need to determine nine parameter values: two technological parameters, α and ν; two parameters governing the productivity process that firms face, ρ and σ; the coefficient of risk aversion, γ; and the discount factor β; the firing cost τ and the collateral constraint parameter λ.

4.1 Data

The main data set used is the ENIA (Encuesta Nacional Industrial Anual), an annual census of the Chilean manufacturing sector. This data set is an unbalanced panel that covers all manufacturing plants with more than 10 employees and plants with less than 10 employees that belong to firms with multiple establishments. I use data for the period 1995-2007, as there were no reforms in the labor market during this time frame, and financial conditions were stable. This is important since I will assume the economy is in a steady state when calibrating the model. Moreover, after 2007 the data set has no way of linking firms across time. For the estimation of the productivity process and the span of control parameter I use the permanent sample of firms.

The ENIA collects data on revenue, employment, wage bill, severance payments, book value of capital, services, intermediate materials, electricity, and four-digit ISIC Rev. 3.1 industry classification, among other variables useful for our quantitative analysis. Previous versions of this census have been used in many studies, given its rich plant-level data.[8]In Chile, the manufacturing sector accounted for roughly 17 percent of value added and 14 percent of employment for the period 1995-2007.

To construct the sample used in this analysis, I drop observations with negative values for book value of capital, gross revenue, intermediate materials, wage bill, services, and electricity. To control for outliers, I trim the top and bottom 1% of these variables. The data set comes with four-digit industry deflators for gross revenue and intermediate inputs.

4.2 Firing Costs

To study the role of firing costs in this economy, I set $g\left(\underline{\ell}, \ell\right) = \tau \max\left\{0, \underline{\ell} - \ell\right\}$. This functional form has been used extensively in the literature.[9] Moreover, this specification is a reduced form of capturing the way firing costs work in Chile. In Chile, a worker who

[8] Previous versions of this data set have been used by Liu (1993), Levinsohn and Petrin (2003), Petrin and Sivadasan (2011), Asker et al. (2014).

[9]See Hopenhayn and Rogerson (1993), Veracierto (2001), Da-Rocha et al. (2016)

is fired for economic reasons has to be given a one month notice or be paid one monthly wage to be dismissed immediately. Moreover, she has to be paid one monthly wage per year worked at the firm, up to 11 months. There are also judicial fees and other costs. To calculate the flow cost of firing a worker in Chile, I use the estimate from Heckman and Pagés (2003). In this study, the authors measure the direct cost as a fraction of monthly wages, of job security provision. These costs include the costs of dismissing a worker for economic reasons. This includes administrative procedures, advanced notification, severance payments, and the legal costs of a trial if workers contest dismissals. They then calculate the present discounted cost of firing a worker. To do this, they assume a discount rate and dismissal rate of 8 and 12 percent respectively. The discount rate is motivated by the hitorical return of an internationally diversified portfolio. The turonver rate is that of the United States. Finally, they assume that the maximum tenure that a worker can attain in a firm is twenty years. According to their assumptions, the expected discounted value of firing a worker in Chile is 3.4 monthly wages. Using their assumptions, I then back out the flow cost of firing a worker in Chile. I find this to be 5.6 monthly wages.[10] Since a period in my model is a year, I then set $\tau = 0.47$ to match the flow cost of dismissal.

Most of this cost is comprised by severance payments. Lazear (1990) points out that, in absence of any other friction, a contract can be written specifying a side payment from the worker to the firm that fully offsets the firing cost. Petrin and Sivadasan (2011) study the effect of a change in the dismissal cost in Chile in 1990, and find no clear evidence that he job security changes were offset through lower wage rates. Moreover, in a setting where firms are subject to financial constraints, the timing of dismissal matters since this would reduce the resources available for the firm to increase their net worth.

[10] I do robustness on the maximum amount of tenure a worker can get, and set it to be a very large number. The flow cost is then 5.74 monthly wages .

4.3 Productivity Process and Span of Control Parameter

To estimate the firm productivity and span of control parameters I use Wooldridge (2009) extension of Levinsohn and Petrin (2003) methodology to estimate firms' production function. Using the panel data described in Section 4.1, I estimate the following gross output production function:

$$y_{ist} = \beta_k^s k_{ist} + \beta_\ell^s \ell_{ist} + \beta_v^s v_{ist} + \beta_e^s e_{ist} + \beta_m^s m_{ist} + \varepsilon_{ist} \tag{4}$$

where y_{ist} is the log of gross output, k_{ist} is the log of book value of capital, ℓ_{ist} is the log of wage bill, v_{ist} is the value of services, e_{ist} is the log of the quantity of electricity used, and m_{ist} is the log of materials used by firm i in industry s at time t. Gross output is deflated using a four-digit industry deflator for gross output. Services, materials and wage bill are deflated by a four-digit industry intermediate input deflator. Capital is deflated using an investment deflator.[11] The estimation is done separately for each 2-digit industry.

The error is assumed to be

$$\varepsilon_{ist} = \mathit{\Omega}_{ist} + \eta_{ist}$$

where $\mathit{\Omega}_{ist}$ is the transmitted component of the firm specific productivity shock, and η_{ist} is the i.i.d. firm specific productivity shock. The idea of the method used is to express the transmitted component as a function of the state variables and a proxy variable. Following Levinsohn and Petrin (2003) , I use materials as a proxy variable.[12] Moreover, since there are adjustment costs to labor in the model analyzed, I include labor as a state variable, in addition to capital. Hence, given some function $h(.,.)$, I assume the transmitted component to be:

$$\mathit{\Omega}_{ist} = h\left(\mathbf{x_{ist}}, m_{ist}\right)$$

[11] I follow Gopinath et al. (2017), Hsieh and Klenow (2009) and others in measuring capital by its book value.

[12] Olley and Pakes (1996) use investment as a proxy variable. Due to lumpiness in investment, there are missing variables for a number of observations. I use materials since all the firms in my data have positive non missing observations for this variable.

where $\mathbf{x_{ist}} = (\ell_{ist}, k_{ist})$ is the vector of state variables.

