Financial Development and International Trade

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ABSTRACT

This paper studies the industry-level and aggregate implications of financial development on international trade. I set up a multi-industry general equilibrium model of international trade with heterogeneous firms subject to financial frictions. Industries differ in capital-intensity, which leads to differences in external finance dependence. The model is parameterized to match key features of firm-level data. Financial development leads to substantial reallocation of international trade shares from labor- to capital-intensive industries, with minor effects at the aggregate-level. These findings are consistent with estimates from cross-country industry-level and aggregate data.

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1 Introduction

International trade costs are large, particularly in developing countries. While recent studies have estimated large gains from reducing these costs, identifying specific policies that may allow poor countries to reduce them remains an important challenge.[2]

Recent papers suggest that the development of financial markets may be one such policy. For instance, Beck (2003) and Manova (2013) find that better financial markets lead industries with higher dependence on external finance to export relatively more. Similarly, Minetti and Zhu (2011) and Amiti and Weinstein (2011), among others, document strong links between measures of access to external finance and international trade at the firm level, suggesting that firms' export decisions are significantly distorted by financial frictions.[3] Furthermore, recent quantitative studies, such as Kohn, Leibovici, and Szkup (2016) and Gross and Verani (2013), find that financial frictions are a key driver of the dynamics of new exporters, suggesting they are an important barrier to international trade.

Several features indeed make international trade a more finance-intensive activity than production for the domestic market. For instance, entering a foreign market typically involves a variety of upfront investments, such as market research, product customization, or the development of distribution networks (Baldwin and Krugman 1989, Dixit 1989). Then, limited access to external finance can prevent firms with low internal funds from undertaking such investments to export. Similarly, international trade transactions are typically subject to higher variable trade costs, due to shipping expenses, duties, or freight insurance. By lowering profits from foreign sales, these costs reduce the extent to which firms can use them to overcome distortions on

[2] Anderson and van Wincoop (2004) show that international trade costs are large in developing countries. Waugh (2010) estimates large welfare gains from reducing them to the level of rich countries.

[3] Hur, Raj, and Riyanto (2006) and Svaleryd and Vlachos (2005) report similar findings at the industry level, while Bellone, Musso, Nesta, and Schiavo (2010) and Berman and Hericourt (2010) document additional firm-level evidence. For a more exhaustive review of the empirical evidence, see Contessi and de Nicola (2013).

export decisions along the intensive margin.[4]

The goal of this paper is to investigate the industry-level and aggregate implications of financial development on international trade through the lens of a standard general equilibrium trade model with one key ingredient: frictions in financial markets. I study a multi-industry model in which firms heterogeneous in productivity produce goods with capital, labor, and intermediate inputs subject to credit constraints. Individuals endogenously choose whether to be workers or entrepreneurs, and entrepreneurs endogenously choose the industry in which to operate. Industries differ in capital-intensity, which leads to differences in their dependence on external finance. International trade is subject to export entry costs, fixed export costs, and variable trade costs.[5] Exporting is more finance-intensive than domestic sales since export entry costs and fixed export costs need to be paid upfront. I parameterize the model to match key features of firm-level data and use it to quantify the impact of financial frictions on international trade relative to production sold domestically.

Financial frictions affect industry-level and aggregate trade shares through two key channels. First, financial frictions distort the production decisions of exporters relative to non-exporters, reducing the share of output that is sold internationally. While financial frictions reduce the production scale of both exporters and non-exporters by limiting the amount of capital that can be financed externally, exporters are distorted relatively more since they have a higher optimal scale: they face a larger market and are also typically more productive. Second, financial frictions distort export entry decisions, leading firms to delay export entry until sufficient internal funds are accumulated to make it a profitable investment. This reduces the share of firms that export and, thus, the share of output sold internationally.

To study the quantitative impact of financial frictions on international

[4]Foley and Manova (2015) survey recent studies that investigate various channels through which financial frictions distort international trade decisions.

[5]International trade is modeled following Melitz (2003) and Chaney (2008), with dynamic features from Alessandria and Choi (2014b). Financial frictions are modeled following Midrigan and Xu (2014) and Buera and Moll (2015). The approach to modeling the interaction between financial frictions and international trade builds on earlier theoretical work by Chaney (2016) and Manova (2013).

trade, I estimate the parameters of the model to match key moments from Chilean firm-level data. I follow a Simulated Method of Moments (SMM) approach targeting moments of the data informative about firms' export decisions and the extent to which financial constraints distort production.

