Financial Development and Trade Liberalization*

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Abstract

We investigate the extent to which frictions in financial markets affect the gains from trade liberalization. We study a small open economy populated with entrepreneurs heterogeneous in productivity and net worth who can trade internationally and are subject to financing constraints. We calibrate the model to match key features of Colombian plant-level data and use it to quantify the role of credit frictions in shaping the economy's response to trade liberalization. We find that frictions in financial markets slow down the response of capital and output in the aftermath of trade liberalization; in contrast, the dynamics of exports adjustment are largely independent of financial development. We document evidence consistent with these findings for the Colombian trade liberalization in the early 1990s.

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1 Introduction

Trade liberalization is often suggested as a policy to promote economic growth and development. On the one hand, it has been shown to foster real GDP growth by encouraging the accumulation of physical capital (Wacziarg and Welch 2008; Sachs et al. 1995; Ravikumar et al. 2017). On the other hand, trade liberalization has been pointed as a source of productivity growth through the reallocation of resources within and across industries (Melitz 2003; Pavcnik 2002) as well as through quality upgrading (Fieler et al. 2018). Despite these potential benefits, trade liberalization is often resisted as a policy to promote economic development, particularly in less developed economies. In this paper we investigate whether these economies have less to gain from trade liberalization.

A salient feature of developing economies that may limit the effects of lowering international trade barriers are frictions in financial markets (Caggese and Cunat 2013; Brooks and Dovis 2011). Financial frictions may limit the degree to which firms are able to accumulate capital in response to the reduction of international trade barriers. Furthermore, limited access to credit may lead to an inefficient reallocation of resources following trade liberalization, preventing economies from attaining the higher productivity gains that would otherwise accrue. However, easier access to foreign markets may allow firms to accumulate assets faster, through higher profits, thus relaxing financing constraints. The goal of this paper is to investigate the extent to which frictions in financial markets affect the dynamics of the economy following a trade liberalization.

We begin by documenting a novel set of empirical facts on the relationship between financial development and the dynamics of international trade flows following trade liberalization. First, we use cross-country data to document the dynamics of the exports-to-GDP ratio following trade liberalization (as identified by Wacziarg and Welch 2008). We contrast these dynamics across countries with different levels of financial development as proxied by their credit-to-GDP ratios. We document that the exports-to-GDP ratio increases less and more gradually in less-financially-developed economies.

Then, we use Colombian plant-level data to examine the dynamics of exports adjustment in the aftermath of its trade liberalization in the early 1990s. We identify the role of frictions in financial markets by contrasting the dynamics of exports adjustment across industries that differ in their dependence on external finance to run their operations, following Rajan and Zingales 1998. We document that the elasticity of exports to changes in tariffs was lower on impact as well as over the decade following trade liberalization across industries that relied relatively more on external finance.

These findings suggest that frictions in financial markets may significantly affect the ag-

gregate dynamics following trade liberalization. We investigate the extent to which this is the case using a quantitative general equilibrium model estimated to match salient features of plant-level data from Colombia prior to the trade liberalization of the early 1990s. In particular, we study a small open economy populated by a large number of individuals that choose endogenously whether to be workers or entrepreneurs. Individuals are subject to idiosyncratic and time-varying shocks to entrepreneurial productivity. Entrepreneurs produce differentiated varieties and choose whether to produce a tradable or non-tradable good. Production relies on physical capital and labor subject to their idiosyncratic productivity, as well as on intermediate inputs if producing a tradable good.

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. Variable costs consist of iceberg trade costs as well as of tariffs, which is the policy instrument through which we study the impact of trade liberalization. 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 decisions.

We start by analyzing the mechanisms through which financial frictions affect international trade flows in our model. We qualitatively describe the equilibrium distortions induced by financial constraints, and explain how financial frictions distort occupational choice, production, and export-entry decisions. Then, we illustrate how the agents' response to a reduction of international trade barriers depends on the magnitude of the financial constraints.

We then use our model to quantify the extent to which frictions in financial markets affect aggregate dynamics following trade liberalization. To do so, we begin by estimating our model to match salient features of Colombian plant-level data over the period prior to the trade liberalization of the early 1990s.

The case of Colombia is particularly interesting for our purposes given that the Colombian government undertook an ambitious trade reform program in the early 1990s, in the context of a financially under-developed economy. By the end of 1990, the government had eliminated the majority of non-tariff import barriers, while reducing average import tariffs from 32 to 12 percent between 1990 and 1992. Yet, despite the impressive scope of trade liberalization there was substantial skepticism whether full gains from trade liberalization would materialize, with the World Bank pointing out to lack of financial development as the main potential

impediment.[1]

We then use our quantitative general equilibrium model estimated to the pre-reform period 1982–1988 to investigate the impact of reducing import tariffs as in Colombia in the early 1990s. In particular, we examine the dynamics of the economy following a one-time unexpected and permanent reduction of imports tariffs from 32 percent to 12 percent.

We find that lower import tariffs lead to a gradual increase of aggregate consumption, as individuals increase their consumption of imports while reducing their demand for domestic goods. Thus, lower import tariffs increase the degree of foreign competition faced by domestic producers, leading to a decline in domestic sales of tradable and non-tradable goods. On the other hand, lower import tariffs reduce the cost of imported intermediate inputs, which leads to a reduction in the price of tradable goods and to a depreciation of the real exchange rate. These changes, thus, lead to an exports boom.

We then focus on firm-level dynamics in order to better understand how financial frictions shape the aggregate dynamics through firms' adjustments. In particular, we analyze how firms' intensive and extensive margin decisions are affected by their initial levels of debt. We focus on firms that export for at least 6 consecutive periods, condition on the productivity level and contrast the observed firms' dynamics to their dynamics in a counterfactual case in which no trade liberalization occurs. We find that firms that hold positive savings in the period before the trade liberalization increase their real exports, capital, and total real sales more than their counterparts with debt, as observed in the data.

Next, we investigate how trade liberalization affects the probability of firms of becoming exporters conditional on their financial position. We observe that in the period of the trade liberalization, all firms increase their probability of exporting conditional on their productivity level. What is more interesting, however, is that more constrained firms increase by more their export probability: While a firm that was unconstrained in the initial period has a 2 percentage points higher probability of being an exporter in the period of the trade liberalization, this number increases to 7 percentage points for a firm in the top 10% of financially-constrained firms. This suggests that trade liberalization has the strongest positive effects on export probability of the most constrained exporters.

Finally, we investigate the extent to which frictions in financial markets account for the aggregate dynamics following trade liberalization. We contrast our economy with a counterpart featuring high financial development, as measured by more relaxed borrowing constraints. We find that frictions in financial markets slow down the response of capital

[1] "Financial markets in Colombia remain characterized by lack of credit and under-developed capital markets. (...) It raises concern that the export response expected from trade liberalization under Economic Modernization Plan is seriously constrained by the existing financial sector." Export Development Project, The World Bank Staff Appraisal Report for Colombia, 1992.

and output in the aftermath of trade liberalization. In contrast, the dynamics of exports adjustment are largely independent of financial development.

In the next section, we discuss the empirical evidence. Then we set up our model in Section 3. In Section 4 we discuss the main mechanisms. Following sections present the quantitative results. Section 7 concludes.

2 Empirical evidence

In this section, we investigate empirically the role of finance in accounting for the dynamics of exports after trade liberalization. First, we use cross-country data to contrast the dynamics of exports in these episodes across countries who differ in financial development. Then, we use industry-level data from Colombia to contrast the dynamics of exports across industries which differ in their dependence on external finance, following the substantial reduction of international trade barriers during the 1980s and early 1990s.

2.1 Cross-country

We begin by investigating the role of financial development on the dynamics of aggregate exports across countries. To do so, we contrast the dynamics of the exports-to-GDP ratio following episodes of trade liberalization across countries that differ in their level of financial development.

First, we identify trade liberalization episodes following Wacziarg and Welch (2008) and Sachs et al. (1995), who define a country to be open to trade in a given year if all of the following conditions hold simultaneously: (i) average tariff rates are below 40 percent, (ii) non-tariff barriers cover less than 40 percent of trade, (iii) the black- market exchange- rate premium is less than 20 percent (if such a market exists), (iv) the government does not monopolize major exports, and (v) the country is not socialist. Following them, we identify the year in which trade is liberalized as the first one in which all of these conditions are met simultaneously.

Second, we classify countries according to their level of financial development based on their aggregate credit-to-GDP ratio, as measured by Beck et al. (2010). In particular, we restrict attention to "private credit by deposit money banks and other financial institutions" relative to GDP. We partition countries into two groups based on their credit-to-GDP ratio in the trade liberalization period. Countries with credit-to-GDP below the median (across countries in the trade liberalization period) are classified as "financially underdeveloped", while countries with credit-to-GDP above the median are classified as "financially devel-

oped."

Finally, we use cross-country data on exports and GDP from the Penn World Tables to contrast the dynamics of the real exports-to-GDP ratio between financially developed and underdeveloped countries following trade liberalization episodes. We restrict attention to countries with non-missing exports-to-GDP data in each of the five years prior opening up to trade as well as in each of the ten years after it. We end up with a balanced panel of 32 countries in total.

The results are reported in Figure 1. The solid lines report the average change of the exports-to-GDP ratio relative to the trade liberalization period across all countries belonging to the respective financial development group. The dashed lines report the data after local polynomial smoothing. We label the lines corresponding financially developed countries as "High Credit/GDP," and those corresponding to financially underdeveloped countries as "Low Credit/GDP."