Three more assumptions are needed to identify the parameters of the production function:

1. The state variables are uncorrelated with the innovation:

$$b_{ist} \equiv \Omega_{ist} - E\left(\Omega_{ist} \mid \Omega_{ist-1}\right)$$

2. Lagged states and proxy variables are uncorrelated with the innovation:

$$\begin{aligned} E\left(\mathbf{x_{ist}}, \mathbf{x_{ist-1}}, \boldsymbol{\phi}_{\mathbf{ist-1}}, m_{ist-1}, ..., \mathbf{x_{is1}}, \boldsymbol{\phi}_{\mathbf{is1}}, m_{is1}\right) &= E\left(\Omega_{ist} \mid \Omega_{ist-1}\right) \\ &\equiv F\left[h\left(\mathbf{x_{ist-1}}, m_{ist-1}\right)\right] \end{aligned}$$

   where $\boldsymbol{\phi}_{\mathbf{ist}} = (e_{ist-1}, v_{ist-1})$ is the vector of variable inputs.

3. An orthogonality condition

$$E\left(b_{ist} + \varepsilon_{ist} \mid \mathbf{x_{ist}}, \mathbf{x_{ist-1}}, \boldsymbol{\phi}_{\mathbf{ist-1}}, m_{ist-1}, ..., \mathbf{x_{is1}}, \boldsymbol{\phi}_{\mathbf{is1}}, m_{is1}\right) = 0.$$

Finally, the function used in the estimation is

$$y_{ist} = \beta_k^s k_{ist} + \beta_\ell^s \ell_{ist} + \beta_v^s v_{ist} + \beta_e^s e_{ist} + \beta_m^s m_{ist} + F\left[h\left(\mathbf{x_{ist-1}}, m_{ist-1}\right)\right] + b_{ist} + \varepsilon_{ist}$$

I approximate $F\left[h\left(\mathbf{x_{ist-1}}, m_{ist-1}\right)\right]$ using general second order polynomial, and use first and second lags of electricity and services, and second lags of wage bill as instruments.

I use the estimated elasticities, and the residuals of the estimation to calculate both the span of control parameter used and to estimate the productivity process.

Span of control parameter The returns to scale are in the range of 0.75 and 1.03 depending on the industry.[13] These values are in line with other estimates from micro-data.[14] The median of these estimates (0.85) is used as the span of control parameter ν.

Productivity process The idiosyncratic productivity process is an AR(1) in logs:

$$z_t = -\frac{\sigma^2}{2(1+\rho)} + \rho z_{t-1} + \sigma u_t^z, \quad \text{with} \quad u_t^z \sim \mathrm{N}(0,1) \tag{5}$$

where ρ is the persistence of the productivity process and σ is the standard deviation of the idiosyncratic productivity shock u_t^z. The constant term normalizes the mean of the idiosyncratic productivity to 1.

To back out these parameters, I used the fitted values of the production function estimation to back out $\hat{\varepsilon}_{ist}$.[15]

I then run the following regression:

$$\hat{\varepsilon}_{ist} = \eta_i + \eta_{st} + \hat{\rho}\hat{\varepsilon}_{ist-1} + \epsilon_{ist},$$

where η_i and η_{st} are a firm fixed effect and an industry-year fixed effect respectively. I then set $\sigma = 0.48$ to match the average of the cross sectional variance of ϵ_{ist}.[16] Including fixed effects generates a downward bias in the estimate of $\hat{\rho}$ due to the short time series. To overcome this caveat, I set $\rho = 0.42$ so that in the model generated data of 13 sample periods, the estimate persistence parameter equals 0.272, which is the value of $\hat{\rho}$ in the data. Note that in the data, the standard deviation of $\log(\hat{\varepsilon}_{ist})$ is equal to 0.67. The model implied standard deviation for $\log(z)$ is 0.61.[17]

[13] Table A.2 in the Appendix summarizes other moments of the span of control parameters found in the data.

[14] Petrin and Sivadasan (2011) use a an earlier version of the ENIA and find 3-digit industry estimates to be between 0.82 and 1.06. Gopinath et al. (2017) do this for a set of European countries and find similar values

[15] To control for outliers, I drop the top and bottom 1% of fitted values $\hat{\varepsilon}_{ist}$ per year

[16] To calculate this measure, I drop the top and bottom 1% of the error terms per year.

[17] To maximize the length of the sample used, I estimate of the productivity process using firms that were

Table 1: Parameters

Parameter	Description	Value	Source
Internally Calibrated:			
λ	Collateral Constrain	1.35	Superintendencia de Bancos de Chile
Externally Calibrated			
ν	Span of Control	0.85	ENIA 1995-2007
ρ	Auto-correlation productivity process	0.42	ENIA 1995-2007
σ	Variance of innovation AR(1)	0.48	ENIA 1995-2007
Other Parameters			
r	Real interest rate	6.45%	Banco Central Chile
γ	CRRA parameter	2.0	
δ	Depreciation	0.06	
β	Discount factor	0.92	
α	Capital elasticity	0.33	

Note: The collateral constrain parameter is set to match the external credit-to-output ratio of Chile in the manufacturing sector equal to 0.33. The externally calibrated parameters are obtained from estimating firms' production function using Wooldridge (2009) method. The interest rate is the average across years of the difference between the nominal interest rate on commercial loans and next year's expected inflation. Parameters without source are conventional parameters from the financial frictions literature.

active for all periods in the sample.

4.4 Other Parameters

Collateral Constraint I calibrate λ by requiring that the model matches the external finance-to-value added ratio for the manufacturing sector of the Chilean economy which is equal to 0.33. This value is taken from the *Superintendencia de Bancos e Instituciones Financieras de Chile*, who measures the total credit balances for the manufacturing industries included in the data base.

Real Interest Rate I measure the real exchange rate, r, as the average across years of the difference between the nominal interest rate on commercial loans and next year's expected inflation. This information is taken from the Banco Central de Chile.

Conventional parameters The reminder of the parameters are chosen from conventional values in the literature. I set $\gamma = 2$, $\alpha = 0.33$, the 1-year depreciation rate is set at $\delta = 0.06$, and the discount factor is set to be $\beta = 0.92$.

4.5 Model Fit

This section summarizes the fit of the model. To do this I compare the cross-sectional implications of the model against the micro data. Table 2 summarizes these findings.

The model does a good job capturing the dispersion of labor in the economy. Since I do not incorporate adjustment costs of capital or time-to-build into the model, capital is more volatile in the model than in the data, since these features are likely to hamper capital dispersion. This also explains why output is more volatile in the data than in the model.

