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DEVELOPMENT BANK OF LATIN AMERICA

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ABSTRACT

We investigate the extent to which financial frictions shape the aggregate effects of a trade liberalization through their impact on aggregate total factor productivity (TFP) and capital misallocation. We study a small open economy populated with heterogeneous entrepreneurs who differ in their productivity and are subject to financing constraints. Individuals choose whether to be workers or entrepreneurs, and entrepreneurs choose whether to export or not. We show how financial frictions distort these decisions and aggregate TFP. We calibrate the model to match key features of Chilean plant-level data and use it to quantify the TFP losses due to misallocation. We then investigate how the presence of financial constraints affects the output and TFP gains from trade liberalization. We find that lowering trade barriers has a stronger positive effect in less financially developed economies. The higher profits that result from trade liberalizations allow firms to accumulate assets and relax their credit constraint, which is particularly valuable in economies where firms are severely constrained.

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RESUMEN

Investigamos hasta qué punto las fricciones financieras moldean los efectos agregados de una liberalización del comercio a través de su impacto en la productividad total agregada de los factores (PFT) y la mala asignación de capital. Estudiamos una pequeña economía abierta, poblada de empresarios heterogéneos que difieren en su productividad y están sujetos a restricciones financieras. Los individuos deciden si son trabajadores o empresarios, y los empresarios deciden si exportan o no. Mostramos cómo las fricciones financieras distorsionan estas decisiones y la productividad agregada. Calibramos el modelo para que replique ciertas características clave de los datos a nivel de planta en Chile y lo usamos para cuantificar las pérdidas de PTF debido a una mala asignación. A continuación, investigamos cómo la presencia de restricciones financieras afecta el producto y las ganancias de PTF provenientes de la liberalización del comercio. Encontramos que la reducción de las barreras comerciales tiene un efecto positivo más fuerte en las economías menos desarrolladas financieramente. Los mayores beneficios resultantes de la liberalización del comercio permiten a las empresas acumular activos y relajar su restricción crediticia, lo que es particularmente valioso en economías donde las empresas están gravemente restringidas.

Financial Frictions, Trade, and Misallocation*

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Abstract

We investigate the extent to which financial frictions shape the aggregate effects of a trade liberalization through their impact on aggregate total factor productivity (TFP) and capital misallocation. We study a small open economy populated with heterogeneous entrepreneurs who differ in their productivity and are subject to financing constraints. Individuals choose whether to be workers or entrepreneurs, and entrepreneurs choose whether to export or not. We show how financial frictions distort these decisions and aggregate TFP. We calibrate the model to match key features of Chilean plant-level data and use it to quantify the TFP losses due to misallocation. We then investigate how the presence of financial constraints affects the output and TFP gains from trade liberalization. We find that lowering trade barriers has a stronger positive effect in less financially developed economies. The higher profits that result from trade liberalizations allow firms to accumulate assets and relax their credit constraint, which is particularly valuable in economies where firms are severely constrained.

JEL: F1, F4, G32.

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1 Introduction

Emerging economies have relatively under-developed financial markets. Since well functioning financial markets are key for the efficient allocation of resources, financial underdevelopment can lead to their misallocation which distorts firms' production decisions as well as individuals' occupational choices. These distortions can affect total output and aggregate total factor productivity (TFP). At the same time, many of these economies have high trade barriers that discourage exporting and limit the growth options of productive firms, further aggravating the output and TFP losses faced by emerging economies. Thus, understanding the interaction between financial frictions and trade barriers is key for evaluating government policies that aim to improve welfare in these economies.

In this paper, we focus on one such policy: trade liberalization. In particular, we examine how the effects of trade liberalizations, like those which many Latin-American countries have implemented in recent decades, are affected by the extent of financial development. To do so, we investigate and quantify two main channels through which financial frictions distort allocations: (*i*) the distortion of firms' production and exporting decisions (see for example Manova, 2013, Leibovici, 2016, Kohn et al., 2016a, Kohn et al., 2016b); and (*ii*) the effect of financial frictions on firms' entry and exit decisions (see for example Asturias et al., 2015 and Fattal-Jaef, 2015)

The importance of trade for aggregate productivity has been highlighted by Melitz (2003) who showed that, in an economy with efficient financial markets, a trade liberalization leads to a reallocation of resources away from less productive firms to more productive ones and results in a higher output and TFP. However, the assumption that financial markets are frictionless might not be well-suited for discussing the effects of a trade liberalization in many economies and, hence, it is important to understand how financial market imperfections affect the gains from reducing trade barriers. In the presence of financial frictions, many firms are forced to operate below their optimal scale which reduces the profits obtained from both domestic and foreign sales. Thus, these firms might be unable to expand their foreign sales following a trade reform and take full advantage of the benefits of a trade liberalization. This suggests that a trade liberalization provides smaller benefits in less financially developed economies. On the other hand, lower trade costs increase profits from exporting which can help exporters grow out of their financial constraints. This effect tends to increase the benefits of a reduction in international trade barriers in less financially developed economies. The goal of this paper is to quantify the strength of these effects and to identify the key distortions that account for our findings.

To answer the above questions, we study a small open economy populated by a large

number of entrepreneurs who can produce domestically, abroad, or not produce at all. Entrepreneurs produce differentiated goods by hiring labor to operate previously accumulated physical capital. The entrepreneurs' productivity is idiosyncratic and follows a stochastic process, leading to productivity heterogeneity across entrepreneurs that changes over time.

The first key ingredient of the model is access to international goods markets. We model international trade decisions as in Melitz (2003), where firms are subject to fixed and variable trade costs. As in Alessandria and Choi (2014) and Kohn et al. (2016b), this cost structure also allows us to capture key statistics of international trade flows observed in plant-level data. The second key ingredient of the model are frictions in financial markets. We assume that entrepreneurs' borrowing is limited to a fraction of their net worth. Thus, productive entrepreneurs with limited net worth are forced to operate below their optimal scale that not only reduces their sales and profits but also distorts their export-entry decisions.

Finally, we enrich the above framework by incorporating an occupational choice. We assume that every period individuals choose whether to be workers or to be entrepreneurs and operate a firm. The presence of financial constraints imply that only individuals with high productivity and high net worth will find it worthwhile to operate a firm. This exacerbates misallocation of resources in the economy leading to further losses in output and aggregate TFP. It also affects the potential gains from trade liberalizations.

We start our analysis by describing qualitatively the equilibrium distortions induced by financial constraints. We explain how financial frictions distort occupational choice, production, and export-entry decisions, and contrast these with the optimal choices in a frictionless economy. We then illustrate how agents' decisions respond to a reduction in trade barriers in economies with and without financial frictions. Finally, we study the role of financial constraints on the impact of lowering international trade barriers on aggregate TFP, and we present a number of measures that we use in the quantitative exercise to quantify the TFP losses from misallocation due to financial constraints.

We then calibrate the model to capture key features of aggregate and plant-level data for Chile and study its quantitative implications. We first use our calibrated model to quantify the extent to which financial frictions affect aggregate productivity in the baseline economy through the distortion of firms' entry and exit, and firms exporting decisions.

Next, we investigate the extent to which financial frictions distort the allocation of resources during a trade liberalization and the channels through which these distortions occur. To quantify these channels, we contrast the stationary equilibrium of the economy before and after a 25% reduction in the variable trade costs. We compute the equilibria for alternative degrees of financial markets development, therefore allowing us to study the interaction of financial constraints and trade costs. The numerical analysis also allows us to account

for general equilibrium effects and dynamic net worth accumulation decisions, which might potentially offset the increase of the distortions due to financial constraints.

The focus of the above analysis is on understanding how trade liberalizations affect aggregate variables, such as GDP, exports, TFP, as well as TFP losses due to misallocation, in economies with different degrees of financial development. We find that trade liberalizations in less financially developed economies tend to result in a larger increase of real GDP and TFP. We show that trade liberalizations result in less financially-constrained firms in economies with lower financial development, as firms take advantage of the higher export profits to accumulate assets and grow out of their borrowing constraints. Firms are more constrained after the trade liberalization with respect to their export entry decisions, but this effect is smaller in economies with less developed financial markets.