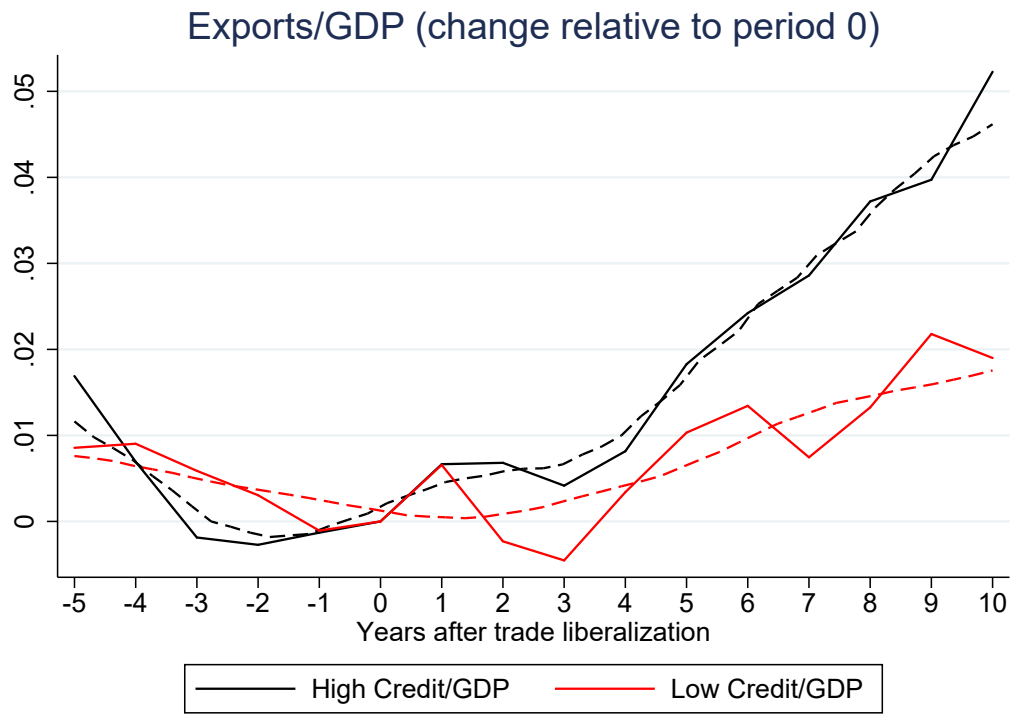


Figure 1: Export dynamics after trade liberalization, by financial development

On the one hand, we observe that in the years prior to trade liberalization, the exports-to-GDP ratio remained relatively unchanged across both country groups. On the other hand, we find that the exports-to-GDP ratio increases gradually across both country groups a few years after trade liberalization. These observations suggest that our approach to

identifying trade liberalization episodes is indeed successful at capturing structural changes in the dynamics of the exports-to-GDP ratio.

Moreover, we crucially observe that the exports-to-GDP ratio increases considerably more in financially developed economies. In particular, the exports-to-GDP ratio increases by 5 percentage points on average across these countries after ten years of opening up to trade. In contrast, exports-to-GDP only increase by approximately 2 percentage points on average across financially underdeveloped economies ten years after trade liberalization. In this paper we investigate the role of frictions in financial markets in accounting for the dynamics of exports across these country groups following trade liberalization.

2.2 Colombia 1980-2002

While the cross-country analysis suggests that financial underdevelopment might slow down the growth of exports following trade liberalization, the observed relationship might also be accounted by other systematic differences between financially developed and underdeveloped economies. Thus, we now investigate the role of financial factors in accounting for the dynamics of exports following trade liberalization by examining the cross-sectional implications of a specific trade liberalization episode.

To do so, we focus on Colombia's substantial reduction of import tariffs between 1988 and 1992: average tariffs fell from 32 percent in 1988 to 12 percent in 1992, staying approximately constant thereafter.[2] In particular, the trade reforms undertaken took two stages. In the first phase, that was completed by the end of 1990, the government eliminated majority of non-tariff import barriers (accompanied by a modest reduction in import tariffs). In the second phase, in 1991, the government reduced the tariffs to 11.7 percent. Thus between 1990 and 1992, the average un-weighted import tariffs fell from around 32 to 12 percent.

Despite the impressive scope of trade liberalization, there was substantial skepticism about whether gains from trade liberalization will fully materialize, with the World Bank pointing out to lack of financial development as the main impediment. According to a World Bank report on Colombia released in 1992, "financial markets in Colombia remain characterized by a continuing lack of long-term credit and under-developed capital markets" while "credit allocation is made overwhelmingly on a collateral basis." The report concludes that "(...) it raises concern that the supply and export response from trade liberalization under EMP is seriously constrained by the existing financial sector (...)". Indeed, the ratio of domestic credit provided by financial sector as a share of GDP stood at 35 percent in

[2]Colombia implemented other deep reforms over this period, such as the Macroeconomic Adjustment Program (1984-1986), the Economic Modernization Plan (adopted in 1990), and the Export Development Program (1992). For more details, see the World Bank document "Export Development Project" (1993).

1992, almost 50 percent lower than the average in Latin America and Caribbean region (see the World Bank's World Development Indicators)

Given the low level of Colombia's financial development, contrasting industries that differ in their dependence on external finance might provide information about the role of financial frictions on export dynamics after trade liberalization. In particular, we study whether finance-intensive industries feature a relatively more gradual adjustment of exports following trade liberalization in contrast to those industries that rely relatively less on external finance.

To do so, we combine industry-level data on Colombian exports and tariffs with information on industries' dependence on external finance. The tariff data is obtained across 4-digit industries from Colombia's National Planning Department while the exports data is from Comtrade for the same 4-digit industries. Finally, we classify industries across external finance dependence based on industry-level data from U.S. public firms (Compustat), following Rajan and Zingales (1998).[3]

We use these data to estimate the elasticity of exports to changes in tariffs over time as well as across industries with different degrees of dependence on external finance. To simplify the analysis, we partition industries into two groups. The first group consists of finance-intensive industries, with external finance dependence above the median across all industries. The second group consists of non-finance-intensive industries, with external finance dependence below the median across all industries.

Then, we estimate the following specification:

$$\ln \frac{\text{Exports}_{i,t}}{\text{Exports}_{i,1988}} = \alpha + \sum_{t=1988}^{2002} (\beta_t + \gamma_t \times \text{High EFD}_{i,t}) \times \text{Year}_t \times \ln \frac{\text{Tariff}_{i,t}}{\text{Tariff}_{i,1988}}$$

where $\ln \frac{\text{Exports}_{i,t}}{\text{Exports}_{i,1988}}$ denotes the log-change of exports in industry i and year t relative to exports of the same industry in year 1988, $\text{High EFD}_{i,t}$ is a dummy variable that is equal to one if industry i is finance-intensive and zero otherwise, Year_t is a dummy that is equal to one in year t and zero otherwise, and $\ln \frac{\text{Tariff}_{i,t}}{\text{Tariff}_{i,1988}}$ denotes the log-change of tariffs in industry i and year t relative to tariffs of the same industry in year 1988.

The elasticity of exports in year t across finance-intensive industries is then given by $\beta_t + \gamma_t$, while the respective elasticity across non-finance intensive industries is given by β_t. We plot these elasticities as well as the aggregate exports elasticity in Figure 2.

On the one hand, we observe that the elasticity of exports to changes in tariffs increases over time across finance-intensive and non-finance-intensive industries as well as in the aggregate. That is, the adjustment of exports to changes in tariffs is gradual.

[3]External finance dependence is measured as the share of capital expenditures not financed via internal cash flows.

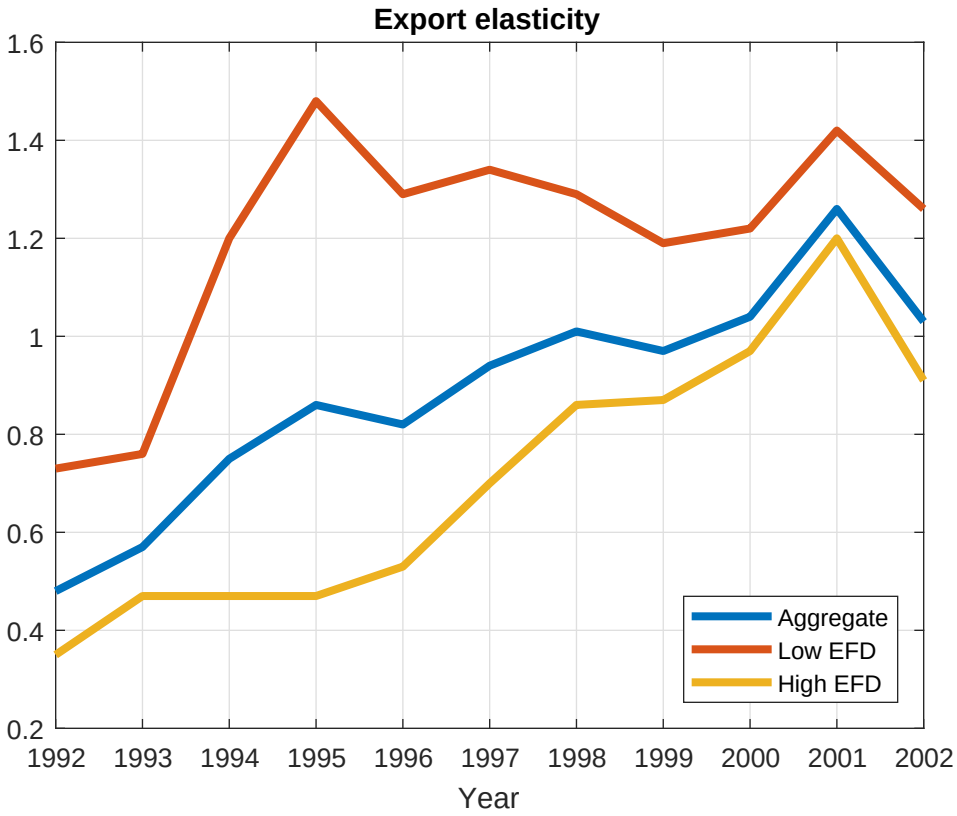


Figure 2: Exports elasticity to tariff changes across industries in Colombia

On the other hand, we observe that the elasticity of exports to changes in tariffs is considerably higher across industries that rely relatively less on external finance. Across these industries, the elasticity of exports is approximately 0.75 in 1992, while the respective elasticity across finance-intensive industries is below 0.40 in 1992. Furthermore, while the elasticity of exports increases across both industry groups, its value across finance-intensive industries remains considerably below its counterpart for non-finance intensive industries over the whole sample.

These findings suggest that differences in the extent to which industries rely on external finance may have slowed down the adjustment of exports in Colombia –and, in particular, for those industries that are intensive on external finance–, following its liberalization of international trade in the late 1980s and early 1990s. In the next sections, we investigate the extent to which this was indeed the case using a quantitative general equilibrium model estimated to match salient features of Colombian plant-level data.