As an external check on the calibration of the firing cost, I calculate the mean across years of the share of firms that pay severance payments (and hence firing costs) in the data and compare it to the model.[18] In the data, this share is 0.22, while in the model is 0.30.

[18] I do this for the years 1995 to 2001, since those are the years in which I have data on severance payments.

Table 2: Cross-sectional Moments, Model and Data

Moment	Data	Model
S.D ($\log z$)	0.67	0.61
S.D. ($\log \ell$)	1.05	2.41
S.D. ($\log k$)	1.60	2.43
S.D. ($\log y$)	1.08	2.48
Top 30% Share Agg. Labor	0.70	0.90
Top 30% Share Agg. Capital	0.80	0.92

Note: standard deviations of variables in the data are the average standard deviation across the years 1996 to 2007.

5 Financial Reform in Chile

In this section I evaluate the effects of a financial reform in Chile. To do this, I use the baseline calibration and explore the effects of increasing the external credit-to-output ratio of Chile from 0.33 to 1.10, a level similar to that of the United Kingdom during the period analyzed.[19]

To study the effects of the reform on productivity, I will first define a measure of total factor productivity and marginal products of capital and labor.

Let total factor productivity be defined as

$$TFP := \frac{Y}{K^{\alpha}L^{1-\alpha}} \tag{6}$$

which is consistent with other studies in the literature.[20]

The marginal product of capital and labor for a given firm i with idiosyncratic state

[19] The UK is a good example since it had a per period cost of firing a worker of 2.5 monthly wages during the period analyzed and its credit-to-output ratio was high. See Heckman and Pagés (2003))

[20] See Restuccia and Rogerson (2008), and Buera and Shin (2013) for an economy where firms have decreasing returns to scale and TFP is defined as in 6. As a robustness check, I redefine TFP to be $TFP := \frac{Y}{(K^{\alpha}L^{1-\alpha})^{\nu}}$ as in Midrigan and Xu (2014) and get similar results.

$(a, \underline{\ell}, z)$ are

$$MRPL \coloneqq \nu (1 - \alpha) \frac{y_i}{\ell_i} = w (1 + \tau_{\ell i}) \tag{7}$$

$$MRPK \coloneqq \nu \alpha \frac{y_i}{k_i} = (r + \delta) (1 + \tau_{ki}) \tag{8}$$

where $\tau_{\ell i}$ and τ_{ki} denote the percent deviation of the marginal products from w and $(r + \delta)$ respectively.

In an economy with no financial frictions and no firing costs $\tau_{\ell i} = \tau_{ki} = 0 \; \forall i$. Most studies that analyze the impact of financial frictions assume a frictionless labor market, which in the present model implies $\tau_{\ell i} = 0 \; \forall i$. In the presence of firing costs, this is not the case anymore. Depending on the idiosyncratic state, firms can have MRPL below or above w. Hence, changes in the dispersion of MRPL are informative of how labor reallocates after a reform. Similarly, in the presence of financial frictions, financially constrained firms will have MRPK higher than $(r + \delta)$. Importantly, the level of firing costs will also interact with the dispersion in MRPK.

5.1 An Economy with Firing Costs

I first analyze the effects of the financial reform in the baseline economy where firing costs are present. Table 3 summarizes the long run effects of the financial reform. Following the reform, TFP increases by 2.5%. This increase is driven by a substantial decrease in the dispersion of the marginal product of capital. This is expected since now the collateral constrained is relaxed and hence firms will be less likely to be financially constrained. There is also an indirect effect that arises when firing costs are present in the economy.

Since firms are less financially constrained, there is an increase in the demand for capital. Since capital and labor are complements, firms also demand more labor. As a result, the wage goes up. This increases the effective cost of firing a worker (recall firing costs are proportional to the wage). Hence, firms who receive good productivity shocks and have low past employment will hire less labor relative to prior the reform, which will in turn make these firms less likely to be financially constrained. This improves the allocation of capital.

Table 3: Aggregate Changes after Financial Reform, $\tau = 0.5$

Moment	Value
$\%\Delta TFP$	2.5
$\%\Delta$S.D.$MRPK$	-81.0
$\%\Delta$S.D.$MRPL$	4.0

The wage increase has a negative effect on the allocation of labor since the effective cost of firing a worker has increased. This generates an increase in the dispersion of the marginal product of labor. However, this effect is not quantitatively large as to offset the effect on TFP of the better allocation of capital.

5.2 Ignoring Firing Costs

In this section I analyze the effects of the reform if firing costs are ignored from the analysis, and compare the results to the economy with firing costs. To carry out this analysis, I set $\tau = 0$ and recalibrate the baseline economy so that the credit-t-output ratio is 0.33 as in the Chilean economy. This is achieved by setting the collateral constraint parameter to $\lambda = 1.4$. This economy has a standard deviation of $\log(\ell)$ equal to 3.27. Since there are no firing costs, firms adjust labor more and therefore it becomes more volatile. Capital and labor share of the top 30% are similar to the economy with firing costs.

The counterfactual exercises is the same as in the previous section. That is, I increase the collateral constraint parameter to $\lambda = 5$.[21] Table 4 summarizes the impact of the reform on TFP and the allocation of resources. Importantly, in this economy TFP only goes up by 0.3%. There are two reasons driving this difference. First, the indirect effect is not present

[21] This implies an external credit-to-output ratio of 1.47 after the reform. I also perform the counterfactual where I increase λ so that the external credit-to-output ratio is equal to 1.10, and obtain similar results.

in the economy with no firing costs. Second, the type of firm that are constrained prior to the reform is different in each economy.