I use the parameterized economy as a laboratory to study the impact of financial frictions on international trade at the industry and aggregate levels. To do so, I contrast the stationary equilibrium of the estimated model with the stationary equilibria of economies featuring alternative levels of financial development. On the one hand, I contrast the estimated model to an economy without credit. On the other hand, I contrast it to an economy in which financial frictions are relaxed to resemble a financially-developed economy.

I first study the effect of financial development on industry-level trade shares. I find that financial development has a heterogeneous impact across industries. In capital-intensive industries, highly dependent on external finance, relaxing the financial constraint increases the trade share since it allows more firms to finance the export entry investment and to increase their scale relative to non-exporters. In contrast, the trade share decreases in labor-intensive industries, with low dependence on external finance, since higher equilibrium factor prices offset the increased incentives to trade and expand production.

To contrast these findings with estimates from industry-level data, I construct an empirical counterpart to the model's quantitative implications. To do so, I use the model to derive an empirical specification that explains an industry's trade share in a given country and year as a function of the country's level of financial development, the industry's capital intensity, and the interaction between them. I estimate the empirical specification using the cross-country industry-level dataset from Manova (2013), with financial development measured as the ratio of aggregate credit to GDP. I extend this dataset to include a measure of industry-level capital intensity, which I compute using firm-level U.S. data from Compustat following the approach of Rajan and Zingales (1998). Finally, I use the estimated specification to compute the change of industry-level trade shares associated with a change in financial development of the same magnitude implied by the quantitative model.

The empirical estimates are consistent with the industry-level implications of the model. While financial development is associated with an increase of the trade share in capital-intensive industries, it is associated with a decrease of the trade share in labor-intensive ones. Moreover, I find that the trade share changes featured by the industries of the model account for more than 45.4% of the changes implied by their empirical counterpart.

I then study the impact of financial development on international trade at the aggregate level. In contrast to the strong relationship between trade and finance implied by the model at the industry level, I find that financial development leads to a moderate increase of the trade share in the aggregate. The substantial reallocation of industry-level trade shares largely offset each other, leading to a lower change of the aggregate trade share.

To contrast these findings with estimates from data at the country-level, I aggregate the cross-country industry-level dataset from Manova (2013) across industries. I use these data to examine the relationship between financial development and aggregate trade shares using a specification analogous to the one estimated at the industry level.[6] Consistent with the implications of the model, the empirical estimates imply that there is a positive but mild relationship between financial development and the aggregate trade share.[7]

I then investigate the welfare implications of these findings. I find that financial development leads to small but nontrivial welfare gains: 4.59% in consumption-equivalence units. However, I find that international trade plays a very minor role in accounting for these gains. These findings are consistent with the aggregate implications of financial development on international trade documented in the paper as well as with previous studies from the literature.

[6] Evidence on the aggregate relationship between trade and finance has been elusive given the challenge to interpret such estimates causally. Amiti and Weinstein (2011) and Paravisini, Rappoport, Schnabl, and Wolfenzon (2015) overcome these difficulties by exploiting rich firm-level data that allow them to estimate the average response of trade-related outcomes across firms with differential exposure to banks affected by an aggregate shock.

[7] While Beck (2002) documents a stronger link between trade and finance in the aggregate, his measures of interest (the ratio of manufacturing exports to total GDP, and the ratio of manufacturing exports to total exports), are not directly comparable to the one I study: they capture the combined impact of financial development on the size of the manufacturing sector and the manufacturing trade share.

Finally, I show that the findings reported in the paper are robust to alternative modeling assumptions and extensions of the model. I summarize these findings in the paper and report the details in the Online Appendix.

This paper is closely related to previous empirical studies, such as Beck (2003) and Manova (2013), which investigate the relationship between financial development and the level of international trade flows across industries. These studies document that better financial markets lead to relatively larger trade flows in finance-intensive industries. To the best of my knowledge, this is the first paper to document the underlying qualitatively heterogeneous response of trade shares across industries: financial development is associated with higher trade shares in capital-intensive industries, but lower trade shares in labor-intensive ones.[8] Moreover, the quantitative implications of the model suggest that the strong reallocation observed in the data is, to a large extent, a causal response to the development of financial markets. My findings also show that this heterogeneity across industries is key for understanding the aggregate impact of financial development on international trade.