3 Model

We consider a small open economy populated by a unit measure of individuals who choose whether to be workers or entrepreneurs. Entrepreneurs choose whether to operate a firm in a tradable or non-tradable sector; if they choose to produce tradable goods they also decide whether to export or not. The economy also features representative producers of tradable, non-tradable, and final goods.

3.1 Economic environment

3.1.1 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 productivity shocks, described below, conditional on the information set in period zero.

Occupational choice Individuals choose whether to be workers or entrepreneurs. If they choose to be workers, they inelastically supply one unit of labor to entrepreneurs. Entrepreneurs choose whether to produce a tradable or non-tradable differentiated variety; we refer to the former as sector T, and to the latter as sector NT. To operate the firm, every period entrepreneurs have to pay a fixed operation cost F_o in units of labor.

Technology Entrepreneurs produce differentiated varieties by operating a production technology

$$y_t = z_t \left(k_t^{\alpha_j} n_t^{1-\alpha_j} \right)^{1-\varphi_j} m^{\varphi_j},$$

where z_t denotes the entrepreneurs' idiosyncratic level of productivity, k_t is the capital stock, n_t is the amount of labor hired, m_t denotes the intermediate inputs, $\alpha_j \in [0,1]$ is the capital share, $\varphi_j \in [0,1]$ is the sector-specific share of intermediate inputs, $j \in \{T, NT\}$. Labor is hired at a wage rate w_t in units 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 Normal 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 fixed export 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 and is equal to 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 two ad-valorem trade costs: (i) a tariff τ_f charged by the rest of the world on the domestic economy's exports, and (ii) an iceberg trade cost $\tau > 1$ which requires firms to ship τ units for every unit that arrives at destination. τ captures variable costs, other than tariffs, such as shipping costs, foreign marketing costs, or costs due to damages incurred during transit of goods.

Financial markets Individuals have access to financial markets, where they can borrow or save by trading a one-period risk-free bond at real interest rate r, which is taken as given from the rest of the world. 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.[4]

Market structure Entrepreneurs are monopolistically competitive 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 schedules solve the problem of producers of tradable and non-tradable goods, while the demand schedule in the international market is given by the rest of the world.

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 domestic 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 save and consume.

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

At the end of the period, agents observe the following period's productivity shock. With that information they decide whether to be workers or entrepreneurs the next period, and whether to produce tradable or non-tradable varieties. Then, they simultaneously issue new debt and choose their new level of physical capital if they decided to be entrepreneurs.

Entrepreneurs' problem Given this setup, the entrepreneurs' problem at time t in sector $j = \{T, NT\}$ consists of choosing sequences of consumption, c_t, labor, n_t, intermediates, m_t, investment, x_t, current period's export status, e_t, and prices and quantities, $y_{h,j,t}, p_{h,j,t}, y_{f,j,t}, p_{f,j,t}$, at which to sell the varieties in each of the markets (where subscript h denotes domestic market, and subscript f denotes foreign market), in order to maximize their expected utility. In addition to the borrowing constraint described above and the market-specific demand schedules 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 $y_{h,j,t} + \tau y_{f,j,t} = z_t \left(k_t^{\alpha_j} n_t^{1-\alpha_j}\right)^{1-\varphi_j} m_t^{\varphi_j}$.[5] Their budget constraint in period t is given by

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

Workers' problem Given this setup, the workers' problem at time t consists of choosing sequences of consumption c_t and debt-holdings 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:

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

3.1.2 Producers of tradable goods

Producers of tradable goods use varieties from entrepreneurs and the rest of the world as inputs in the production process. To do so, they operate a constant elasticity of substitution (CES) technology with elasticity of substitution $\sigma > 1$. Let the set $\mathcal{S}_T \subset [0,1]$ denote the set of tradable-good producers, and let $\{p_{h,T,t}(i)\}_{i \in \mathcal{S}_T}$ and $p_{m,t}$ be the prices of varieties charged by them and the rest of the world, respectively.[6] Imports are subject to an ad-valorem tariff τ_m. Given these prices, producers of tradable goods choose the bundle of inputs of domestic and imported varieties, $\{y_{h,T,t}(i)\}_{i \in \mathcal{S}_T}$ and $y_{m,t}$, that maximizes their profits. Thus,

[5] Notice that $y_{f,NT,t} = 0$ for nontradables.

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

the problem of tradable good producers is given by

$$\max_{\left\{y_{h,T,t}(i)\right\}_{i\in\mathcal{S}_T},y_{m,t}} Y_{T,t} - \int_{i\in\mathcal{S}_T} p_{h,T,t}(i)y_{h,T,t}(i)di - (1+\tau_m)\xi_t p_{m,t}y_{m,t}$$

subject to

$$Y_{T,t} = \left[\int_{i\in\mathcal{S}_T} y_{h,T,t}(i)^{\frac{\sigma-1}{\sigma}}di + y_{m,t}^{\frac{\sigma-1}{\sigma}}\right]^{\frac{\sigma}{\sigma-1}},$$

where $Y_{T,t}$ denotes the amount of tradable goods produced, and ξ denotes the real exchange rate which is expressed as the price of a foreign final good in units of domestic final goods. The solution to this problem is given by $y_{h,T,t}(i) = [p_{h,T,t}(i)]^{-\sigma} Y_{T,t}$ and $y_{m,t} = [(1+\tau_m)\xi_t p_{m,t}]^{-\sigma} Y_{T,t}$, which are the demand schedules faced by entrepreneurs and the rest of the world, respectively.

3.1.3 Producers of non-tradable goods

Producers of non-tradable goods combine varieties produced by entrepreneurs who operate firms in non-tradable sector. They operate a constant elasticity of substitution (CES) technology with elasticity of substitution $\sigma > 1$. Let the set $\mathcal{S}_{NT} \subset [0,1]$ denote the set of non-tradable-good producers, and let $\{p_{h,NT,t}(i)\}_{i\in\mathcal{S}_{NT}}$ be the prices of varieties charged by them. Given these prices, producers of non-tradable goods choose the bundle of inputs of domestic varieties, $\{y_{h,NT,t}(i)\}_{i\in\mathcal{S}_{NT}}$ that maximizes their profits. Then, the problem of non-tradable good producers is given by

$$\max_{\left\{y_{h,NT,t}(i)\right\}_{i\in\mathcal{S}_{NT}}} Y_{NT,t} - \int_{i\in\mathcal{S}_{NT}} p_{h,NT,t}(i)y_{h,NT,t}(i)di$$

subject to

$$Y_{NT,t} = \left[\int_{i\in\mathcal{S}_{NT}} y_{h,NT,t}(i)^{\frac{\sigma-1}{\sigma}}di\right]^{\frac{\sigma}{\sigma-1}},$$

where $Y_{NT,t}$ denotes the amount of non-tradable goods produced. The solution to this problem is given by $y_{h,NT,t}(i) = [p_{h,NT,t}(i)]^{-\sigma} Y_{NT,t}$.

3.1.4 Producers of final goods

Final good producers purchase tradable and non-tradable goods and aggregate them to produce a final good. To do so, they operate a Cobb-Douglas technology $Y_t = Y_{T,F,t}^{\nu} Y_{NT,F,t}^{1-\nu}$, where $Y_{T,F,t}$ and $Y_{NT,F,t}$ denote the tradable and non-tradable goods used as inputs, ν denotes

the share of tradables used in the production of final goods, and Y_t denotes the final good produced. Then, given prices $P_{T,t}$ and $P_{NT,t}$ of tradable and non-tradable goods, the problem of final good producers is given by:

$$\max_{Y_t, Y_{T,F,t}, Y_{NT,F,t}} Y_t - P_{T,t} Y_{T,F,t} - P_{NT,t} Y_{NT,F,t}$$

subject to

$$Y_t = Y_{T,F,t}^{\nu} Y_{NT,F,t}^{1-\nu}$$

3.1.5 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, $y_{f,t} = [(1+\tau_f)p_{f,t}]^{-\sigma} Y_{f,t}$, 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 $p_{m,t} = \bar{p}_m$.

3.2 Recursive formulation

Let $a = k - \frac{d}{1+r}$ be the net worth that the agents choose to save for the current period.[7] Then we can reformulate the agents' problem in terms of two individual state variables: net worth, a, and idiosyncratic productivity, z.

Let $g(a,z)$ be the value function for an agent with net worth a and productivity z who decides whether he wants to be an entrepreneur (i.e. operate a firm) in the tradable sector, be an entrepreneur in the nontradable sector, or be a worker next period. For each of these cases, let $g(a,z,T)$, $g(a,z,NT)$ and $g(a,z,W)$, be the value function for the agent that chose to be a tradable firm, a nontradable firm or a worker, respectively. Then,

$$g(a,z) = \max_{s \in \{W,NT,T\}} g(a,z,s)$$

For each $s \in \{W, NT, T\}$, we can write the consumption-saving decision problem recur-

[7] We assume $a \geq 0$.

sively as,

$$
\begin{aligned}
g\left(a,z,s\right) = & \max_{c,a'} \frac{c^{1-\gamma}}{1-\gamma} + \beta \mathbb{E}_{z'}\left[g\left(a',z'\right)\right] \\
& \text{subject to} \\
& c + a' = (1+r)a + \mathbb{I}_{\{s=NT\}}\pi_{NT}(a,z) + \mathbb{I}_{\{s=T\}}\pi_{T}(a,z) + \mathbb{I}_{\{s=W\}}w \\
& a' \geq 0
\end{aligned}
$$

where:

$$
g(a',z') = \max_{s\in\{W,NT,T\}} g(a',z',s')
$$

In the case of a firm in the tradable firm, profits are given by,

$$
\begin{aligned}
\pi_T\left(a,z\right) &= \max_{e,n,k,m} p_{h,T}y_{h,T} + e\xi p_f y_f - (r+\delta)k - wn - P_T m - ewF \\
& \text{subject to} \\
\tau y_f + y_{h,T} &= z\left(k^{\alpha_T}n^{1-\alpha_T}\right)^{1-\phi_T} m^{\phi_T} \\
y_{h,T} &= \left(\frac{p_{h,T}}{P_T}\right)^{-\sigma} Y_T, \quad y_f = \left(\left(1+\tau_f\right)p_f\right)^{-\sigma} Y_f \\
k &\leq \frac{1+r}{1+r-\theta}a
\end{aligned}
$$