Table 4: Aggregate Changes after Financial Reform, $\tau = 0.0$

Moment	Value
$\%\Delta TFP$	0.3
$\%\Delta$S.D.$MRPK$	-77.0
$\%\Delta$S.D.$MRPL$	0.0

The indirect effect is an important driver of the results. The first row of Table 5 shows the percentage of constrained firms before and after the reform in each economy. Prior to the reform, roughly 14 percent of firms are financially constrained in both economies. This is expected since both are calibrated to have the same external credit-to-GDP ratio. However, after the reform the fraction of constrained firms in the economy with firing costs is 2.67 percent, whereas it is 5.25 percent in the economy with no firing costs. After the reform, firms with good productivity shocks will hire less labor and demand less capital in the economy with firing costs relative to prior the reform. This is triggered by an increase in the effective cost of firing a worker due to an increase in the wage of 8 percent. In the economy with no firing costs, this effect is not present since labor can be costlessly adjusted.[22]

Table 5: Constrained Firms in Both Economies

Moment	Economy with $\tau = 0.5$		Economy with $\tau = 0.0$	
	$\lambda = 1.35$	$\lambda = 5.0$	$\lambda = 1.35$	$\lambda = 5.0$
% of Financially Constrained Firms	13.77	2.67	13.85	5.25
Share low z	0.11	0.00	0.07	0.00

[22]The wage goes up by 15 percent in the economy with no firing costs.

The second row of Table 5 shows the share of firms who receive shocks below the 80th percentile who are financially constrained. This fraction is higher in the economy with firing costs. This is due to the fact that in the presence of firing costs, there are firms that are financially constrained because they hoard too much labor and therefore demand a large amount of capital. Relaxing the problem of this type of firms is important since they have a larger marginal product of capital relative to the economy with no firing costs.

6 Studying Different Economies

In this section I further explore the interaction between firing costs and financial frictions through two policy experiments. Using the baseline calibration, I first study the effect of relaxing collateral constraints for economies with different levels of firing costs. Interestingly, the elasticity of the wage with respect to the collateral constraint parameter plays a key role in understanding the magnitude of the change in TFP across economies. Second, I study the effects of an increase in firing costs for economies with different levels of financial development. I find that economies with higher level of financial development (i.e. higher λ) suffer a smaller drop on TFP after an increase in firing costs.[23]

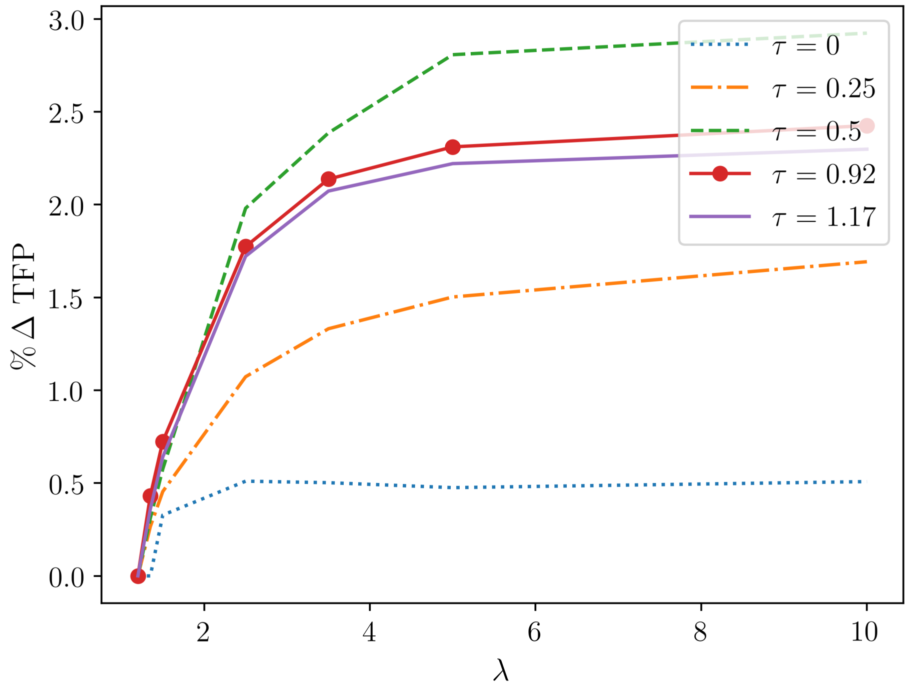
6.1 Relaxing Collateral Constraints

To examine how firing costs interact with a relaxation of collateral constraints, I do the following policy exercise. I fix all the parameters of the baseline economy and analyze an increase in λ from $\lambda = 1.20$ to $\lambda = 10.0$ for economies with different levels of τ. This change in the collateral constraint is motivated by the empirical fact that the external credit-to-output ratio ranges from 0.10 to 1.79.[24] This is done for economies with firing costs ranging from $\tau = 0$ to $\tau = 1.17$, which is equivalent to 14 monthly wages.[25] This is the range that

[23]All the results shown below have to be understood as steady states comparison of different economies.
[24]This range is taken from the update of 2018 of the Financial Development and Structure Database (See Beck et al. (2000).
[25]Specifically, I analyze firing costs equivalent to 0, 3, 6, 11 and 14 monthly wages.

Heckman and Pagés (2003) find for countries in Latin America.

Figure 2: Change in TFP for Different τ



The effect of the change in the collateral constraint on TFP can be seen in Figure 2. There is a non monotonical relationship between the increase in TFP from an increase in λ and the level of the firing cost. This is explained by the increase in the effective cost of firing a worker (τw) following an increase in the collateral constraint. Figure 3 shows this change for the economies analyzed. In economies where the firing cost is low, wages go up more since its is less costly to adjust labor and hence firms demand more labor. In economies with high firing costs, the wage does not adjust as much since adjusting labor is too costly, but firing costs were high to begin with. The effective cost of firing increases more in economies with lower firing costs.[26] As a result, the standard deviation of MRPL increases more in such economies as can be seen from Figure 4.

[26] The economy with $\tau = 0$ is not depicted in the graph since the effective cost of firing in this economy is always 0.