1.1 Literature review

Financial frictions and productivity Recent papers investigate the role of financial development in driving aggregate TFP in models with heterogeneous agents, such as Buera et al. (2011), Moll (2014), or Buera and Moll (2011), among others. On the one hand, Midrigan and Xu (2014) calibrate a dynamic model with heterogeneous firms, and find small losses in aggregate TFP induced by misallocation of capital due to borrowing constraints. On the other hand, Meza et al. (2015) find larger effects in a multisector model, induced by working capital constraints and the distorted use of intermediate inputs due to financial constraints. In this paper, we study two additional channels through which financial frictions can induce misallocation of capital and, thus, reduce aggregate TFP: entry and exit into the industry, and entry and exit into foreign markets.

Entry barriers and financial frictions Asturias et al. (2015) study the interaction between financial frictions and entry barriers. They find that improving the access to finance has a larger impact on output when entry costs are large, consistent with the empirical evidence. Fattal-Jaef (2015) evaluates welfare gains associated with a reversal of the financial frictions in developing countries. He finds that TFP gains are small because of the offsetting response in entry and exit decisions of firms.

Trade and productivity Melitz (2003) highlighted the role of exporting and trade liberalizations in generating aggregate productivity growth through selection. In this model, a trade liberalization –or any other export-inducing policy– generates a transfer of resources away from low-productivity firms, that leave the market, to high-productive firms, which expand their production as they gain access to the foreign market. In models with heterogeneous agents, Alessandria and Choi (2007), Ghironi and Melitz (2005), and Fattal-Jaef and

Lopez (2014) study the role of entry and exit of firms, and the extensive margin of exports, in generating aggregate fluctuations.

Our paper is also related to Arkolakis et al. (2012) who find that the impact of international trade on aggregate TFP is identical across a large class of trade models. Our framework with financial frictions does not belong to this class of models, potentially providing additional channels for productivity gains from international trade.

Financial frictions and exports Kohn et al., 2016a, Kohn et al., 2016b, and Leibovici, 2016 study the role of financial frictions as a driver of firm-level and aggregate exports. They show that financial frictions affect the export decision of firms through the intensive and extensive margins, and study their implications for aggregate quantities and prices.

In this paper, we study the effect of financial frictions on aggregate productivity through their effect on firms' decisions along two different margins: (i) their entry and exit of the industry; and (ii) the decision to export or not. We quantify the role of each of these channels and study their interaction with a trade liberalization for different degrees of financial development.

Financial frictions and trade liberalization. Brooks and Dovis (2011) and Caggese and Cunat (2013) also study the effects of a trade liberalization and their dependence on financial development. The former investigate how these effects depend on whether borrowing constraints are backward-looking (i.e. collateral constraints as in our model) or forward-looking. The latter investigate the effects of a trade liberalization on aggregate TFP in an industry-model (i.e. partial-equilibrium setup). Both find that a trade liberalization has a larger effect on aggregate consumption, wages and TFP in an economy without financial frictions than in one subject to borrowing constraints. Instead, we find that trade liberalizations in less financially developed economies tend to result in a larger increase in real GDP and TFP, as firms take advantage of the higher export profits to accumulate assets and grow out of their borrowing constraints.

2 Model

In this section, we present the theoretical framework. The model consists of an economy populated by a unit measure of individuals and final good producers who trade with the rest of the world. Individuals can choose to be workers or entrepreneurs. There are three types of goods in the economy: final goods, domestic varieties, and foreign varieties. Final goods are produced by final good producers and used by workers and entrepreneurs for consumption and investment. Domestic varieties are produced by entrepreneurs and sold to final good producers and the rest of the world. Finally, foreign varieties are produced by the rest of

the world and sold to final good producers. Only varieties can be traded internationally.

2.1 Economic environment

2.1.1 Workers and entrepreneurs

Preferences Individuals are risk averse, with preferences over streams of consumption of final goods. Preferences are represented by the expected lifetime discounted sum of a constant relative risk aversion period utility function, $\mathbb{E}_0 \sum_{t=0}^{\infty} \beta^t \frac{c_t^{1-\gamma}}{1-\gamma}$, where γ denotes the coefficient of relative risk aversion, β is the subjective discount factor, and $\mathbb{E}_0$ denotes the expectation operator taken over the realizations of a productivity shock that is described below, conditional on the information set in period zero.

Occupational choice Individuals can choose to be workers or entrepreneurs. If they choose to be workers, they supply inelastically a unit of labor to firms. If they choose to be entrepreneurs, they operate a firm that produces a differentiated variety. To operate the firm, entrepreneurs have to pay a fixed operation cost F_o every period in units of labor.

Technology Entrepreneurs produce differentiated varieties by operating a production technology $y_t = z_t k_t^{\alpha} n_t^{1-\alpha}$, where z_t denotes an idiosyncratic level of productivity, k_t is the capital stock, n_t is the amount of labor hired, and $\alpha \in (0, 1)$ is the capital share. Labor is hired at a wage w_t in terms of final goods. Idiosyncratic productivity z_t follows a time invariant AR(1) process $\ln z_t = (1-\rho)\mu + \rho \ln z_{t-1} + \varepsilon_t$, where ε_t is distributed according to a Normal distribution with mean zero and standard deviation σ_{ε}.

Capital is accumulated internally by transforming final goods invested in period t into physical capital in period $t+1$. Capital depreciates at rate δ after being used for production, leading to a law of motion for capital that is given by $k_{t+1} = (1-\delta)k_t + x_t$.

International trade Entrepreneurs can trade internationally conditional on payment of export-entry costs and variable trade costs. A firm's export choice at time t is denoted by e_t, and is equal to 1 if the firm exports in period t or 0 otherwise. Firms have to pay a fixed cost F_e, in units of labor, every period that they decide to export. Furthermore, exporters are subject to an ad-valorem trade cost $\tau > 1$, which requires firms to ship τ units for every unit that arrives at destination.

Financial markets Individuals have access to financial markets, where they can borrow or save by trading a one-period risk-free bond at a real interest rate r_t. They face a borrowing

constraint that limits the amount they can borrow to a fraction θ of the value of the capital stock at the time that the loan is due for repayment.

While entrepreneurs can trade this bond to save as much as they desire, the amount borrowed d_{t+1} has to satisfy $d_{t+1} \leq \theta k_{t+1}$ and the natural borrowing limit. Workers can only use this bond to save.[1]

Market structure Entrepreneurs compete with each other under monopolistic competition and choose the quantities and prices at which to sell in each market subject to their respective demand schedules. In the domestic market, the demand schedule is such that it solves the final good producer's problem, while the demand schedule faced in the international market is given by the rest of the world. Denote the quantities and prices of varieties sold in the domestic market by $y_{h,t}$ and $p_{h,t}$, respectively, and those sold in the foreign market by $y_{f,t}$ and $p_{f,t}$, respectively. The price of varieties sold to the rest of the world, $p_{f,t}$, is denominated in units of the foreign final good. The real exchange rate, ξ, is the price of a foreign final good in terms of a domestic final good.