This paper is also related to a growing literature that studies the aggregate implications of financial frictions on international trade flows through the lens of equilibrium models. For instance, Wynne (2005), Matsuyama (2005), and Antras and Caballero (2009) study their qualitative impact on the pattern of comparative advantage. Brooks and Dovis (2013) and Caggese and Cuñat (2013) investigate their quantitative impact on the gains from reducing trade barriers. My paper combines the quantitative approach of the latter with the multi-industry approach of the former to investigate the extent to which frictions in financial markets act as a barrier to international trade.

Finally, this paper is also broadly related to a literature that investigates the role of domestic institutions as a barrier to trade. In particular, frictions in product markets, labor markets, and financial markets, among others, have been documented to distort the pattern of comparative advantage across countries, suggesting they may have important implications at the aggregate level

[8]In the Online Appendix I also investigate the impact of financial development on the level of international trade flows.

— for a review of this literature, see Nunn (2014). My paper examines the extent to which this is the case for frictions in financial markets.

The paper is organized as follows. Section 2 presents the model. Section 3 discusses the channels through which financial frictions distort international trade flows. Section 4 presents the quantitative analysis. Section 5 contrasts the quantitative findings with estimates from the data. Section 6 concludes.

2 Model

The model consists of an economy populated by a unit measure of infinitely-lived individuals who choose whether to be workers or entrepreneurs. Entrepreneurs choose the tradable sector in which to operate, and produce differentiated varieties that can be sold domestically and abroad. The economy is also populated by the rest of the world, and by representative producers of nontradable, tradable, and final goods.

There are five types of goods in the economy: domestic tradable varieties, imported tradable varieties, tradable goods, nontradable goods, and final goods. Final goods are produced by aggregating tradable and nontradable goods, while tradable goods are produced by aggregating domestic and imported tradable varieties. Final goods are used by all individuals for consumption, and entrepreneurs also use them for investment. Tradable goods are used to produce final goods and as intermediate inputs in the production of domestic tradable varieties. Domestic tradable varieties are produced by entrepreneurs and imported tradable varieties are produced by the rest of the world; these are the only goods that can be traded internationally.

2.1 Individuals

2.1.1 Preferences

Individuals have preferences over streams of consumption of final goods represented by the expected lifetime discounted sum of a constant relative risk-aversion period utility function. The utility function is given by $\mathbb{E}_0 \sum_{t=0}^{\infty} \beta^t \frac{c_t^{1-\gamma}}{1-\gamma}$, 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 idiosyncratic productivity process described below, conditional on the information set in period zero.[9]

2.1.2 Occupational choice

Every period individuals choose whether to be workers or entrepreneurs. Individuals that choose to be entrepreneurs then decide whether to operate a labor- or capital-intensive technology. Choosing the latter requires them to pay a fixed cost of operation M denominated in units of labor; choosing to be a worker or a labor-intensive entrepreneur is costless.

I refer to the set of labor-intensive and capital-intensive entrepreneurs as tradable sectors L and H, respectively; throughout the paper, I use the terms "sectors" and "industries" interchangeably.

2.1.3 Workers

Individuals that choose to be workers supply labor inelastically to entrepreneurs through a competitive labor market. They supply a unit of labor and are paid a wage rate w_t. Workers then allocate their labor income and savings from previous periods, between consumption and savings to carry over to the following period at a risk-free interest rate r; workers cannot borrow.

2.1.4 Entrepreneurs

Technology Entrepreneurs produce a differentiated variety by operating a constant-returns-to-scale production technology $y_t = z_t \left(k_t^{\alpha} n_t^{1-\alpha}\right)^{1-\varphi} h_t^{\varphi}$, where z_t is their idiosyncratic level of productivity; k_t is the capital stock; n_t is the amount of labor hired; h_t is the amount of intermediate inputs used; $\varphi \in (0,1)$ is the share of intermediate inputs; and $\alpha \in (0,1)$ is the capital share. Intermediate inputs are denominated in units of tradable goods and purchased from tradable-good producers. Labor-intensive entrepreneurs operate the production technology with a low capital share $\alpha = \alpha_L$, and capital-intensive entrepreneurs operate it with a high capital share $\alpha = \alpha_H$, where $\alpha_L < \alpha_H$.

Idiosyncratic productivity z_t is time-varying and follows an autoregressive process of degree one $\ln z_t = (1-\rho_z)\ln \mu_z + \rho_z \ln z_{t-1} + \varepsilon_t$, where ε_t is an *i.i.d.* shock distributed Normal with mean zero and standard deviation σ_z.