Figure 3: Change in Effective Cost of Firing for Different τ

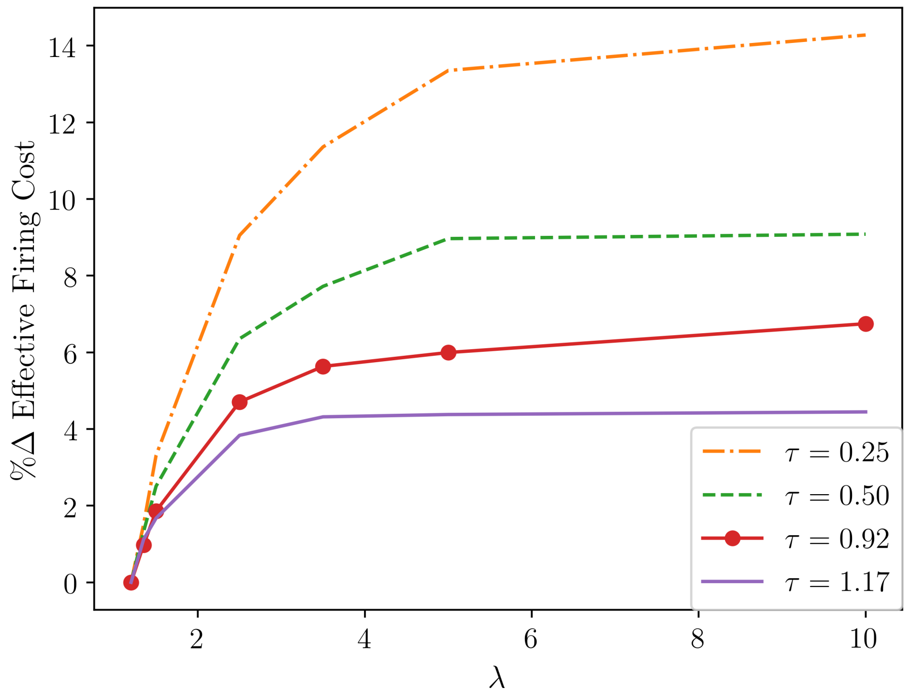
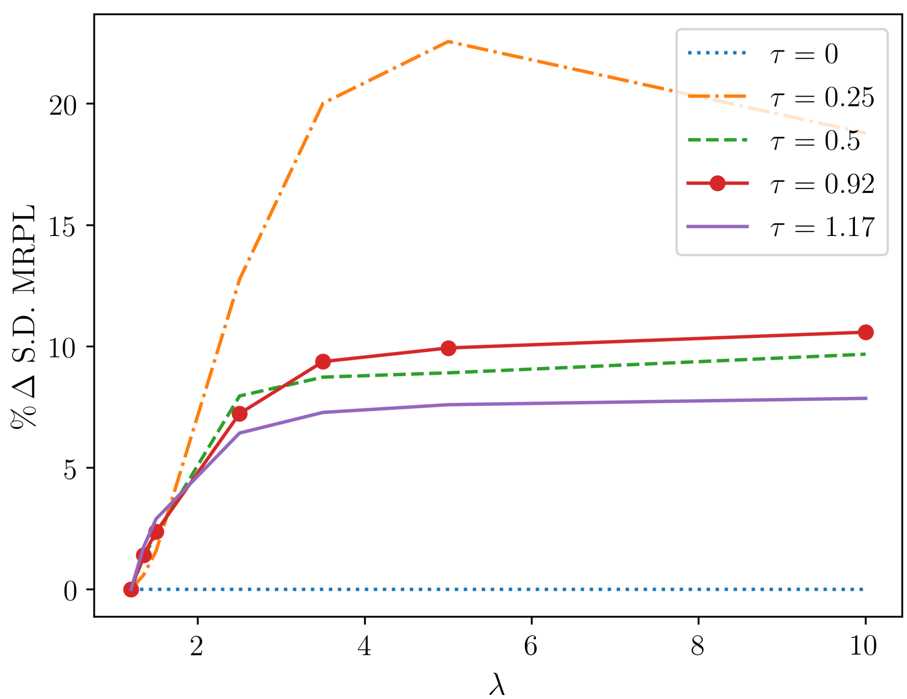


Figure 4: Change in Standard Deviation of MRPL for Different τ



Due to the indirect effect explained in the previous section the marginal product of capital drops more in economies with higher levels of τ, as can be seen in Figure 5. This is an important driver of the larger increase in TFP for such economies. However, the initial conditions prior to the change in λ are part of the reason why the relation between τ and the change in TFP is non monotonic. Table 6 reports the share of constrained firms who receive shocks below the 80th percentile for economies where $\lambda = 1.20$. This share first increases and then decreases as τ increases. Thus, in economies where τ is too low or to high, this share is lower. When τ is low, it is relatively cheaper for firms to adjust labor and therefore they fire workers after receiving a bad shock. When τ is large, firms remain small and therefore do not hoard labor. Hence, the effect on TFP after an increase in λ through the direct channel is stronger for moderate values of τ.