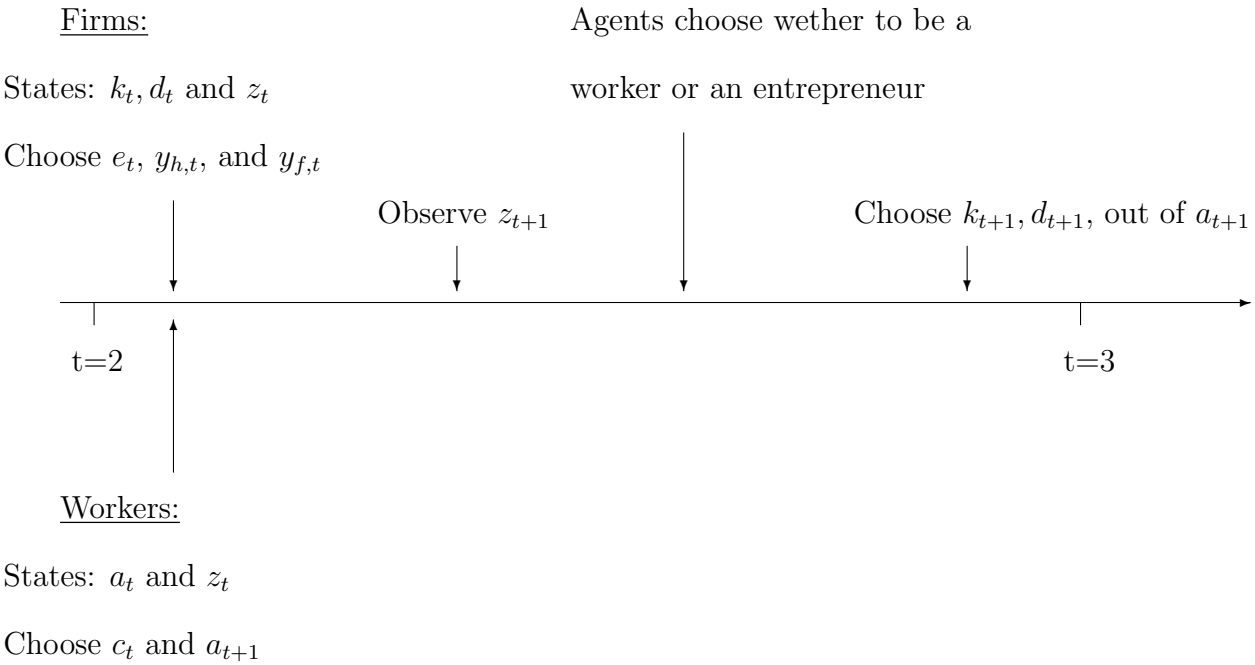

Figure 1: Timing

[1]Only firms can hold capital, so workers have no collateral to borrow against.

Timing The timing of individuals' decisions is as follows. At the beginning of the period, workers supply labor, earn their labor and interest income, and choose how much to consume or save.

At the same time, entrepreneurs hire labor, produce their variety, and then sell it in each of the markets in which they choose to operate. If they decide to export, $e = 1$, then they also pay the fixed export costs. They repay their old debt and decide how much net worth, a, to carry over to the following period.

At the end of the period, agents observe the following period's productivity shock, and with that information they decide whether to be workers or entrepreneurs the next period.

Then, they simultaneously issue new debt and choose, if they decided to be entrepreneurs, their new level of physical capital. Figure 1 presents the timing of the entrepreneurs' problem.

Workers' problem Given this setup, the workers' problem at time t consists of choosing sequences of consumption c_t and bond-holdings (minus) d_{t+1} in order to maximize their lifetime expected utility. In addition to the borrowing constraint described above ($d_{t+1} \leq 0$), their choices are subject to a sequence of period-by-period budget constraints. Their budget constraint in period t is given by:

$$c_t + d_t = w_t + \frac{d_{t+1}}{1 + r_t}.$$

Entrepreneurs' problem Given this setup, the entrepreneurs' problem at time t consists of choosing sequences of consumption c_t, labor n_t, investment x_t, current period's export status e_{t+1}, and prices and quantities $y_{h,t}, p_{h,t}, y_{f,t}, p_{f,t}$ at which to sell the varieties in each of the markets, in order to maximize their expected utility. In addition to the borrowing constraint described above and the market-specific demand schedules that are described below, their choices are subject to a sequence of period-by-period budget constraints, law of motion for capital $k_{t+1} = [(1 - \delta)k_t + x_t]$, and production technology $y_{h,t} + \tau y_{f,t} = z_t k_t^{\alpha} n_t^{1-\alpha}$. Their budget constraint in period t is given by:

$$c_t + x_t + d_t = p_{h,t} y_{h,t} + e_t \left(\xi_t p_{f,t} y_{f,t} - w_t F_e\right) - w_t n_t - w_t F_o + \frac{d_{t+1}}{1 + r_t}$$

2.1.2 Final good producers

Final good producers purchase varieties from entrepreneurs and the rest of the world, and aggregate them to produce a final good. They operate a constant elasticity of substitution (CES) technology with elasticity of substitution $\sigma > 1$. Let the set $[0, 1]$ index the unit measure of entrepreneurs in the economy, and let $\{p_{h,t}(i)\}_{i \in [0,1]}$ and $p_{m,t}$ be the prices of

varieties charged by the entrepreneurs and the rest of the world, respectively.[2] Given these prices, final good producers choose the bundle of inputs of domestic and imported varieties, $\{y_{h,t}(i)\}_{i\in[0,1]}$ and $y_{m,t}$, that maximizes their profits. Then, the problem of final good producers is given by:

$$\max_{y_{h,t}(i),y_{m,t}} Y_{h,t} - \int_0^1 p_{h,t}(i)y_{h,t}(i)di - \xi_t p_{m,t}y_{m,t}$$

subject to

$$Y_{h,t} = \left[\int_0^1 y_{h,t}(i)^{\frac{\sigma-1}{\sigma}}di + y_{m,t}^{\frac{\sigma-1}{\sigma}}\right]^{\frac{\sigma}{\sigma-1}},$$

where $Y_{h,t}$ denotes the quantity produced of the final good.

The solution to this problem is given by $y_{h,t}(i) = (p_{h,t}(i))^{-\sigma} Y_{h,t}$ and $y_{m,t} = (\xi_t p_{m,t})^{-\sigma} Y_{h,t}$, which are the demand schedules faced by entrepreneurs and the rest of the world, respectively.

2.1.3 Rest of the world

The rest of the world demands varieties from entrepreneurs –the domestic economy's exports– and supplies varieties to final good producers –the domestic economy's imports. The foreign demand for varieties produced by entrepreneurs is assumed to be given by a downward-sloping demand function with the same constant elasticity of substitution σ, $y_{f,t} = (p_{f,t})^{-\sigma} Y_{f,t}$, where $Y_{f,t}$ denotes the aggregate quantity of the rest of the world, and $p_{f,t}$ is denominated in units of the foreign final good. The supply of varieties from the rest of the world, imported by final good producers, is assumed to be perfectly elastic at price $p_{m,t} = \bar{p}_m$.

2.2 Occupational choice problem: Recursive formulation

Let $g(a,z)$ be the value for an entrepreneur/worker with net worth a and productivity z, who decides whether he wants to operate a firm –be an entrepreneur– or be a worker next period. Let $g_e(a,z)$ ($g_w(a,z)$) be the value for an entrepreneur (worker) with net worth a and productivity z:

$$g(a,z) = \max\{g_w(a,z), g_e(a,z)\}$$

[2] $p_{m,t}$ is denominated in units of the foreign good

2.3 Entrepreneur's problem: Recursive formulation

Let $v_e(k,d,z)$ be the value function for an entrepreneur with capital k, debt d, and productivity z, who is making consumption and saving decisions, and production decisions for the foreign and domestic markets. Let $g_e(a,z)$ be the value for an entrepreneur with net worth a and productivity z, who decides how much capital k and debt $\frac{d}{1+r}$ carry on to the next period.

Then, the entrepreneur's problem can be described as:

$$\begin{aligned} v_e(k,d,z) = & \max_{c,n,a',p_h,p_f,y_h,y_f,e\in\{0,1\}} \frac{c^{1-\gamma}}{1-\gamma} + \beta \mathbb{E}_{z'}\left[g(a',z')\right] \\ & \text{subject to} \\ & c + a' + d + wn + ewF_e + wF_o = p_h y_h + e\xi p_f y_f + (1-\delta)k \\ & y_h + \tau y_f = z k^{\alpha} n^{1-\alpha}, \quad y_h = (p_h)^{-\sigma} Y_h, \quad y_f = (p_f)^{-\sigma} Y_f \end{aligned} \tag{1}$$

and:

$$\begin{aligned} & g_e(a',z') = \max_{k',d'} v_e(k',d',z') \\ & \text{subject to} \\ & a' = k' - \frac{d'}{1+r} \\ & d' \leq \theta k' \end{aligned}$$

2.4 Workers' problem: Recursive formulation

Let $v_w(d,z)$ be the value function for a worker with bond-holdings (minus) d and productivity z, who is making consumption and saving decisions. Let $g_w(a,z)$ be the value for a worker with net worth a and productivity z, who decides how much bond-holdings (minus) d to carry on to the next period.