[9] If $\gamma = 1$, the utility function is given by $\mathbb{E}_0 \sum_{t=0}^{\infty} \beta^t \ln c_t$.

Capital is accumulated internally by transforming final goods invested in period t, x_t, into physical capital k_{t+1} 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. To export, they need to pay export entry costs and fixed export costs. Export entry costs S are only paid if entrepreneurs didn't export in the previous period; in contrast, fixed export costs F are paid every period. Both S and F are denominated in units of labor. Exporters are also subject to a per-period ad-valorem iceberg trade cost $\tau > 1$, which requires firms to ship τ units of the good exported for every unit sold at destination.

Following Manova (2013) and Chaney (2016), entrepreneurs need to pay the fixed and entry costs of exporting before production takes place and revenues are received, making exporting more finance-intensive than domestic sales.

Financial markets Entrepreneurs have access to an internationally integrated financial market, in which they can save or borrow from each other, from workers, and from the rest of the world by trading a one-period risk-free bond. The bond is denominated in units of the final good and trades at interest rate r.

Entrepreneurs can borrow but are subject to a borrowing constraint, which limits the amount borrowed to a fraction θ of the value of the capital stock at the time that the loan is due for repayment. Thus, they can borrow an amount d_{t+1} that is limited by the borrowing constraint $p_{t+1}d_{t+1} \leq \theta p_{t+1}k_{t+1}$ and the natural borrowing limit, where p_{t+1} denotes the price of final goods.

Market structure Within each tradable sector, entrepreneurs compete with each other and with imported varieties under monopolistic competition, and choose the quantities and prices for each market subject to their respective demand schedules. In the domestic market, the demand schedule is such that it solves the tradable-good producer's problem, while the demand schedule faced in the international market is the rest of the world's. These demand schedules are described in detail below.

Denote a given entrepreneur's quantities and prices in the domestic (or "home") market by $y_{h,t}$ and $p_{h,t}$, and those corresponding to the rest of the world (or "foreign") by $y_{f,t}$ and $p_{f,t}$, respectively.

2.1.5 Timing protocol

A period begins with a partition of individuals between workers and entrepreneurs, and a partition of entrepreneurs between labor- and capital-intensive producers. Then, the timing of the decisions of individuals is as follows. Workers begin the period by supplying labor to entrepreneurs. Entrepreneurs begin the period by hiring labor, purchasing intermediate inputs, producing their differentiated domestic variety, and then selling it in each of the markets in which they chose to operate at the end of the previous period.

After productive activities have taken place, individuals repay their debt from the previous period (or receive the savings from the previous period, with interest), and choose how to allocate the remaining resources between consumption and net worth, a_{t+1}, to carry over to the following period.

At the end of the period, they observe the following period's productivity shock and, then, choose their next period's occupation: worker, labor-intensive entrepreneur, or capital-intensive entrepreneur. Finally, entrepreneurs allocate their net worth between savings (or debt), physical capital, and the upfront payment of the fixed and entry costs of exporting (if they choose to start or continue to export).[10]

2.1.6 Individuals' problem

Given this setup, the individuals' problem at time zero consists of choosing sequences of consumption c_t, net worth a_t, and occupation $m_t \in \{W, L, H\}$, in order to maximize their lifetime expected utility; where $m_t = W$ if the individual chooses to be a worker, $m_t = L$ if the individual chooses to be a labor-intensive entrepreneur, and $m_t = H$ if the individual chooses to be a capital-intensive entrepreneur.

[10] The assumption that capital accumulation and savings decisions are made after observing next period's productivity follows Midrigan and Xu (2014) and Buera and Moll (2015), among others. This assumption simplifies the numerical solution of the model by making the capital accumulation decision risk-free; see the Online Appendix for details.

In periods in which individuals choose to be workers, these choices are made subject to a sequence of period-by-period budget constraints given by $p_t c_t + p_t a_{t+1} = w_t + (1+r) p_t a_t$.