Instead, in the case of a firm in the nontradable sector, profits are given by,

$$
\begin{aligned}
\pi_{NT}\left(a,z\right) &= \max p_{h,NT}y_{h,NT} - wn_{NT} \\
& \text{subject to} \\
y_{NT} &= z\left(k^{\alpha_{NT}}n^{1-\alpha_{NT}}\right)^{1-\phi_{NT}} m^{\phi_{NT}}, \quad y_{h,NT} = \left(\frac{p_{h,NT}}{P_{NT}}\right)^{-\sigma} Y_{NT} \\
k &\leq \frac{1+r}{1+r-\theta}a
\end{aligned}
$$

3.3 Equilibrium

Let $\mathcal{S}$ denote the state space of workers and entrepreneurs and 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 $\{w, \xi, P_T, P_{NT}\}$, policy functions $\{d', k', e, c, m, n, y_{h,T}, y_{h,NT}, y_f, p_{h,T}, p_{h,NT}, p_f, Y, y_m\}$, value functions $\{g(a,z), g(a,z,T), g(a,z,NT), g(a,z,$ and a measure $\phi : \mathcal{S} \to [0,1]$ such that the following occur:

1. Policy and value functions solve the entrepreneurs' and workers' problems.

2. Policy functions solve the final good producers', tradable goods producers', and non-tradable goods producers' problems

3. Markets for each variety clear

4. Markets for tradable and non-tradable goods clear, and in particular,

$$Y_T = Y_T^F + \int_{\mathcal{S}} m(s)\phi(s)ds$$

5. The labor market clears:

$$\int_{\mathcal{S}} \left[n(s) + e(s)F_e + F_o I_{[o=1]}\right] \phi(s)ds = \int_{\mathcal{S}} I_{[o=0]}\phi(s)ds$$

.

6. The final good market clears:

$$\int_{\mathcal{S}} \left[c(s) + x(s)\right] \phi(s)ds = Y$$

7. Measure ϕ is stationary.

4 Mechanism

In this section, we describe the extent to which financial constraints impact the effects of lower 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. For simplicity, for this section, we look at an economy without non-tradables.

4.1 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 and higher productivity. Figure 3 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 4 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.

Occupational choice In addition, financial frictions also distort the allocation of individuals between workers and entrepreneurs(occupational choice). 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 occupational 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, as individuals' occupational choices depend on their levels 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 4 contrasts the occupational choice between an economy with financial frictions and its frictionless counterpart, while keeping aggregate prices and quantities fixed. The red area depicts the state space in which individuals choose to be workers, while the green and blue areas depict 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.

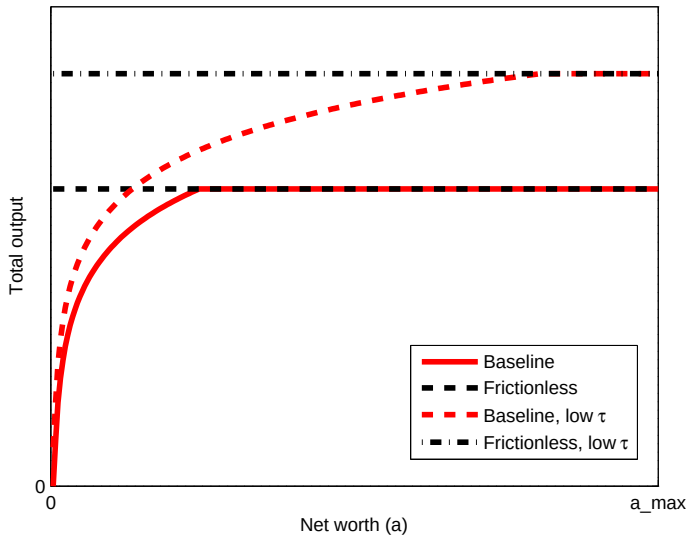
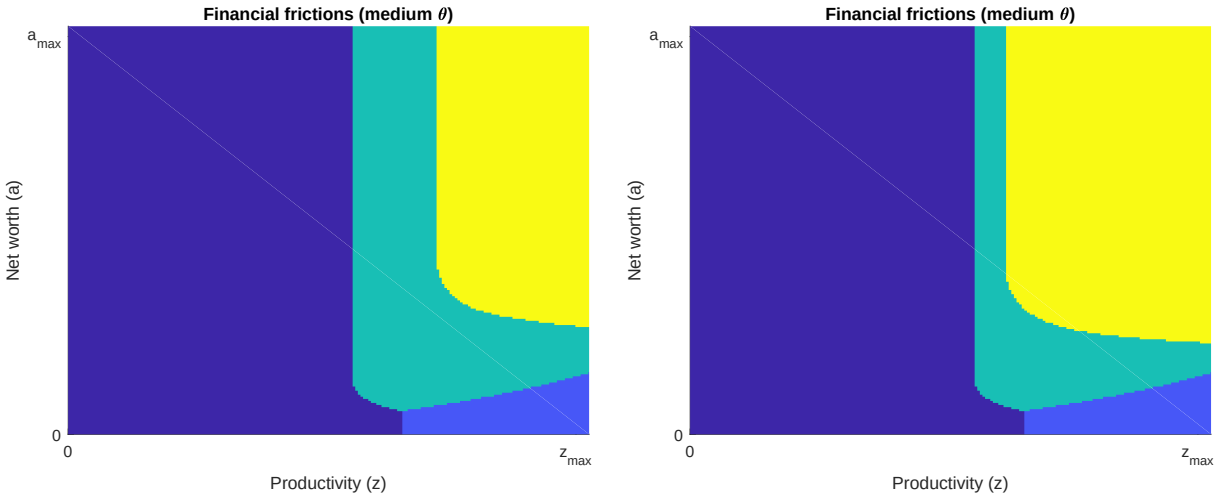


Figure 3: Production decisions



Baseline **Lower Trade Cost**

Figure 4: Occupation and exporting decisions

4.2 Trade liberalization and firms' decisions

Given the impact on individuals' occupational choice, production and export decisions, we now examine the extent to which financial frictions impact the effects of lower international

trade barriers, τ.

Production decisions We begin by contrasting the impact lower trade barriers have on firms' production decisions in an economy with financial frictions and in its frictionless counterpart. To illustrate these effects, Figure 3 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, in each economy.

We find that a reduction of international trade costs increases the amount of output produced with or 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 3, note that the dashed red line is strictly above the solid red line at all levels of net worth.

Figure 3 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 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 lower trade barriers have on firms' occupation and exporting decisions in an economy with financial frictions and in its frictionless counterpart. To illustrate these effects, Figure 4 plots the optimal occupation and exporting decisions along the individuals' state space under high and low variable trade costs τ for the two economies. 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 4, 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.[8] 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 4 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.

5 Quantitative analysis

In this section, we investigate quantitatively the impact of trade liberalization in a economy that features frictions in financial markets. To do so, we begin by calibrating the model to match key features of Colombian plant-level data prior to the trade liberalization of the late 1980s and early 1990s. We then use this economic environment to quantify the role of credit market frictions in shaping the economy's response to the drastic drop in import tariffs observed in Colombia from 32 percent in 1988 to 12 percent in 1992.

5.1 Calibration

To calibrate the model, we partition the parameter space into two groups. The parameters in the first group are pre-assigned while those in the second group are estimated jointly to match key moments of plant-level data from Colombia.

Pre-assigned parameters The first group of parameters is presented in Table 1 and consists of γ, β, σ, δ, r, ρ, ν, α, α_{NT}, α_m, η, τ_m, τ_f, and P_f. We set the risk aversion parameter γ to 2, the elasticity of substitution σ to 4, and the depreciation rate δ to 0.06;

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

these are standard values used in the literature. In addition, we set the discount factor β and the interest rate r to equal 0.80 and 0.06, respectively, to ensure that the model features a stationary equilibrium in which there always exist some firms that are financially constrained. Following previous studies (Buera et al. 2011; Midrigan and Xu 2014; Moll 2014), we also assume that idiosyncratic productivity ρ is persistent and set it equal to 0.90.

We set the share of tradable goods in GDP to equal 47 percent as observed in Colombia in this period. We assume that tradable producers operate a more capital-intensive technology than producers of non-tradable goods. In particular, we set the capital share in the tradable sector to equal 0.60 and its counterpart in the non-tradable sector to equal 0.20.[9] Consistent with previous work (Alessandria and Choi 2014, Leibovici 2016), we set the share of intermediates α_m in the production of tradable goods at a relatively high value equal to 0.40, which is also consistent with plant-level data from Colombian manufactures, described below. Finally, we set import and export tariffs to equal 32 percent, the value of average import tariffs in Colombia in 1988. The price index in the rest of the world is normalized to unity.

Table 1: Pre-Assigned Parameters

Parameter	Value	Description
γ	2	Risk aversion
β	0.8	Discount factor
σ	4	Elasticity of substitution
δ	0.06	Capital depreciation rate
r	0.06	Interest rate
ρ	0.9	Persistence of prod. shocks
ν	0.47	Share of tradables in GDP
α	0.6	Share of capital in T sector
α_{NT}	0.2	Share of capital in NT sector
α_m	0.4	Share of intermediate inputs
τ_m	0.32	Imports tariffs
τ_f	0.32	Exports tariffs
P_f	1	Foreign price index

Estimated parameters The set of estimated parameters is presented in Table 2 and consists of F, τ, σ_ε, and θ. The table reports their estimated values along with their respective target and model-implied moments.

[9]Given that the contribution to total GDP by each of the sectors is evenly split between them, this assumption implies that the sales-weighted average capital share in the economy is consistent with the aggregate capital share typically observed in the data, around $0.47 \times 0.60 + 0.53 \times 0.20 = 0.388$.

We estimate these parameters to target salient features of plant-level data from Colombian manufactures. In particular, we study the Annual Manufacturing Survey, which is collected by the Departamento Administrativo Nacional de Estadistica (DANE) and surveys all manufacturing firms with more than 10 workers.[10] Following Fieler et al. (2018), we use data from 1982 to 1988 to calibrate the model for the period prior to the reduction in tariffs implemented in subsequent years.