Then, the worker's problem can be described as:

$$\begin{aligned} v_w(d,z) = & \max_{c,a'} \frac{c^{1-\gamma}}{1-\gamma} + \beta \mathbb{E}_{z'}\left[g(a',z')\right] \\ & \text{subject to} \\ & c + a' = w - d \end{aligned}$$

and:

$$g_w(a', z') = \max_{d'} v_w(d', z')$$

subject to

$$a' = -\frac{d'}{1+r}$$

$$d' \leq 0$$

2.5 Equilibrium

Let $\mathcal{S}$ denote the state space of workers and entrepreneurs, and let let $s \in \mathcal{S}$ denote an element of the state space. For a given value of the interest rate r, a *recursive stationary competitive equilibrium* of this economy consists of prices $\{w, \xi\}$, policy functions $\{d', k', e, c, n, y_d, y_f, p_d, p_f, Y_h, y_m\}$, value functions $\{g, g_e, g_w, v_e, v_w\}$, and a measure $\phi : \mathcal{S} \to [0, 1]$ such that:

1. Policy and value functions solve the entrepreneurs' problem and the workers' problem;
2. Policy functions solve the final good producers' problem;
3. Labor market clears: $\int_{\mathcal{S}} \left[n(s) + e(s)F_e + F_o I_{[o=1]} \right] \phi(s)ds = 0$;
4. Final good market clears: $\int_{\mathcal{S}} \left[c(s) + x(s) \right] \phi(s)ds = Y$;
5. Measure ϕ is stationary.

3 Trade liberalization under financial frictions

In this section, we describe the role of financial constraints on the effects of lowering international trade barriers. We begin by explaining how financial constraints distort agents' decisions relative to a frictionless environment. We then illustrate how agents' decisions respond to changes in international trade barriers when subject to credit frictions. Finally, we study the role of financial constraints on the impact of lowering international trade barriers on aggregate TFP.

3.1 Financial frictions and firms' decisions

Production and export decisions Previous studies show that financing constraints distort firms' production and exporting decisions both at the intensive and extensive margins (see Kohn et al. 2016a and Leibovici 2016).

First, financial frictions reduce firms' total production, since productive firms with low net worth are forced to operate below their optimal scale. This results in lower output than in the absence of credit frictions. Moreover, conditional on a given level of net worth, these distortions are larger among exporters since they typically have a higher optimal scale given the larger markets faced as well as their higher productivity. Figure 2 contrasts an individuals' production decisions between an economy with financial frictions and its frictionless counterpart. To ease the exposition, we restrict attention to an entrepreneur with a given level of productivity z who chooses to export ($e = 1$), while keeping aggregate prices and quantities fixed. The dashed black line shows that total output is independent of net worth in the frictionless economy. In contrast, the solid red line shows that individuals with low net worth operate below their optimal scale when subject to credit constraints.

Second, borrowing constraints distort firms' decision about whether to export or not. The lower scale at which credit-constrained exporters operate reduces the returns to paying the fixed export costs, relative to an economy without financial constraints. As a result, in an economy with financial frictions, productive firms with low net worth choose not to export. Figure 3 contrasts the optimal export decision between an economy with financial frictions and its frictionless counterpart, while keeping aggregate prices and quantities fixed. The green area depicts the points of the state space at which entrepreneurs only sell domestically, while the blue region illustrates the points at which they choose to export. While low productivity entrepreneurs always choose to be non-exporters regardless of financial constraints, high productivity entrepreneurs with low net worth choose to be non-exporters under financial frictions but export in a frictionless environment.

Occupation decisions In addition, financial frictions also distort the allocation of individuals between workers and entrepreneurs (occupation decisions). To see this, note that individuals choose whether or not to be workers by comparing the static profits from operating a firm with the labor income they would obtain by supplying labor to other entrepreneurs. Given that profits are increasing in productivity while labor income is not, the optimal occupation choice in a frictionless economy is simple: sufficiently productive individuals choose to be entrepreneurs, while the rest chooses to be workers.

In contrast, in an economy with financial constraints, the individuals' occupation choice depends on their level of net worth. As explained above, entrepreneurs with low net worth cannot operate at their optimal scale, which reduces the static profits from operating the firm. Therefore, productive individuals with low net worth choose to be workers, even though they would choose to be entrepreneurs in the absence of credit frictions.

Figure 3 contrasts the occupation choice between an economy with financial frictions

and its frictionless counterpart, while keeping aggregate prices and quantities fixed. The red area depicts the points of the state space at which individuals choose to be workers, while the green and blue ones are those in which they choose to be entrepreneurs. While low productivity individuals always choose to be workers regardless of financial constraints, high productivity individuals with low net worth choose to be workers under financial frictions but choose to be entrepreneurs in a frictionless environment.

3.2 Trade liberalization and firms' decisions

Given the impact on individuals' occupation, production, and export decisions, we now examine the role of financial frictions in affecting the effects of lowering international trade barriers τ.

Production decisions We begin by contrasting the impact of lowering trade barriers on firms' production decisions between an economy with financial frictions and its frictionless counterpart. To illustrate these effects, Figure 2 plots the output of an exporter with a given level of productivity as a function of net worth under high and low variable trade costs τ, for the economies with and without financial frictions.

We find that a reduction of international trade costs increases the amount of output produced with and without financial frictions. As exporting becomes more profitable, exporters experience an increase in their optimal scale, which leads them to increase total output at all levels of net worth. In particular, even borrowing-constrained exporters increase the amount of output produced: as exporting becomes more profitable, they increase the amount of labor employed despite not being able to increase their stock of physical capital. To see this in Figure 2, note that the dashed red line is strictly above the solid red line at all levels of net worth.

Figure 2 also shows that, as the optimal scale of exporters increases following a trade liberalization, the distortions from financial frictions become larger. Conditional on a given level of net worth, borrowing-constrained firms would like to have a higher scale with the same amount of physical capital than before the change in trade costs. Therefore, firms' output in the economy with financial frictions is now a lower fraction of its optimal unconstrained output than before the trade liberalization, suggesting that financial frictions might lead to stronger distortions along the intensive margin in economies that are more open to trade.

This analysis abstracts from two key channels that we examine in the quantitative analysis conducted in the following section. First, general equilibrium prices respond to changes in international trade costs, potentially affecting the extent to which distortions due to financial frictions increase. Second, firms' incentives to accumulate net worth accumulation