Figure 5: Change in Standard Deviation of MRPK for Different τ

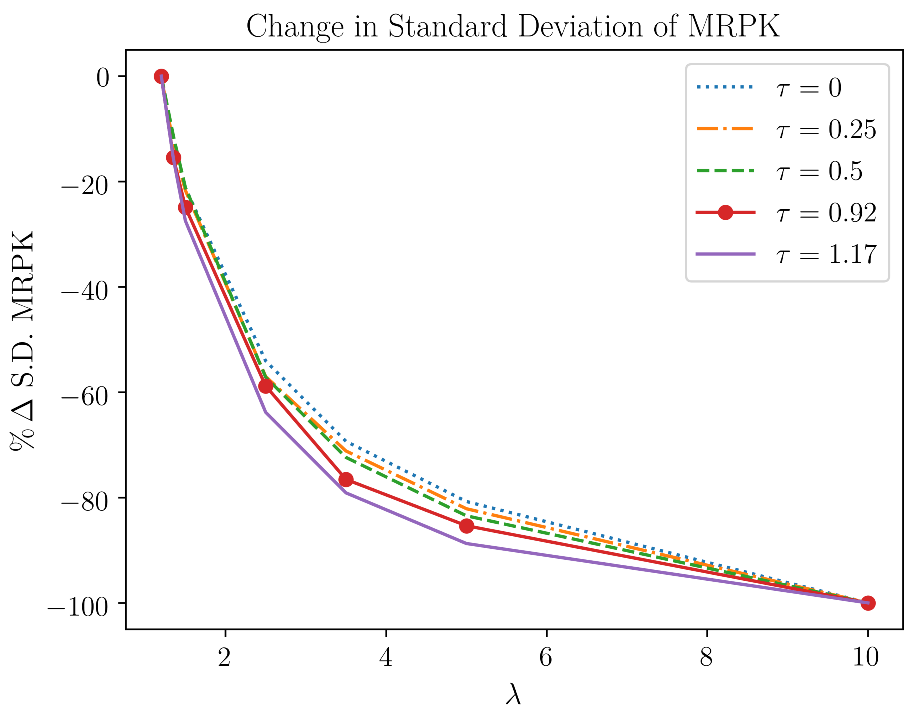


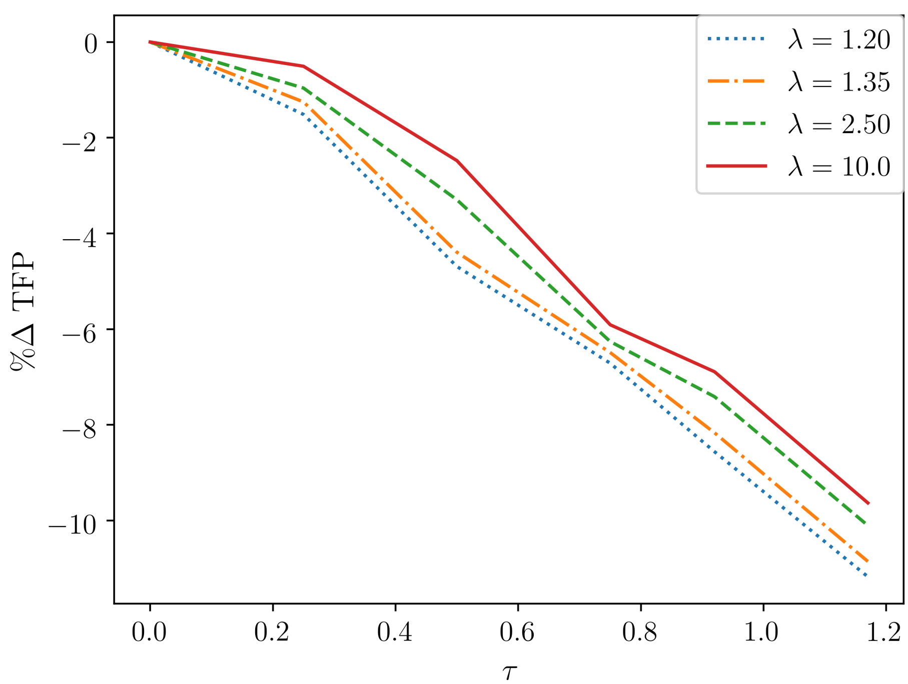
Table 6: Share of Constrained Firms with z Below 80th Percentile, $\lambda = 1.20$

Moment	$\tau = 0.0$	$\tau = 0.25$	$\tau = 0.5$	$\tau = 0.92$	$\tau = 1.17$
Share constrained firms w/low z	0.10	0.15	0.17	0.09	0.07

6.2 Increasing Firing Costs

In this section I study an increase in the firing cost for economies with different levels of financial development. As in the previous subsection I fix all the parameters to the baseline and increase τ from 0 to 1.17 for economies with different levels of λ. The results of this analysis are summarized in Figure 6. There is a monotonic relationship between the drop in TFP after an increase in τ and the level of λ. That is, TFP drops less for higher levels of the collateral constraint parameter.

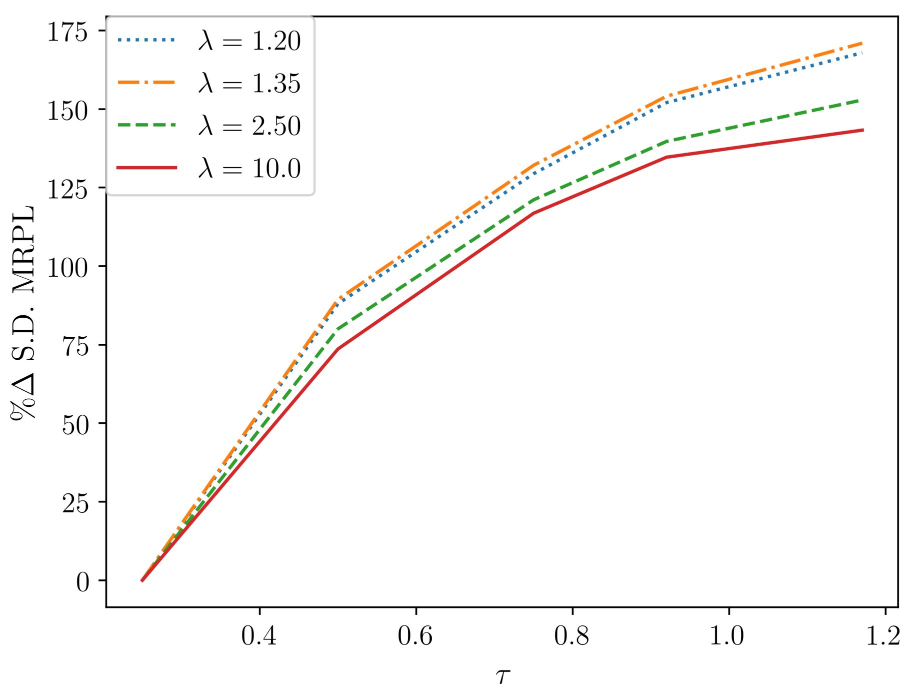
Figure 6: Change in TFP for Different λ



There are two forces driving this result. On one hand, an increase in firing costs worsens the allocation of labor but less so in economies with more developed financial markets. On the other hand, an increase in the firing cost distorts the allocation of capital in economies with financial frictions, but less so in economies where these frictions are less severe.