We choose the set of estimated parameters following a simulated method of moments approach to target moments from the data informative about the magnitude of the trade and financial frictions featured by the model. On the one hand, we choose the export fixed and variable trade costs, F and τ, to target salient features of international trade participation observed in the data. In particular, we target the share of tradable firms that choose to export in our model as well as the (sales-weighted) average export intensity of those who export.[11] On the other hand, we choose the collateral constraint parameter θ to target the aggregate credit-to-GDP ratio observed in the data, which allows us to discipline the magnitude of the financial frictions faced by agents in our model. Finally, we choose the volatility of the idiosyncratic productivity shocks σ_ε to target the size of exporters relative to non-exporters, as given by the ratio between the average domestic sales of exporters to the average domestic sales of non-exporters.

Table 2: Estimated Parameters

Parameter	Value	Target moment	Target value	Model
F	9.5	Share of exporters	0.11	0.11
τ	4.5	Weighted Avg. Export Intensity	0.54	0.54
σ_ε	0.245	Exporter domestic sales premium	5.68	5.58
θ	0.21	Credit / GDP	0.15	0.15

5.2 Trade liberalization

Given the calibration approach described above, this economic environment captures salient features of Colombian plant-level data over the period 1982-1988, prior to the large tariff reduction implemented between 1988 and 1992. Thus, we now use it as a laboratory to investigate the role of financial frictions in accounting for the aggregate dynamics observed in Colombia after this policy change.

[10] This data has been used before by Roberts and Tybout (1997), Ruhl and Willis (2014), and Fieler et al. (2018), among others.

[11] We compute firm-level export intensities as the ratio of exports to total sales. We target the sales-weighted average export intensity to account for the relatively small fraction of large firms with high export intensity documented by Kohn et al. (2016a).

To do so, we consider the stationary equilibrium of our calibrated model and examine the impact of reducing import tariffs by the magnitudes observed in Colombia between 1988 and 1992. In particular, we focus on a one-time, unexpected, permanent reduction of import tariffs from 32 percent to 12 percent. That is, a reduction of τ_m from 0.32 to 0.12.

The timing of the trade liberalization is as follows. Initially, in period 1, the economy is in a stationary equilibrium, and we refer to period 1 as the pre-liberalization period. In period 2, after entrepreneurs' production takes place, agents learn that trade liberalization will be implemented in period 3. Thus, in anticipation of the trade liberalization, agents are able to adjust their consumption and investment decisions in period 2. We assume this timing to capture the fact that trade liberalizations are rarely unexpected.

We begin the quantitative analysis by examining the impact of lowering import tariffs in our baseline model. Thus, in sections 5.3 and 5.4 we examine the dynamics of key aggregate and firm-level statistics in our model following the tariff reduction. Our goal is to understand the key forces that shape the response of our model after a fall in τ_m. This analysis helps us understand qualitatively the role played by financial friction in the model.

In Section 6, we analyze quantitatively how financial frictions shape the response of the economy to import tariffs reduction. I particular, we contrast the implications of our model with those implied by a counter-factual economy identical to the baseline but with higher financial development (i.e., higher θ).

5.3 Aggregate dynamics

In this section, we describe how trade liberalization affects dynamics of key aggregate variables. Note that a decrease in import tariffs has two immediate effects on the economy. First, it reduces the price of imported tradable varieties, which decreases the demand for domestic tradable varieties, but which makes domestic tradable composite good, and hence also the final goods, cheaper. As a result, real exchange rate depreciates (see Figure 6) increasing the foreign demand for domestic tradable varieties. Second, the fall in the price of domestic decreases the cost of intermediate inputs making domestic firms in the tradable sector more competitive. These two effects interact, however with financial frictions, leading to rich and interesting dynamics that we describe below.

We consider first dynamics of aggregate GDP, consumption, capital, and credit, depicted in Figure 7 . Note that all variables are expressed as percentage deviations relative to the stationary equilibrium (period 1). We see that following the trade liberalization GDP increase on impact by approximately 1.5%, and then expand gradually further over the next 7 periods to reach a level 2.5% higher than pre-liberalization in period 10. Dynamics

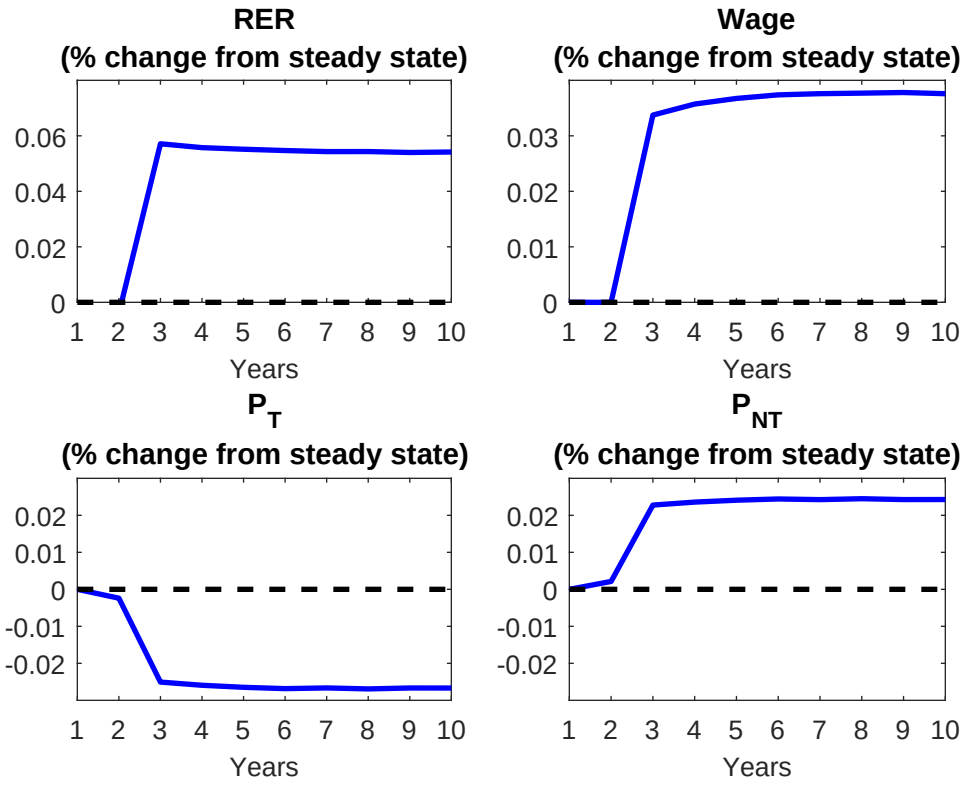


Figure 6: Price dynamics

of aggregate consumption follow closely the dynamics of GDP. Consumption increases on impact as enterpreneurs earn higher profits and workers earn higher wages. Afterwards, it further gradually increases driven by both increase in wages of workers and profits of initially constrained entrepreneurs.

In contrast, the capital stock initially decreases and only then expands gradually. To understand this note that trade liberalization has two opposite effect on investment in tradable sector. First, existing exporters increase their scale since foreign demand for domestic tradable goods increases. On the other hand, less productive entrepreneurs to leave the tradable sector because of the fall of the demand for domestic tradable varieties, which tends to depress aggregate investment. When financial development is low, the first effect is relatively weak, and as a consequence the aggregate investment falls in period 2, translating into an initial fall of aggregate capital. Afterwards, capital starts to grow, partly due accumulation of capital by constrained exporters and partly due to the entry of new firms into non-tradable sector. Credit follows closely the dynamics of aggregate capital since, in the model, credit is mostly used for capital investment.

Figures 8 and 9 show that trade liberalization leads to a substantial reallocation of economic activity in the model. In particular, Figure 8 contrasts dynamics of real sales of

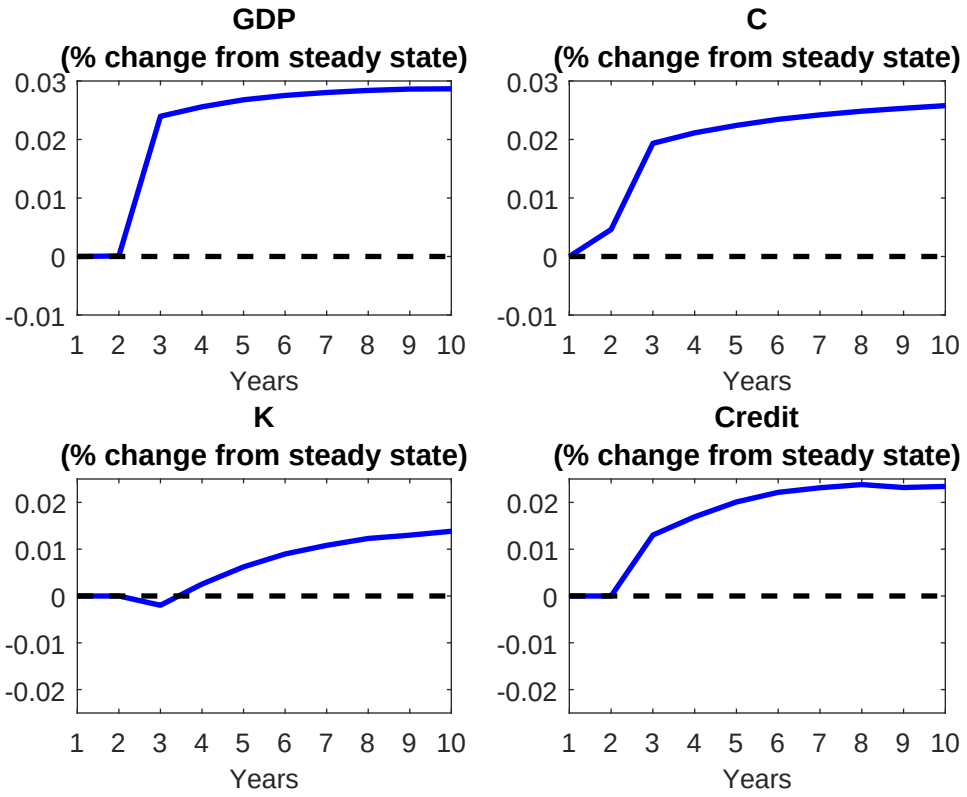


Figure 7: Aggregate dynamics (GDP, Consumption, Capital, and Credit)

tradable and non-tradable goods, as well as dynamics of domestic and foreign real sales of tradable goods. We see that following trade liberalization real sales of tradable and non-tradable and non-tradable goods fall as a result of increased foreign competition.[12]

Interestingly, even though there is a decline in the total sales of domestically-produced tradable goods, this decline masks a sharp reallocation of sales across markets. While real domestic sales of tradable goods decline by almost 20 percent, real export sales of tradable goods increase by a similar amount. While the domestic market becomes less attractive to domestic producers of tradable goods, the foreign market becomes relatively more attractive following the real depreciation.As a result, existing exporters boost their exports by expanding their scale (subject to borrowing constraints) and reallocating sales across markets. In addition, some of previous non-exporters, following the depreciation, find it optimal to start to export.