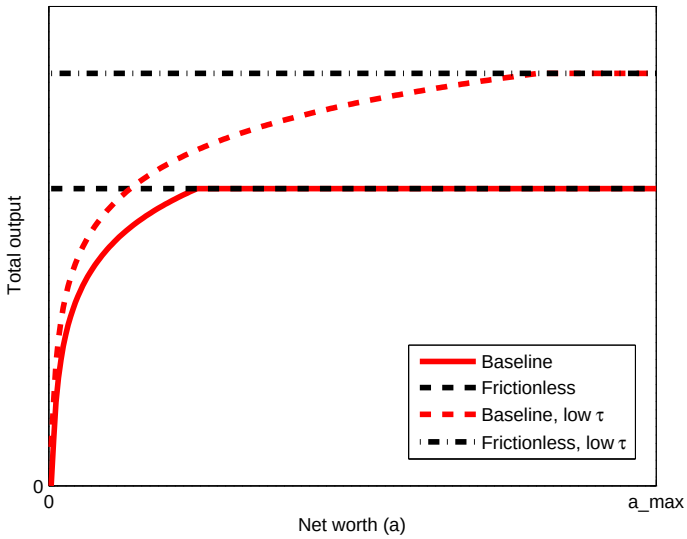

Figure 2: Production decisions

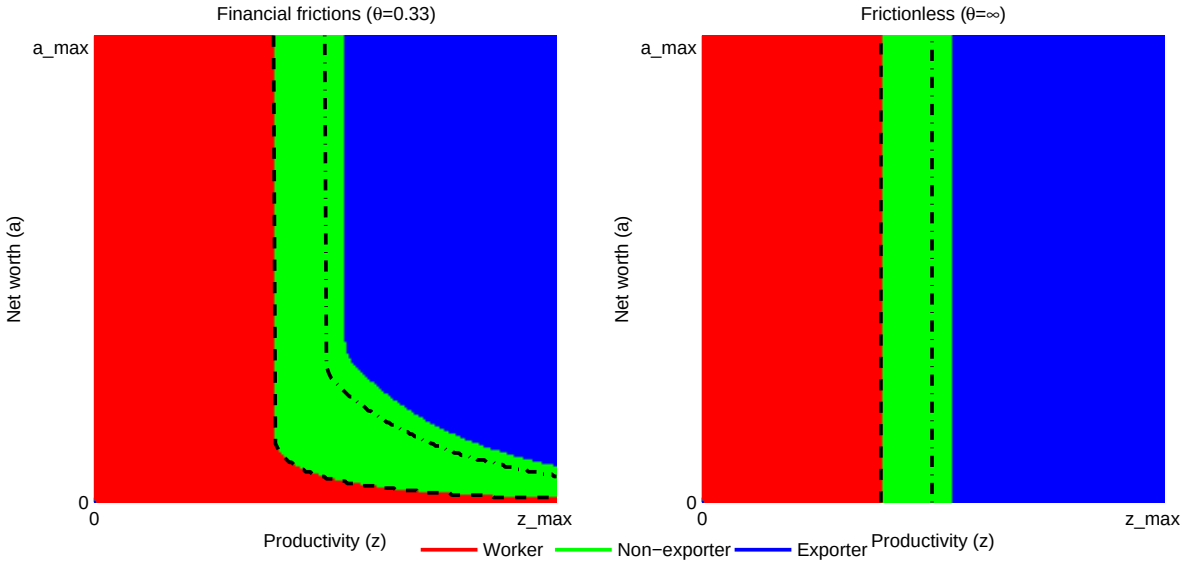

Figure 3: Occupation and exporting decisions

also respond to changes in international trade costs, potentially offsetting the increase of the distortions due to financial constraints.

Occupation and exporting decisions We now contrast the impact of lowering trade barriers on firms' occupation and exporting decisions between an economy with financial frictions and its frictionless counterpart. To illustrate these effects, Figure 3 plots the optimal occupation and exporting decisions along the individuals' state space under high and low variable trade costs τ, for the economies with and without financial frictions. In particular, the colored regions depict the allocation of individuals based on their occupation and exporting decisions under high variable trade costs, while the lines represent the thresholds for becoming an entrepreneur (dashed lines) and for becoming an exporter (dashed-dotted lines) under a lower τ.

Consider first the effect of a trade liberalization on the extensive margin decisions in the frictionless economy. From the right panel of Figure 3, we observe that the change in τ affects exporting decisions: as the dashed-dotted line moves to the left of the blue region, we find that there are entrepreneurs who previously chose to be non-exporters and now choose to export.[3] This is intuitive, as the lower trade costs increase the profitability of exporting, making it more attractive for previous non-exporters to pay the fixed export cost. In contrast, the change in trade costs does not affect occupation decisions: with the dashed line right on top of the border between the red and green regions, the allocation of individuals between workers and entrepreneurs remains unchanged.

Finally, consider the effect of a trade liberalization on the extensive margin decisions in the economy with financial frictions. As in the frictionless economy, the left panel of Figure 3 shows that a decrease in τ leads to an increase in the set of entrepreneurs that choose to export. However, in contrast to the frictionless economy, the response of the exporting threshold is now a function of both net worth and productivity.

3.3 Trade liberalization and aggregate TFP

In this section, we study the aggregate effects of reducing international trade costs τ in an economy with financial constraints. To do so, we restrict attention to the impact on aggregate TFP since it is a key channel through which credit constraints distort aggregate outcomes.[4] In the quantitative analysis conducted in the following section, we examine the impact on a wider set of aggregate outcomes.

[3] In particular, the set of entrepreneurs with state variables that fall in the green region to the right of the dashed-dotted line.

[4] See, for example, Midrigan and Xu (2014).

We begin by examining the impact of a trade liberalization on aggregate TFP in a frictionless economy. Then, we contrast our findings with those implied by an economy with financial constraints. Finally, we present a number of measures that we use in the following section to quantify the TFP losses from misallocation due to financial constraints.

To compute aggregate TFP in our economy, we begin by defining aggregate real GDP to be given by:

$$\text{Real GDP} = \frac{\text{GDP}}{\text{PPI}}$$

where GDP denotes the value of gross domestic product in units of domestic final goods, and PPI denotes a production price index that is used to deflate the value of GDP by the price of domestically-produced varieties in units of domestic final goods.

On the one hand, aggregate GDP in our economy is given by:

$$\text{GDP} = \int_{v \in \mathcal{S}} \left[p_h(v) q_h(v) + \mathbb{I}_{\{e(v)=1\}} \xi p_f(v) q_f(v) \right] \phi(v) dv$$

where $p_j(v)q_j(v)$ are sales of firms in state $v = (a, z)$ in market $j \in \{h, f\}$, ϕ is the density function over the state-space, $\mathcal{S}$ corresponds to all (a, z)-pairs for which individuals find it optimal to be entrepreneurs, and $e(v)$ denotes the exporting decision (equal to one if firms choose to export).

On the other hand, we consider the following production price index (PPI):

$$\text{PPI} = \left[\int_{v \in \mathcal{S}} \left[p_h(v)^{1-\sigma} + \mathbb{I}_{\{e(v)=1\}} \frac{\xi^\sigma Y_f}{Y_h} (\xi p_f(v))^{1-\sigma} \right] \phi(v) dv \right]^{\frac{1}{1-\sigma}}$$

which inherits the CES structure of the final goods' price index, and assigns a higher weight to export prices according to the size of the foreign market relative to the domestic market.

Finally, we plug the entrepreneurs' optimal prices and quantities, as well as the rest of their optimal choices, to express aggregate real GDP as an aggregate production function:

$$\text{Real GDP} = \text{TFP } K^\alpha N^{1-\alpha}$$

where $K = \int_{v \in \mathcal{S}} k(v)\phi(v)dv$, $N = \int_{v \in \mathcal{S}} n(v)\phi(v)dv$, and TFP is a function of equilibrium objects that we describe below.

Frictionless economy In the frictionless economy, aggregate TFP is given by:

$$\text{TFP} = \left[\int_{v\in\mathcal{S}} \Phi(v) z(v)^{\sigma-1} \phi(v) dv\right]^{\frac{1}{\sigma-1}} \tag{2}$$

where $\Phi(v) = \left[1 + \mathbb{I}_{\{e(v)=1\}} \frac{\tau^{1-\sigma}\xi^{\sigma} Y_f}{Y_h}\right]$. This expression can be intuitively interpreted as an index across the productivity levels of all the entrepreneurs in the economy, where the individual productivity levels are weighted by the share of entrepreneurs in each element $v \in \mathcal{S}$ of the state space as well as by the markets served at each such state.

In a closed economy, we have that $\Phi = 1$ and, hence, aggregate TFP simply consists of a geometric average across productivity levels, scaled by the measure of entrepreneurs, and weighted by the share of entrepreneurs at each point of the state space. In an open economy, as some firms choose to export, aggregate real GDP increases even if there is no change in aggregate labor and capital: international trade increases aggregate output by leading to an increase in aggregate TFP, as $\Phi(v)$ is higher among firms that export.