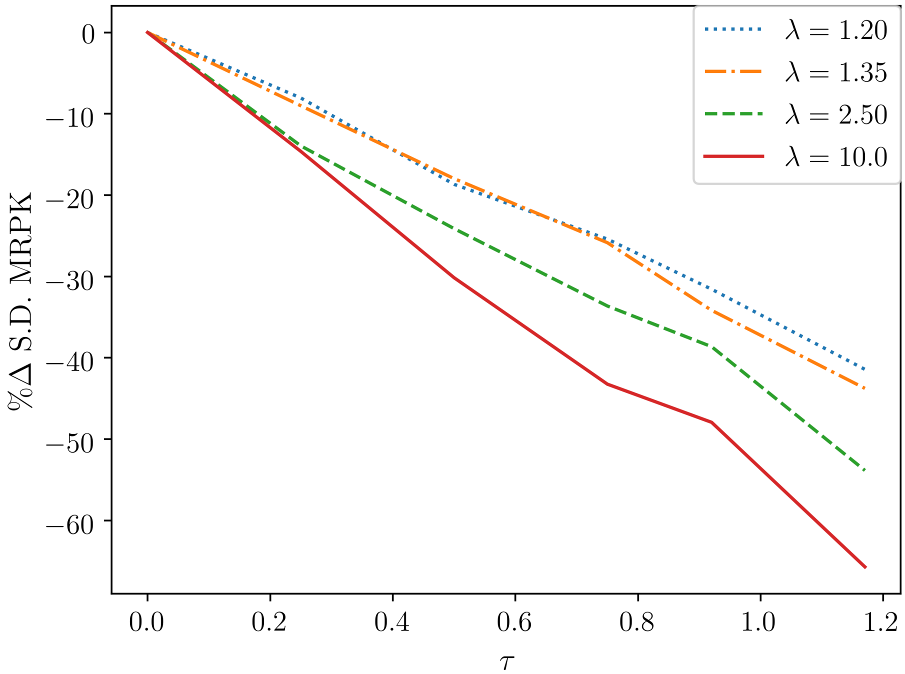
Figure 7 depicts the change in standard deviation of MRPL following an increase in τ. Notice that it increases less in economies with higher λ. Hence, labor is relatively less distorted after an increase in firing costs in economies were financial markets are more developed. This is because when the collateral constraint parameter is high, firms do not have to accumulate net worth to relax their financial constraint, and therefore can use some of the internal resources to pay for the firing cost and have a better allocation of labor.

Figure 7: Change in Standard Deviation of MRPL for Different λ



The change in the dispersion of MRPK following an increase in τ is shown in Figure 8. The reason why there is a relatively better allocation of capital is that increasing firing costs lowers the size of firms with high productivity shocks, and as a result these firms are less likely to be financially constrained. This effect is stronger in economies where the collateral constraint parameter is higher.

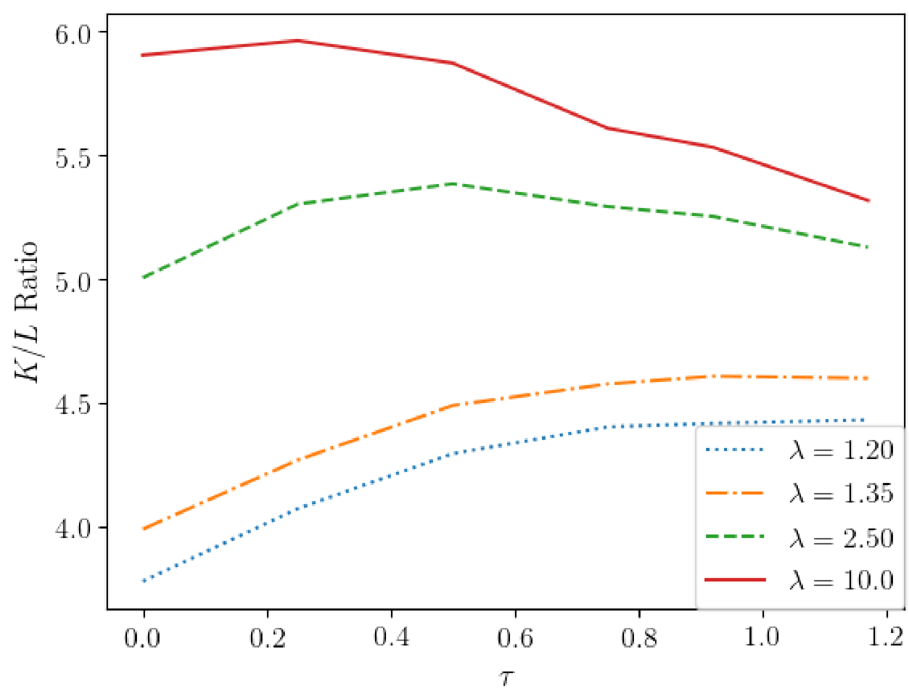
Figure 8: Change in Standard Deviation of MRPK for Different λ



Finally, I explore how the aggregate capital-to-labor ratio changes when firing costs increase in economies with different levels of financial development. I find qualitatively similar results to the empirical literature that analyzes the joint effect of employment protection and financial development on firms' investment. There are studies that find that increasing employment protection generates an increases in the capital-output ratio, and there are studies that find the opposite. The key distinction between these studies is the types of economies they analyze. Autor et al. (2007) find that in the U.S. a small increase in the cost of firing workers (starting from a situation with almost no cost) the capital to labor ratio increases. As can be seen in Figure 9, in economies with high λ there is a slight increase in the capital to labor ratio for moderate changes of τ starting from $\tau = 0$. Similarly, Cingano et al. (2014) study a small increase in employment protection in Italy in 1990 when firms below the threshold of fifteen employees where no longer exempt from paying severance payments. They also find a positive relation between the capital-labor ratio and the level of employment protection. On the contrary, Calcagnini et al. (2009) and Cingano et al. (2010)

find a negative relation between firing costs and capital-labor ratio. These studies make use of cross country variation in labor protection legislation across European countries. These countries are characterized by highly regulated labor markets and a relatively high level of financial development. Similarly, I find that in economies where λ is relatively high, the capital-labor ratio is decreasing for large levels of the firing cost. Intuitively, increasing τ moderately stating from $\tau = 0$ induces firms to hoard labor and hence demand more capital. However, for larger levels of τ is too costly for firms to hoard labor and do not have incentives to grow. Hence firms become smaller and demand less capital.

Figure 9: Aggregate Capital-Labor Ratio for Different λ



7 Conclusion

The goal of this paper is to study and quantify the impact of the interaction between financial frictions and firing costs. In particular, I study the effect of a financial reform in an economy where firms find it costly to fire workers. To do this, I set up a model with heterogeneous firms that face both firing costs and collateral constrains. I calibrate the model using census plant level data from the manufacturing sector in Chile and aggregate moments. Using the calibrated model, I quantify the long run change in total factor productivity after a financial reform. I find that TFP increases by 2.5% following the reform. If firing costs are not taken into account in the analysis, after a financial reform TFP increases by only 0.3%. Acknowledging firing cots is important since it worsens the allocation of capital prior to the reform and hence the reform has a larger impact on productivity. The model can qualitatively replicate certain features of the empirical literature. The impact of firing costs on productivity is smaller in economies with more developed financial markets. Furthermore, the relationship between the capital-labor ratio and the level of firing costs is hump-shaped for certain levels of financial frictions.