Figure 9 depicts changes in the composition of firms following the tariff reduction. It indicates that part of the reallocation of economic activity depicted in Figure 8 is driven by reallocation of entrepreneurs across different activities in the economy. In particular,

[12]The demand for non-tradable varieties falls as final good producers switch to using more of tradable composite good, which becomes cheaper following trade liberalization.

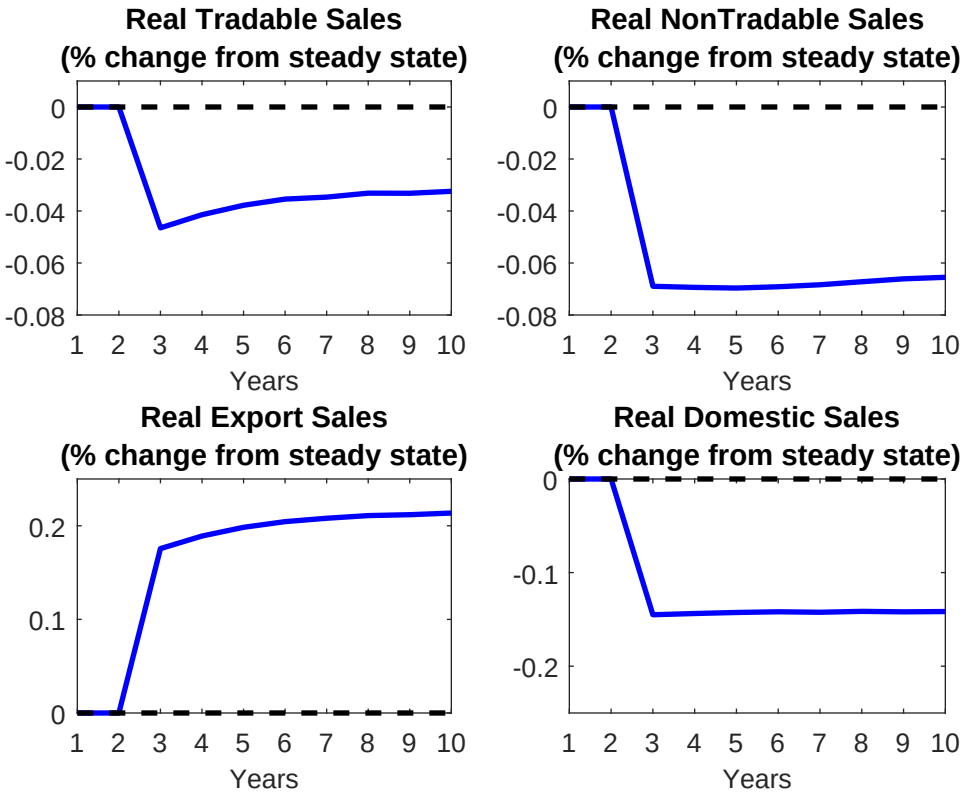


Figure 8: Aggregate dynamics (Sales across Sectors and Markets)

following trade liberalization we observe a sharp increase in the share of exporters driven by the depreciation of real exchange rate. On the other hand, we also observe a sharp decline in the share of tradable firms in the economy which is driven by a fall in demand for domestic tradable variaties due to cheaper imports as well as by an increase in wages, both of which push the least productive entrepreneurs out of this sector of the economy.

Interestingly, we see that in contrast to the tradable sector, the share of firms in the non-tradable sector increases. On the one hand, non-tradable producers have a lower incentive to operate given the increased competition from cheaper imports. On the other hand, some individuals who used to operate tradable firms before the trade liberalization decide to switch and become non-tradable producers after the policy change. However, the increase in the number of non-tradable firms is not large enough to compensate for the exit of firms from tradable sector, and the total share of firms in the economy falls.

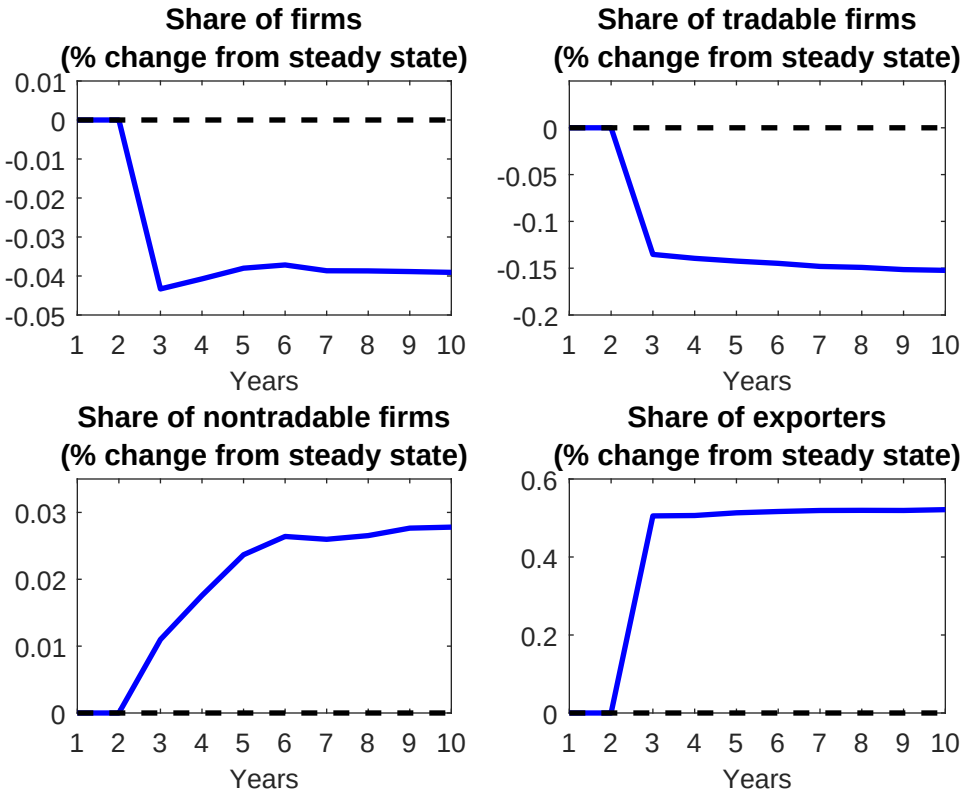


Figure 9: Aggregate dynamics (Firm Composition across Sectors and Markets)

5.4 Firm-level dynamics

Above, we investigate the response of aggregate variables to the trade liberalization. In contrast, in this section, we focus on firm-level dynamics in order to better understand how financial frictions shape the aggregate dynamics through firms' adjustments. In particular, below we analyze how firms' intensive and extensive margin decisions are affected by their initial level of debt.

5.4.1 Intensive margin

We now investigate how firms adjust total sales, domestic sales, exports, and capital, depending on their financial position in the initial steady state. More precisely, we divide firms into two categories: those with savings and those with debt in the initial stationary equilibrium, a period before trade liberalization is announced. Intuitively, firms with savings should be able to respond to trade liberalization optimally since they are unlikely to face binding borrowing constraints. On the other hand, the response of firms with debt is likely constrained by their relatively low net worth.[13]

[13] While in our economy that vast majority of firms holds some debt, we find that the behavior of firms with debt in these figures is driven by those that are very borrowing-constrained.

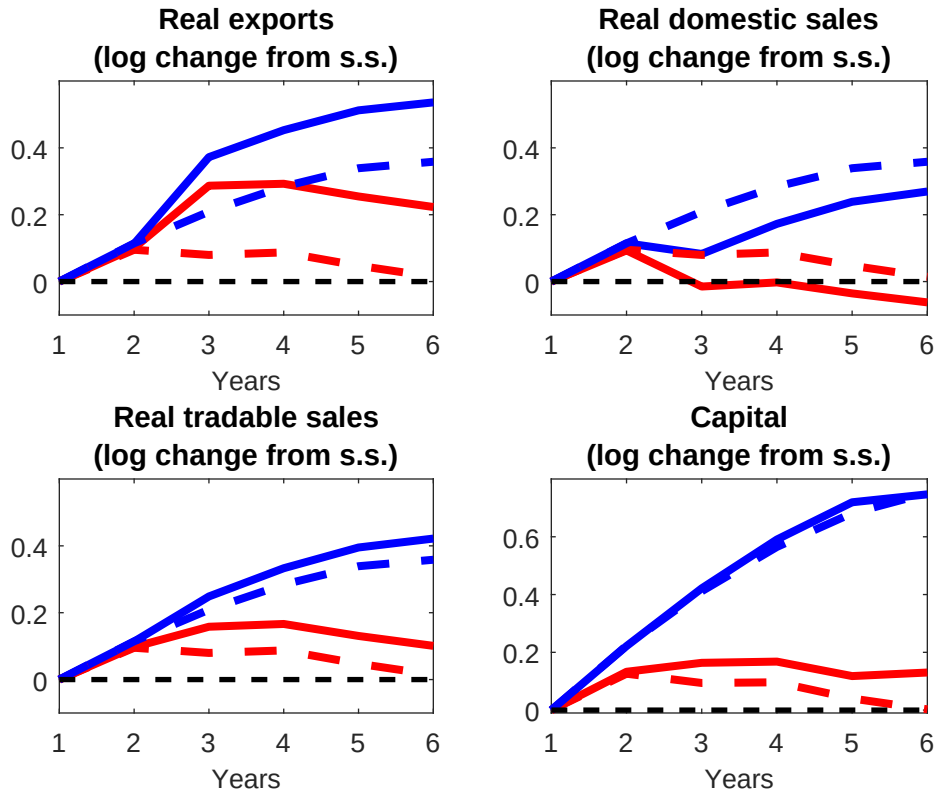


Figure 10: Firm-level dynamics following trade liberalization

In what follows, we focus on firms that export for at least 6 consecutive periods. We do this so to avoid the selection bias associated with exit and entry of firms. In addition, to control for potentially different levels of productivity across these two sets of firms, we regress the variables of interest on a constant and firms' productivity level. Thus, all the effects depicted in figures below are *conditional on* productivity. Since we are interested in the effect of the trade liberalization, we contrast the observed firms' dynamics to their dynamics in a counterfactual case in which no trade liberalization occurs (i.e. we use their steady state optimal policies).