Then, a reduction in international trade barriers increases aggregate TFP through two channels. On the one hand, a reduction of τ increases aggregate TFP by increasing the amount exported, as captured by an increase in $\Phi(v)$ among firms that export. On the other hand, a trade liberalization can increase aggregate TFP by increasing the share of firms that export.[5]

Financial frictions economy We now examine what determines aggregate TFP in the economy with financial frictions. Following the same steps as in the previous case, we find that aggregate TFP is given by:

$$TFP = \left[\int_{v\in\mathcal{S}} \Phi(v) z(v) \left[\tfrac{r+\delta}{r+\delta+\mu(v)}\right]^{\alpha(\sigma-1)} \phi(v) dv\right]^{\frac{1}{\sigma-1}} \left[\frac{\int_{v\in\mathcal{S}} \Phi(v) z(v)^{\sigma-1} \left[\frac{r+\delta}{r+\delta+\mu(v)}\right]^{\alpha(\sigma-1)} \phi(v) dv}{\int_{v\in\mathcal{S}} \Phi(v) z(v)^{\sigma-1} \left[\frac{r+\delta}{r+\delta+\mu(v)}\right]^{\alpha(\sigma-1)+1} \phi(v) dv}\right]^{\alpha} \tag{3}$$

where, as before, $\Phi(v) = \left[1 + \mathbb{I}_{\{e(v)=1\}} \frac{\tau^{1-\sigma}\xi^{\sigma} Y_f}{Y_h}\right]$, and $\mu(v)$ denotes the Lagrange multiplier on the borrowing constraint. The first term of this expression captures distortions to the aggregate production price index due to financial frictions, while the second term captures the effect of financial constraints on the effective productivity of the aggregate physical capital installed.

Following our discussion in the previous subsections, financial frictions distort aggregate TFP through three channels. First, distortions to occupation decisions affect the set of in-

[5] To the extent that general equilibrium effects lead to an increase in the share of individuals that choose to be entrepreneurs, this may be an additional channel through which a trade liberalization increases aggregate TFP.

dividuals $\mathcal{S}$ that choose to be entrepreneurs in this economy. Second, distortions to firms' export decisions $e(v)$ affect the terms $\Phi(v)$ above. Finally, distortions to firms' production decisions are captured by the Lagrange multipliers $\mu(v)$, reducing the contribution of constrained entrepreneurs to the above measure of aggregate productivity. As we show below, financial frictions reduce aggregate TFP through these three channels.

TFP losses from misallocation To measure the TFP losses from misallocation due to financial frictions, we consider three alternative statistics that correspond to the three channels described above through which financial frictions distort aggregate TFP.

First, we measure the TFP losses from misallocation through distortions along the intensive margin. To do so, we contrast aggregate TFP in the economy with financial frictions with a counter-factual level of aggregate TFP which abstracts from distortions to firms' production decisions along the intensive margin. In particular, we compute this counter-factual level of aggregate TFP applying Equation 3 using the optimal occupation and export decisions from the economy with financial frictions but setting all Lagrange multipliers $\mu(v)$ to equal zero. We denote this level TFP as $\text{TFP}_{\text{Scale}}$, and compute the TFP losses from misallcation as $1 - \frac{\text{TFP}}{\text{TFP}_{\text{Scale}}}$. While this level of TFP is not necessarily consistent with a competitive equilibrium of the economy, it provides an intuitive and easy-to-compute measure of the distortions introduced by financial frictions.

Second, we measure the TFP losses from misallocation through distortions along the intensive margin as well as on exporting decisions. To do so, we first compute the optimal exporting decisions in the absence of financial constraints $e_{\text{frictionless}}$ given the equilibrium prices and aggregate quantities from the baseline economy. Then, as above, we compute the counter-factual level of aggregate TFP applying Equation 3 using the optimal occupation decisions from the economy with financial frictions, but evaluating it with export policy function $e_{\text{frictionless}}$ and setting all Lagrange multipliers $\mu(v)$ to equal zero. We denote this level TFP as $\text{TFP}_{\text{Scale,ExportEntry}}$, and compute the TFP losses from misallcation as $1 - \frac{\text{TFP}}{\text{TFP}_{\text{Scale,ExportEntry}}}$.

Finally, we measure the TFP losses from misallocation through distortions along the intensive margin, exporting decisions, and occupation decisions. To do so, we first compute the optimal occupation decisions in the absence of financial constraints, as encoded in the set of entrepreneurs $\mathcal{S}_{\text{frictionless}}$ given the equilibrium prices and aggregate quantities from the baseline economy. Then, as above, we compute the counter-factual level of aggregate TFP applying Equation 3 using the occupation decisions encoded in $\mathcal{S}_{\text{frictionless}}$, export policy function $e_{\text{frictionless}}$, and setting all Lagrange multipliers $\mu(v)$ to equal zero. We denote this level TFP as $\text{TFP}_{\text{Scale,ExportEntry,FirmEntry}}$, and compute the TFP losses from misallcation as

$1 - \frac{\text{TFP}}{\text{TFP}_{\text{Scale,ExportEntry,FirmEntry}}}$.

4 Quantitative analysis

In this section, we study the quantitative implications of our model. We calibrate it to match key moments of plant-level and aggregate data and investigate the extent to which financial frictions distort the allocation of resources after a trade liberalization.

To do so, we contrast the stationary equilibrium of the economy before and after a trade liberalization. We compute these equilibria under different degrees of financial frictions, therefore allowing us to study the interaction between financial constraints and the reduction of international trade costs.

Moreover, to understand the role played by the different margins distorted by financial constraints, we recompute the results when the distortions on each of these are sequentially switched off: the intensive margin, firms' export entry and exit decisions, and firms' entry and exit decisions.

4.1 Calibration

Data We calibrate the model using plant-level data from the Chilean Annual Manufacturing Survey (ENIA), collected by the National Institute of Statistics (INE) for the years 1995 to 2007. The survey collects longitudinal data on all plants with more than ten workers, and provides information on foreign and domestic sales, which constitute our main interest.

We exclude observations with negative or missing sales in the domestic or foreign markets, as well as those with zero or missing total sales. We also exclude observations from the following International Standard Industrial Classification (ISIC) Revision 3 categories given their large dependence on natural resource extraction: category 2720 (manufactures of basic precious and non-ferrous metals), and category 2411 (manufactures of basic chemicals, except fertilizers and nitrogen compounds). Our empirical results are robust to the inclusion of these categories.

Calibration We divide the parameter space into two groups. The parameters in the first group are predetermined, while those in the second group are calibrated to match key moments of the data.

The first group of parameters consists of γ, σ, δ, α, and r. We set the risk aversion parameter, γ, to 2 and the elasticity of substitution across varieties, σ, equal to 4. These

Table 1: Parameterization

Predetermined		Calibrated	
γ	2	F	2.00
σ	4	τ	4.91
δ	0.06	ρ_z	0.93
α	0.33	σ_ε	0.18
r	0.06	β	0.80
		θ	0.34

values fall well within the values used in previous studies.[6] We follow Kohn et al. (2016a) and set $\delta = 0.06$, and $\alpha = 0.33$. Finally, we set the real interest rate to 0.06.[7]

The second group of parameters consists of the fixed cost of exporting, F; the variable export cost, τ; the first-order autocorrelation and standard deviation of productivity shocks, ρ_z and σ_ε; the subjective discount factor, β; and the collateral constraint parameter, θ. We choose them to match the following moments: (i) the share of exporters; (ii) aggregate exports-to-value-added; (iii) the ratio between the average sales of exporters and the average sales of non-exporters; (iv) the exit rate of firms; (v) net exports-to-value-added, averaged over the period 1995 to 1999, and (vi) the credit-to-value-added ratio. We compute target moments (i) to (v) using the Chilean plant-level data described above and aggregate data. For (vi), we obtain the total external finance from *Superintendencia de Bancos e Instituciones Financieras de Chile*,[8] and sales from Chilean plant-level data.