References

Andreasen, E., S. Bauducco, and E. Dardati (2018): "Capital Controls and Firm Performance: The Effects of the Chilean Encaje," Research Department working papers 1153, CAF Development Bank Of Latinamerica.

Arellano, C., Y. Bai, and P. J. Kehoe (2016): "Financial Frictions and Fluctuations in Volatility," Working Paper 22990, National Bureau of Economic Research.

Asker, J., A. Collard-Wexler, and J. De Loecker (2014): "Dynamic Inputs and Resource (Mis)Allocation," *Journal of Political Economy*, 122, 1013 – 1063.

Autor, D. H., W. R. Kerr, and A. D. Kugler (2007): "Does Employment Protection Reduce Productivity? Evidence From US States*," *The Economic Journal*, 117, F189–F217.

Beck, T., A. Demirguc-Kunt, and R. Levine (2000): "A New Database on the Structure and Development of the Financial Sector," *World Bank Economic Review*, 14, 597–604.

Buera, F. J., R. N. F. Jaef, and Y. Shin (2015): "Anatomy of a credit crunch: From capital to labor markets," *Review of Economic Dynamics*, 18, 101 – 117, money, Credit, and Financial Frictions.

Buera, F. J., J. P. Kaboski, and Y. Shin (2011): "Finance and Development: A Tale of Two Sectors," *The American Economic Review*, 101, 1964–2002.

Buera, F. J. and Y. Shin (2013): "Financial Frictions and the Persistence of History: A Quantitative Exploration," *Journal of Political Economy*, 121, 221–272.

Calcagnini, G., A. Ferrando, and G. Giombini (2014): "Does employment protection legislation affect firm investment? The European case," *Economic Modelling*, 36, 658–665.

Calcagnini, G., G. Giombini, and E. Saltari (2009): "Financial and labor market imperfections and investment," *Economics Letters*, 102, 22 – 26.

Cingano, F., M. Leonardi, J. Messina, and G. Pica (2010): "The effects of employment protection legislation and financial market imperfections on investment: evidence from a firm-level panel of EU countries," *Economic Policy*, 25, 117–163.

——— (2014): "Employment protection legislation, capital investment and access to credit: evidence from Italy," Working Papers 4, Department of the Treasury, Ministry of the Economy and of Finance.

Da-Rocha, J.-M., M. M. Tavares, and D. Restuccia (2016): "Firing Costs, Misallocation, and Aggregate Productivity," Working Paper 23008, National Bureau of Economic Research.

Gopinath, G., Ş. Kalemli-Özcan, L. Karabarbounis, and C. Villegas-Sanchez

(2017): "Capital Allocation and Productivity in South Europe*," *The Quarterly Journal of Economics*, 132, 1915–1967.

Heckman, J. and C. Pagés (2003): "Law and Employment: Lessons from Latin America and the Caribbean," Working Paper 10129, National Bureau of Economic Research.

Hopenhayn, H. and R. Rogerson (1993): "Job Turnover and Policy Evaluation: A General Equilibrium Analysis," *Journal of Political Economy*, 101, 915–938.

Hsieh, C.-T. and P. J. Klenow (2009): "Misallocation and Manufacturing TFP in China and India*," *The Quarterly Journal of Economics*, 124, 1403–1448.

Lazear, E. P. (1990): "Job Security Provisions and Employment," *The Quarterly Journal of Economics*, 105, 699–726.

Levinsohn, J. and A. Petrin (2003): "Estimating Production Functions Using Inputs to Control for Unobservables," *The Review of Economic Studies*, 70, 317–341.

Liu, L. (1993): "Entry-exit, learning, and productivity change Evidence from Chile," *Journal of Development Economics*, 42, 217 – 242.

Midrigan, V. and D. Y. Xu (2014): "Finance and Misallocation: Evidence from Plant-Level Data," *The American Economic Review*, 104, 422–458.

Moll, B. (2014): "Productivity Losses from Financial Frictions: Can Self-Financing Undo Capital Misallocation?" *American Economic Review*, 104, 3186–3221.

Olley, G. S. and A. Pakes (1996): "The Dynamics of Productivity in the Telecommunications Equipment Industry," *Econometrica*, 64, 1263–1297.

Petrin, A. and J. Sivadasan (2011): "Estimating Lost Output from Allocative Inefficiency, with an Application to Chile and Firing Costs," Working Paper 17373, National Bureau of Economic Research.

Restuccia, D. and R. Rogerson (2008): "Policy distortions and aggregate productivity with heterogeneous establishments," *Review of Economic Dynamics*, 11, 707 – 720.

Veracierto, M. (2001): "Employment Flows, Capital Mobility, and Policy Analysis," *International Economic Review*, 42, 571–595.

Wooldridge, J. M. (2009): "On estimating firm-level production functions using proxy variables to control for unobservables," *Economics Letters*, 104, 112 – 114.

A Data

A.1 Representativeness of Sample

Table A.1 presents the representativeness of our sample with respect to the manufacturing sector by size category. For value added, the share of firms with more than 200 employees is 7 percentage points higher in the manufacturing sector than in our sample. On the contrary, this share is 6 percentage points lower in the manufacturing sector relative to our sample for firms with 50 to 199 employees. The representativeness of our sample is better across the three different size categories for employment and the wage bill.

Table A.1: Shares of Total Manufacturing Economic Activity By Size Category (Average for 1995-2007)

Economic Activity:	10 - 49 employees	50 - 199 employees	200+employees
Share of Value Added:			
Sample	0.11	0.26	0.63
Manufacturing Sector	0.10	0.20	0.70
Share of Wage Bill:			
Sample	0.14	0.29	0.57
Manufacturing Sector	0.12	0.26	0.62

Notes. This table only analyzes plants with more than 10 employees since those with less than 10 are underrepresented in the ENIA.

A.2 Span of Control Parameter

Table A.2: Values of Span of Control Parameter for Chile 1995-2007

Moment	Value
Min	0.75
Max	1.03
Median	0.85
Mean	0.88
Variance	0.09

Source: authors calculations using the ENIA for the years 1996 to 2007.

Note: Values are calculated by summing the elasticities resulting from the production function estimation using Wooldridge (2009) method.