Figures 10 and 11 depict the results. In particular, Figure 10 shows the dynamics of real total sales, real domestic sales, real exports and capital for both firms with savings (solid blue lines) and firms with debt (solid red lines) and their dynamics in the counterfactual case of no trade liberalization (dashed blue and red lines). Similarly, Figure 11 shows the effects of the trade liberalization on real total sales, real domestic sales, real exports and capital (i.e. the difference between the solid and dashed lines above).

Figure 10 suggests that firms with debt increase real exports, sales and capital more than firms with initial debt position. To isolate the effect of the trade liberalization, however, we need to contrast these dynamics with the hypothetical dynamics in the case of no change

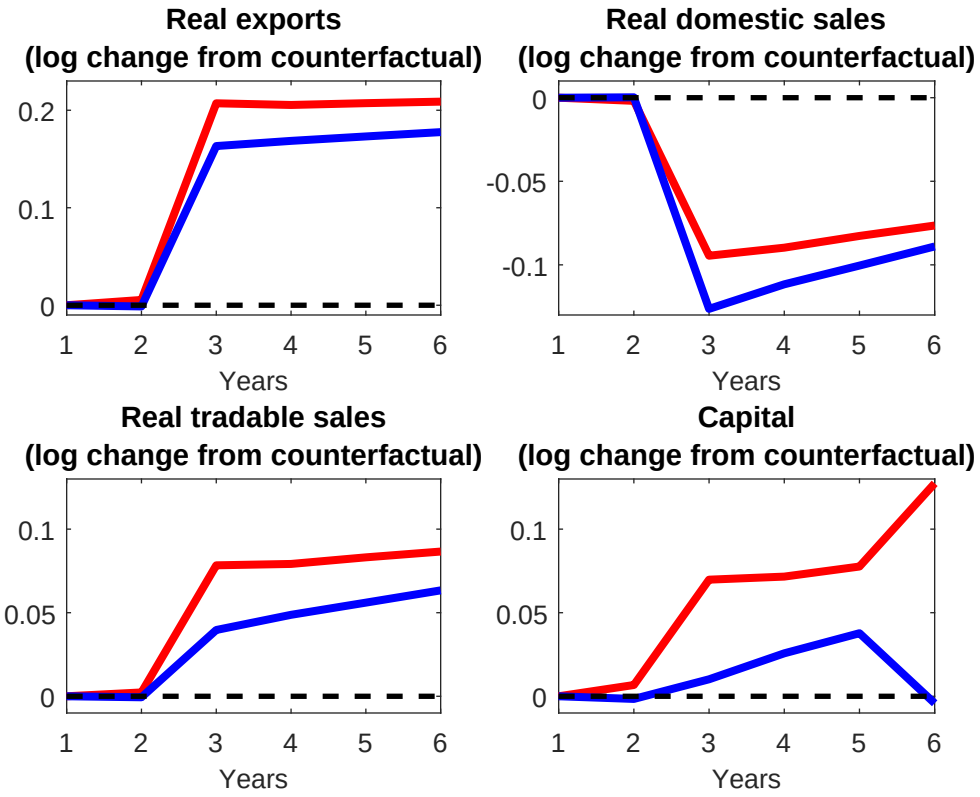


Figure 11: Firm-level dynamics following trade liberalization

in tariffs –dashed lines–, which shows that also in this case firms with debt would have increased their sales and capital more than those with debt, since they were constrained in the first place. 11 shows the difference between these two cases and suggests that firms that hold positive savings in the period before the trade liberalization increase more their real exports, capital, and total real sales than their counterparts with debt, as observed in the data. Moreover, while both sets of firms decrease their domestic tradable sales, tradable sales of firms with debt decrease by more than those with savings. Thus, both types of firms reallocate their sales from domestic to foreign market, though firms with debt reallocate their sales more aggressively. This is because these firms do not have debt capacity needed to increase their foreign sales without decreasing their domestic sales below the optimal unconstrained level.[14]

5.4.2 Extensive margin

Next, we investigate how trade liberalization affects the probability of firms of becoming exporters conditional on their financial position. To do so we simulate the behavior of 5

[14]Kohn et al. (2016a) find a similar reallocation mechanism in a model of large devaluation and find empirical evidence for it using Mexican plant-level data.

million agents which translates into approximately 270,000 firms in the tradable sector. We classified firms in the tradable sector into five categories depending on how constrained are these firms in the initial stationary equilibrium, before trade liberalization occurs: (1) unconstrained (29% of tradable firms); (2) somewhat constrained (i.e., firms with debt below the median among financially constrained firms; 36%); (3) constrained (firms with debt above the median but below the 90th percentile, 29%); (4) severely constrained firms (with debt between the percentile 90 and percentile 99 of debt distribution among financially constrained firms, 6%); and (5) firms that are extremely constrained (firms in top 1% of distribution by tightness of their borrowing constraints, 1% of tradable firms).

Table 3 presents the unconditional export probability –share of exporters– for each of these groups of firms and how it evolves over time. Two observations become apparent from this table. First, in the model constrained firms are the most productive ones and tend to export while unconstrained firms tend to produce for domestic market. Second, as time progresses, the number of exporters among unconstrained firms increases while decreases among constrained firms. These results are driven by the mean-reverting productivity. The most constrained firms received a sequence of extremely high productivity shocks; as such, they have a very large optimal scale and they borrow aggressively to build up their capital and reach that scale. However, since productivity is mean reverting these firms tend to receive negative shocks over time and exit the export market. In contrast, firms with savings are those firms that have relatively low productivity but managed to accumulate high assets in the past. Therefore, as time progresses, these firms are more likely to receive high productivity shocks that make exporting profitable to them.

Table 3: Export probability

t	Unconstrained	Constrained 0% to 50%	Constrained 50% to 90%	Constrained 90% to 99%	Constrained top 1%
1	0.028	0.055	0.057	0.686	1.000
2	0.038	0.045	0.048	0.544	0.962
3	0.055	0.052	0.057	0.521	0.923
4	0.052	0.046	0.053	0.442	0.838
5	0.048	0.042	0.050	0.374	0.715
6	0.046	0.040	0.047	0.320	0.626
N	76,525	95,438	76,499	16,858	1,906

As the next step, we separate the effect of the initial asset position of firms –how tight is their borrowing constraint– from that of productivity. To do so, we condition the export probability on the productivity level and investigate the change in the export probability with respect to the initial period. To do this, we first run a regression of an export dummy

on a constant and firms' productivity. Then, we construct the average residual by groups of firms and compute the change in this residual from the initial steady state. In addition, to isolate the effect of the trade liberalization, we compute the difference between the change in the export probability observed in the case of trade liberalization and the change in export probability observed in a counterfactual case without trade liberalization. Table 4 presents these results.

Table 4: Export probability change due to trade liberalization

t	Unconstrained	Constrained 0% to 50%	Constrained 50% to 90%	Constrained 90% to 99%	Constrained top 1%
1	0	0	0	0	0
2	0.001	0.001	0.002	0.006	0.014
3	0.018	0.016	0.017	0.073	0.077
4	0.018	0.015	0.018	0.075	0.083
5	0.017	0.014	0.018	0.073	0.093
6	0.016	0.015	0.018	0.069	0.095
N	76,525	95,438	76,499	16,858	1,906

We can observe that in the period of the trade liberalization, $t = 3$, all groups increase their probability of exporting conditional on their productivity level. What is more interesting, however, is that more constrained firms increase by more their export probability: while a firm that was unconstrained in the initial period has a 2 percentage points higher probability of being an exporter in the period of the trade liberalization, this number increases to 7 percentage points for a firm in the top 10% of financially-constrained firms. This suggests that trade liberalization has the strongest positive effects on export probability of the most constrained exporters. This is in contrast to the findings above, where we showed that the more financially-constrained firms tend to increase exports, total sales and capital by less than the unconstrained firms.

6 Financial development and trade liberalization

We now investigate the role played by frictions in financial markets in accounting for the response of the economy to trade liberalization. To do so, we ask: How would have our baseline economy responded to trade liberalization if its financial markets would have been better developed? We answer this question by recomputing the trade liberalization experiment conducted in the previous section for an economy with a high value of θ (equal to 0.6) but otherwise identical to the baseline model. We identify the role of financial frictions in accounting for the post-trade-liberalization dynamics as the difference between our baseline

model and the counter-factual financially developed economy considered here.

We begin by examining the role of financial frictions in accounting for the impact on aggregate price dynamics. As import tariffs fall, figure 12 shows that the decline in the price of domestic tradable goods is relatively steeper with developed financial markets. With financial frictions that are less severe, the decline in tariffs allows productive tradable producers to take better advantage of the cheaper intermediate inputs that can be purchased from the rest of the world, lowering the overall price of domestic tradable goods relative to the economy with credit constraints.

The better use of imported intermediates under financial development leads to a milder decline of real tradable sales, as illustrated in figure 13. Consequently, this adds further pressure to labor markets, leading to a higher wage increase than in our baseline model and, thus, to a larger increase in the price of non-tradable goods. Then, while the price of final goods declines regardless of financial development, the decline is milder in the financially-developed economy, also leading to a milder real exchange rate depreciation.