Table 2: Target moments

	Data	Model
Share of exporters	0.21	0.20
Exports / Value added	0.25	0.24
Average exporter sales premium	7.18	7.31
Firms exit rate	0.10	0.10
Net exports / Value added	0.00	0.00
Credit / Value added	0.33	0.32

[6] See Guvenen (2006), Blundell et al. (1993) for the intertemporal elasticity of substitution, and Broda and Weinstein (2006) for the elasticity of substitution across varieties, σ.

[7] In addition, we normalize the exogenous variables by setting $p_m = 1$, $P_f = 1$ and $Y_f = 10$.

[8] Total credit balances for manufactures, corresponding to the sectors in our plant-level data.

Calibration strategy The parameters that we use in our calibration are presented in Table 1, while the moments targeted and their model counterparts are presented in Table 2.

To calibrate the model we follow a Simulated Method of Moments approach. We choose the parameters to minimize the objective function MWM', where M is a row vector of the log-difference between each target moment and its model counterpart. W is a weighting matrix that allocates the same weight to each of the cross-sectional moments (i) to (vi). As observed in Table 2, the model matches the target moments almost exactly.

Identification While all parameters affect each of these moments, we provide a heuristic argument for thinking about the mapping between the calibrated parameters and the target moments. The discount factor β affects the net exports-to-value-added ratio.[9] The iceberg trade cost parameter τ determines the extent to which sales abroad are costlier than domestic sales, thus affecting the ratio of exports-to-value-added. The volatility of the idiosyncratic productivity process σ_ε allows us to match the exporter size premium, by affecting the dispersion between high and low productivity firms. Finally, parameter F allows us to match the share of exporters, θ allows us to match the credit to sales ratio, and ρ_z allows us to match the exit rate of firms.

4.2 Misallocation in the baseline economy

In this section, we analyze the effects of financial frictions in the baseline calibration of the economy, as parameterized in Table 1.

Panel A of Table 3 shows that agents in the baseline economy can borrow up to a maximum of 33.7% of the value of their capital stock —as implied by the estimated value of θ—, which represents approximately 46.7% of their net worth. As described above, this tightness of the borrowing constraint results from choosing θ to target the credit-to-GDP ratio observed in the data. Panel B shows that in the economy with financial frictions 11.6% of agents decide to operate a firm and 20.5% among them decide also to export. We now analyze the extent to which credit constraints distort firm-level decisions.

Panel C shows that firms are severely constrained in the stationary equilibrium of this economy: Almost 88% of the firms do not operate at their unconstrained optimal scale due to the impact of financial frictions. Moreover, among these firms, average profits are, ceteris paribus, 39% lower than they would be in the absence of these distortions. Credit frictions

[9] In our calibration, the discount factor β is equal to 0.80, which is a relatively low value. In our model firms are infinitely lived, but in models in which firms face a death probability every period (for instance, Arellano et al., 2012), the effective rate at which firms discount the future is around 0.86, a value close to ours.

Table 3: Baseline economy: Financial frictions and misallocation

	Panel A: Financial development
Max leverage (d/k)	33.7%
Credit / GDP	32.3%
	Panel B: Firms and exporters
Share of firms	11.6%
of which: Share of exporters	20.5%
	Panel C: Financial frictions
Intensive margin	87.6%
Profit losses due to FF	38.8%
Extensive margin (Export entry)	42.4%
Extensive margin (Firm entry)	20.6%
	Panel D: TFP losses due to misallocation
Scale	11.1%
Scale and export entry	16.4%
Scale, export entry, and firm entry	25.8%

Notes: This table shows statistics for the calibrated economy with parameters in Table 1. *Intensive margin* is the share of firms that have profits less than the unconstrained optimum due to financial frictions. *Profit losses due to FF* are the average profit losses of firms constrained in the intensive margin, as a percentage of the unconstrained optimum profits. *Extensive margin (Export entry)* is the share of firms that do not export due to the financial constraints. *Extensive margin (Firm entry)* is the share of individuals that do not choose to be a firm due to financial frictions. (i) *Scale*, (ii) *Scale and export entry*, and (iii) *Scale, export entry, and firm entry* report TFP losses due to financial frictions in the intensive margin (i), intensive and extensive margin in export entry (ii), and also adding losses due to the extensive margin in production entry (iii), respectively.

also have a substantial impact on decisions along the extensive margin. On the one hand, they severely distort export participation decisions: 42% of the firms would, ceteris paribus, choose to export in the absence of credit constraints. On the other hand, financial frictions also have a significant impact on occupation decisions: 23% of the workers would choose to be entrepreneurs in the absence of these distortions.

In Panel D of Table 3, we investigate the aggregate implications of financial frictions in this economy. Following our analysis from the previous section, we focus on their impact on aggregate total factor productivity (TFP). The first row of this panel reports the TFP losses from misallocation due to distortions to firms' optimal scale, as defined above. We

find that TFP would be 11 percent higher if firms could produce and sell as much as they wanted, while keeping export and occupation choices fixed at those from the equilibrium of the baseline model. If firms were also allowed to adjust their export decisions to those they would choose in the absence of financial frictions, TFP would be an additional 5 percentage points higher (16 percent higher than the baseline), as reported in the second row of this panel. Finally, we find that TFP would be an additional 10 percentage points higher (26 percent higher than the baseline) if individuals were able to become firms as they would do in the absence of credit constraints. Therefore, we find that TFP is 26 percent lower than it would otherwise be due to the impact of financial constraints on firms' production, export, and entry decisions is equal to 26 percent.

Notice that the losses from misallocation reported in Panel D are all static and partial equilibrium measures: in response to the relaxation of borrowing constraints, the equilibrium wage and real exchange rate, as well as firms' asset accumulation decisions would adjust, partially offsetting these effects. Nonetheless, the findings above show that firms' decisions in the baseline economy are heavily affected by financial constraints. Given their impact on firms' export decisions, these findings suggest that credit frictions may also affect the aggregate implications of lowering international trade barriers.

4.3 Aggregate effects from trade and financial development

We now investigate the extent to which the aggregate implications of trade liberalizations depend on the degree of financial development. To do so, we model trade liberalizations as a reduction in variable trade costs; in particular, we consider a 25% decline in τ. We contrast the effects of this trade reform across four economies that only differ in the severity of the financial frictions. These economies are: (1) a *Low credit* economy where $\theta = 0.03$ and total credit equals 3% of GDP; (2) the *Baseline* economy, with $\theta = 0.34$ and credit-to-GDP equal to 32%; (3) a *High credit* economy, where $\theta = 0.84$ and credit-to-GDP equals to 112%; and (4) a *Frictionless* economy, where firms are not subject to the borrowing constraint, in which the credit-to-GDP ratio is equal to 183%.[10]

Our goal is to understand the extent to which the impact of trade liberalizations on aggregate outcomes depends on the economy's degree of financial development. Thus, we focus on the impact of trade liberalization on GDP, exports, and TFP, and examine the extent to which these effects depend on the tightness of the credit constraints.

[10] See Table 7 in the Appendix to further details about the initial stationary equilibria of these economies.

Table 4: Aggregate effects of trade liberalization

	Low credit	Baseline	High credit	Frictionless
GDP	3.9%	3.9%	3.6%	3.0%
Exports	50.6%	48.7%	43.8%	37.5%
Domestic sales	-11.5%	-10.7%	-9.4%	-8.6%
Exports / GDP	45.0%	43.1%	38.8%	33.5%
Consumption	4.0%	4.0%	3.8%	3.7%
Real exchange rate	-11.1%	-11.3%	-12.2%	-13.7%
Wage	4.2%	4.2%	3.8%	3.9%
Share of firms	-11.5%	-10.7%	-10.2%	-11.8%
Share of exporters	51.1%	47.6%	44.7%	45.4%

Aggregate effects of trade liberalization We first investigate the effects of a trade liberalization in the baseline economy. As shown in Table 4, in response to the decrease in τ, exports increase almost by 50%, while domestic sales decrease by 11% as firms reallocate sales from the domestic market to the foreign market. As a result, the ratio of exports to GDP increases by 43% while GDP increases by 3.9%. Notice that the reduction of international trade barriers leads to a 4% increase of consumption, which is driven by firms' higher profits following the trade liberalization. The increase in aggregate economic activity described above bids up the wage by 4.2%, as the demand for labor increases. At the same time the decline in domestic sales leads to an increase in the price of the final good, and consequently an 11% real appreciation. Finally, the increase in the real wage leads more agents to become workers (the share of firms decreases by 11%), while the real appreciation does not counteract the effect on the share of exporters which increases almost as much as exports over GDP. Note that the decline in the number of firms following a trade liberalization is as in Melitz (2003): in the new stationary equilibrium, there are less firms given that entrepreneurs with low-productivity and/or low-assets decide to become workers due to the higher wage.