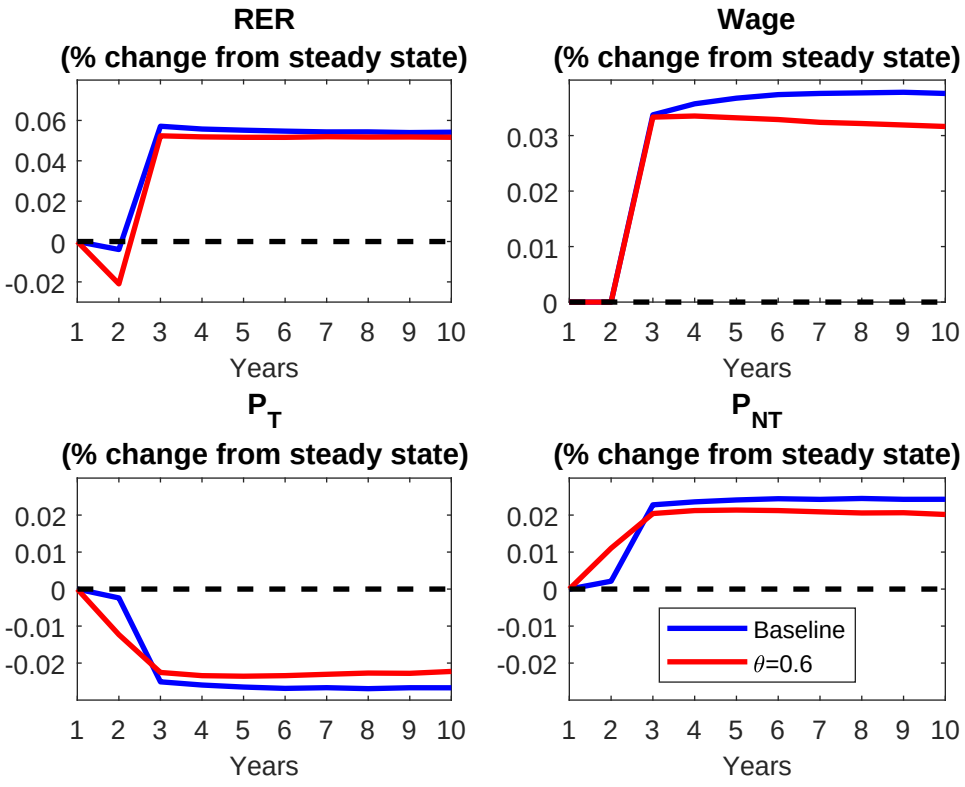


Figure 12: Price dynamics

These effects on prices are mirrored by the aggregate dynamics of sales across sectors and markets illustrated in figure 8. In particular, we observe that domestic sales of tradable goods experience a relatively milder decline in the financially-developed economy given the cheaper

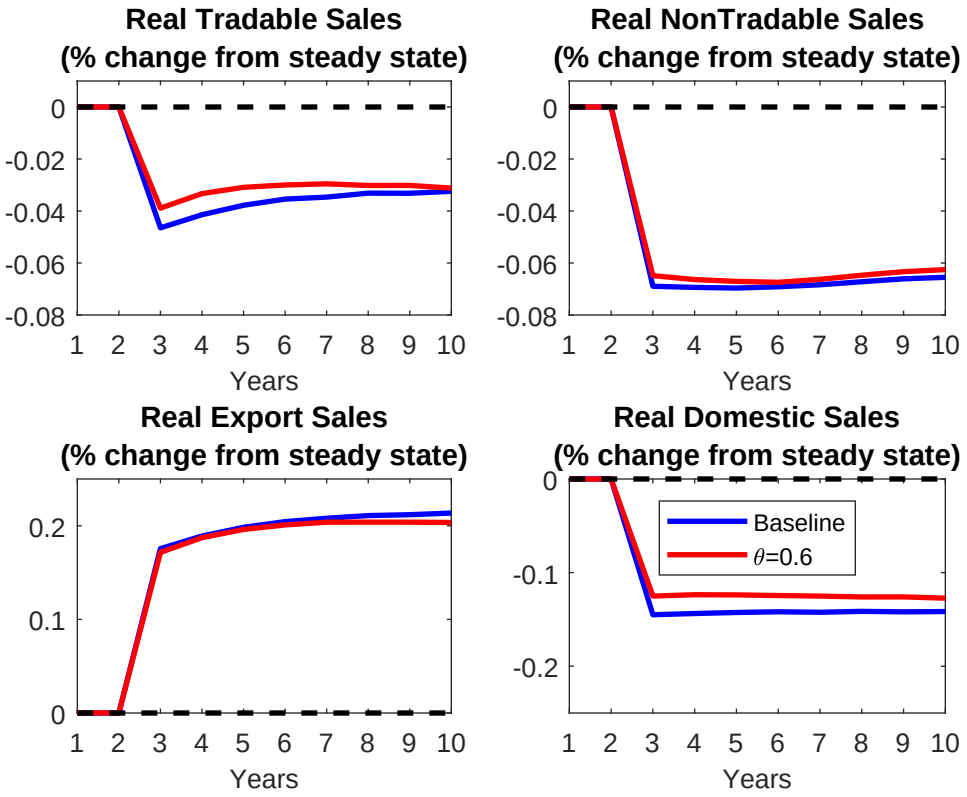


Figure 13: Aggregate dynamics (Sales across Sectors and Markets)

imported intermediates and the better access to finance that allows firms to expand in response. In contrast, the response of non-tradable and export sales remain largely unaffected by the development of financial markets.

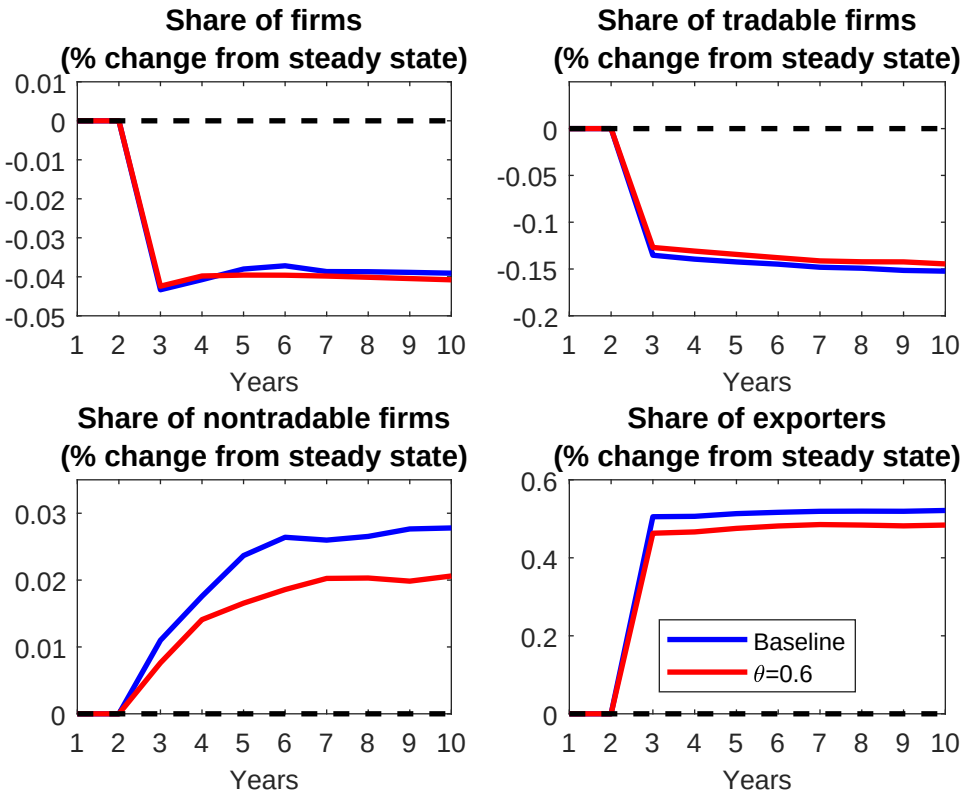


Figure 14: Aggregate dynamics (Firm Composition across Sectors and Markets)

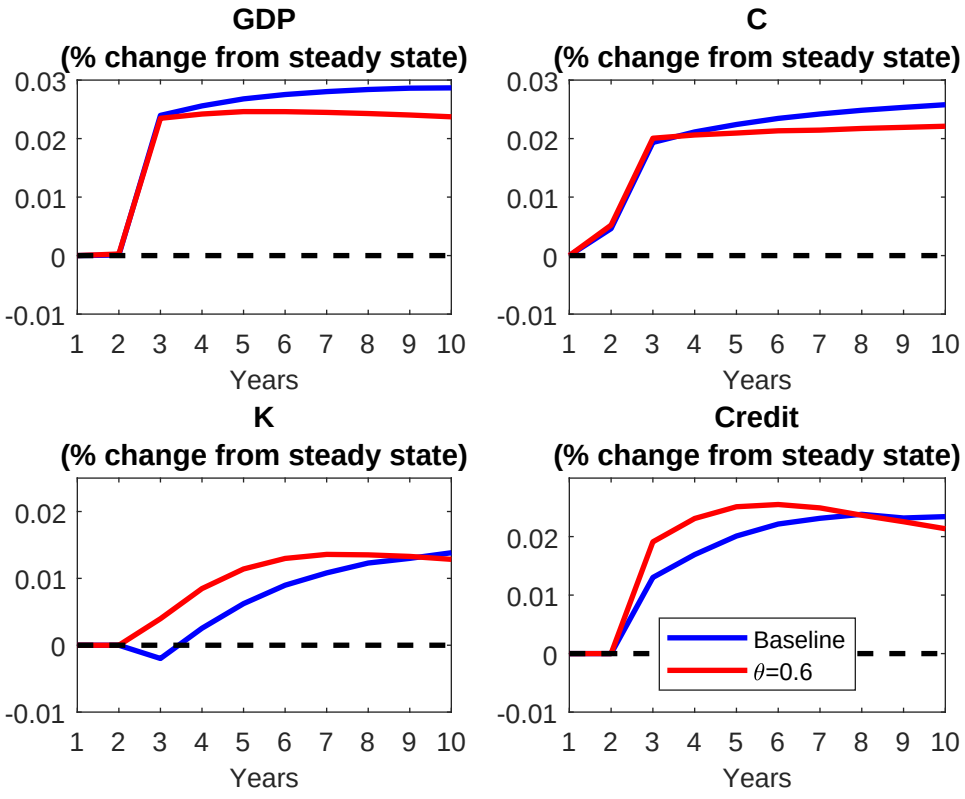


Figure 15: Aggregate dynamics (GDP, Consumption, Capital, and Credit)

7 Conclusion

In this paper, we investigate the extent to which financial development affects the dynamics following trade liberalization. To do so, we study a small open economy with heterogeneous firms, international trade subject to variable and fixed costs, endogenous occupational, sectoral and export decisions, and financial frictions modeled as collateral constraints.

We estimate the model to match salient features from Colombian plant-level data, and use it to examine the impact of reducing import tariffs from 32 to 11 percent, as implemented in Colombia in the late 1980s. We find that financial development substantially increases the speed of adjustment of the economy following trade liberalization relative to an economy with large frictions in financial markets.

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