We now examine the extent to which these effects depend on the tightness of the borrowing constraint. On the one hand, notice that the effects of the trade liberalization in the *Low Credit* economy look close to those in the *Baseline*. As illustrated in Panel C of Table 7 of the Appendix, this is explained by the similarity of these economies in the fraction of firms that are constrained both on the intensive and extensive margins.

On the other hand, the *High Credit* economy has half as many firms that are constrained

on the extensive margin and approximately two-thirds of the number of firms constrained on the intensive margin — and whose profit losses are, on average, half as large. Therefore, we find that the aggregate implications of the trade liberalization that we consider has larger differences with those implied by the *Baseline*. In particular, GDP and exports increase by less (3.6% and 44%, respectively) than in the baseline economy, leading to a lower increase in the share of exports over GDP and the share of exporters.

Surprisingly, in this economy aggregate consumption of the final good and the real wage increase by less (both increase by 3.8%; vs. 4% and 4.2%, respectively, in the baseline). These results are in line with the results corresponding to the frictionless economy, where, following a trade liberalization, GDP increases by only 3%, aggregate consumption increases by 3.7%, and the real wage by 3.9%. These results stand in stark contrast to the results reported by Brooks and Dovis (2011) and Caggese and Cunat (2013), who find that a trade liberalization has a larger effect on aggregate consumption, wages and TFP in an economy without financial frictions than in one subject to borrowing constraints.

GDP and TFP growth To investigate further the drivers of these results, we now turn to study the sources of the increase in GDP following a trade liberalization. In particular, we now investigate the extent to which these are accounted by changes in factor inputs or TFP.

Table 5: Trade liberalization: Growth decomposition

	Low credit	Baseline	High credit	Frictionless
Real GDP	3.9%	3.9%	3.6%	2.9%
Labor in production	-0.3%	-0.3%	-0.2%	-0.8%
Capital	4.7%	4.5%	3.6%	3.0%
Real TFP	2.5%	2.6%	2.5%	2.4%

As shown in Table 5, in the baseline economy, the change in GDP after the trade liberalization is explained by a 4.5% increase of capital and a 2.6% increase in TFP. Following the trade liberalization, not only can firms now finance a larger stock of capital with their higher profits, but the large increase in the number of exporters also contributes to the increase of TFP (see Section 3.3 for details). Meanwhile, labor inputs used in production decrease, as more labor is allocated to cover the fixed costs required to export. In the *High Credit* economy, on the other hand, real GDP increases by less, mainly driven by a lower increase in capital (which increases 80% of the increase in the *Baseline*), as firms were already closer

to their unconstrained choices than in the baseline economy. TFP also increases by a sightly lower amount driven by a lower increase in the number of exporters. Finally, in the frictionless economy, real GDP, capital, and TFP also increase by less than in the previous two economies.

TFP losses due to misallocation To better understand the lower increase in TFP, we now analyze whether the extent to which firms are affected by financial constraints changes with the trade liberalization.

Panel A in Table 6 shows the changes in the share of constrained firms and in the extent to which they are constrained for the four economies considered above. Contrasting the *Baseline* economy with the *High Credit* economy, we observe that following a trade liberalization, the share of firms constrained on the intensive margin decreases in the former, while it increases in the latter. This is consistent with the explanation provided above: by allowing them to accumulate more assets through higher profits, the trade liberalization allows firms in the more financially constrained economy to increase their scale relatively more. Furthermore, in both economies the average profit losses, among constrained firms, decrease after the trade liberalization. Instead, the share of constrained firms on the extensive margin of exporting (i.e, the share of firms that would export without borrowing constraints, but decide not to do it in their presence) increases in both economies although the increase is much larger in the economy with a higher share of credit. On the contrary, there is a decrease in the share of workers constrained on the extensive margin, but in the baseline economy the decrease is lower than in the more financially developed economy.

Finally, Panel B of Table 6 shows how the contribution to misallocation of the different margins distorted by financial frictions evolve in response to the trade liberalization. In every case (except the frictionless economy where there is no misallocation either before or after the trade reform), the TFP losses due to misallocation increase in response to the lower trade costs. However, notice that TFP losses increase by more in the economy with higher credit to GDP, consistent with our previous findings. In the *Baseline* economy, there is an increase in the TFP losses due to the lower scale of firms, induced by financial frictions, equal to 3% of the aggregate TFP compared to the case where all firms were unconstrained on the intensive margin but their extensive margin decisions where kept unchanged. Moreover, the losses due to both extensive margins increase by even more (5.4% the export choice and 6.5% when also including losses due to the occupation choice). In the case of the *High Credit* economy, however, the ranking is different, and the misallocation losses due to the extensive margin in the export decisions are the largest.

Table 6: Trade liberalization: TFP losses due to misallocation

	Low credit	Baseline	High credit	Frictionless
	Panel A: Financial constraints			
Intensive constrained	-0.7%	-0.7%	0.7%	0.0%
Profit losses due to FF	-1.4%	-1.5%	-1.3%	0.0%
Extensive constrained (Export entry)	5.8%	8.4%	45.7%	0.0%
Extensive constrained (Firm entry)	-3.3%	-3.8%	-11.4%	0.0%
	Panel B: TFP losses due to misallocation			
Scale	3.3%	3.0%	4.2%	0.0%
Scale & export entry	4.7%	5.4%	15.7%	0.0%
Scale, export & firm entry	6.7%	6.5%	7.6%	0.0%

5 Conclusions

Under-developed financial markets in emerging economies affect capital allocation and induce TFP losses due to distortions to firms' decisions. In this paper, we investigate the extent to which financial frictions shape the aggregate effects of a trade liberalization like the one that many Latin-American countries have undergone in the recent decades through their impact on TFP and capital misallocation.

We model a small open economy populated with heterogeneous entrepreneurs who differ in their productivity and are subject to financing constraints in which entrepreneurs choose whether to be workers, operate a firm that produces only for the domestic market, or operate a firm that sells at both foreign and domestic markets. We calibrate the model to Chilean plant-level data and show how financial frictions distort each of these channels and, as a result, aggregate TFP.

We then investigate how the presence of financial constraints affects the output and TFP gains from trade liberalization. We find that lowering trade barriers has a stronger positive effect in less financially developed economies. The higher profits that result from the trade liberalization allow firms to accumulate assets and relax their credit constraint, which is particularly valuable in economies where firms are severely financially constrained.

Appendix

Table 7: Financial development (levels in initial steady state)

	Low credit	Baseline	High credit	Frictionless
	Panel A: Financial development			
Max leverage (d/k)	3.4%	33.7%	84.3%	∞
Max leverage (d/a)	3.3%	46.7%	388.7%	–
Credit / GDP	2.8%	32.3%	112.2%	183.2%
	Panel B: Firms and exporters			
Share of firms	11.8%	11.6%	11.5%	11.9%
Share of exporters	20.5%	20.5%	19.9%	21.9%
	Panel C: Financial frictions			
Intensive margin	91.4%	87.6%	69.0%	0.0%
Profit losses due to FF	43.8%	38.8%	24.5%	0.0%
Extensive margin (Export entry)	47.4%	42.4%	18.9%	0.0%
Extensive margin (Firm entry)	26.9%	20.6%	8.3%	0.0%

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