Whenever individuals choose to be entrepreneurs, they also choose investment x_t, hire workers n_t, purchase intermediate inputs h_t, decide whether or not to export e_t, and choose prices and quantities $y_{h,t}$, $p_{h,t}$, $y_{f,t}$, $p_{f,t}$ at which to sell their differentiated variety in each of the markets. If they choose to export, then $e_t = 1$; otherwise, $e_t = 0$. In addition to the borrowing constraint $p_{t+1} d_{t+1} \leq \theta p_{t+1} k_{t+1}$ 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, laws of motion of capital $k_{t+1} = (1-\delta) k_t + x_t$, and production technologies $y_{h,t} + \tau y_{f,t} = z_t \left(k_t^{\alpha} n_t^{1-\alpha} \right)^{1-\varphi} h_t^{\varphi}$. Their budget constraint in period t is given by $p_t a_t = p_t k_t + w_t S \mathbb{I}_{\{e_t=1, e_{t-1}=0\}} + w_t F \mathbb{I}_{\{e_t=1\}} - \frac{p_t d_t}{1+r}$ and $p_t c_t + p_t a_{t+1} + p_t d_t + w_t M \mathbb{I}_{\{m_t=H\}} + w_t n_t + p_{T,t} h_t = p_{h,t} y_{h,t} + p_{f,t} y_{f,t} + (1-\delta) p_t k_t$, where p_t denotes the price of the final good; $p_{T,t}$ denotes the price of the tradable good; w_t denotes the wage rate; and $\mathbb{I}_{\{.\}}$ is an indicator function that is equal to one if its argument is true and zero otherwise.

2.2 Rest of the world

The rest of the world demands domestic varieties from entrepreneurs (the domestic economy's exports) and supplies foreign varieties to tradable-good producers (the domestic economy's imports). The demand for varieties produced by entrepreneurs of either type is assumed to be given by a downward-sloping demand function with constant elasticity of substitution σ, $y_{f,t} = \left(\frac{p_{f,t}}{\bar{p}^*} \right)^{-\sigma} \bar{y}^*$, where $\bar{y}^*$ and $\bar{p}^*$ are parameters that denote the aggregate absorption and its associated price index, respectively, in the rest of the world. The supply of varieties from the rest of the world is assumed to be perfectly elastic at price $\bar{p}_M$, which is set to be the numeraire good; imports are also subject to the ad-valorem iceberg trade cost τ.

Domestic entrepreneurs also trade with the rest of the world in international financial markets, where they face a perfectly elastic supply (or demand) at exogenous interest rate r.

2.3 Producer of nontradable goods

A representative producer of nontradable goods operates a constant-returns-to-scale technology that only uses labor. The technology is such that $n_{N,t}$ units of labor produce $y_{N,t} = n_{N,t}$ units of the nontradable good.[11]

2.4 Producer of tradable goods

A representative producer of tradable goods aggregates domestic and imported varieties to produce tradable goods. To do so, it operates a production technology with two nests. In its inner nest, tradable good producers combine domestic and imported varities to produce tradable sectoral goods using a constant elasticity of substitution (CES) production technology, with elasticity of substitution $\sigma > 1$. In its outer nest, tradable good producers combine tradable sectoral goods from each of the sectors to produce tradable goods using a Cobb-Douglas production technology.[12]

Let the set $[0, 1]$ index the unit measure of individuals in the economy, and let $\mathcal{S}_{j,t} \subset [0, 1]$ denote the set of individuals that choose to be entrepreneurs in each sector $j = L, H$. Given prices $\{p_{h,t}(i)\}_{i \in \mathcal{S}_{j,t}}$ charged by entrepreneurs in each sector and the price of imported varieties $\bar{p}_M$ charged by the rest of the world, tradable good producers choose the bundle of inputs of domestic varieties $\{y_{h,t}(i)\}_{i \in \mathcal{S}_{j,t}}$ and imported varieties $y_{j,M,t}$ from each sector $j = L, H$ that maximizes their profits. The tradable good producer's problem is then given by:

[11] This specification of nontradable goods is consistent with Midrigan and Xu (2014) and equivalent to abstracting from producers of nontradable goods, while allowing workers to choose whether to supply labor to entrepreneurs or to produce one unit of a homogeneous nontradable good.

[12] The technology to aggregate domestic and imported varieties within tradable sectors follows Armington (1969), Melitz (2003), and Alessandria and Choi (2014b). The technology to aggregate sectoral goods follows Caliendo and Parro (2014).

$$\max_{\substack{y_{T,t},\, y_{L,t},\, y_{H,t} \\ \{y_{h,t}(i)\}_{i \in \mathcal{S}_{L,t}},\, y_{L,M,t} \\ \{y_{h,t}(i)\}_{i \in \mathcal{S}_{H,t}},\, y_{H,M,t}}} \quad p_{T,t} y_{T,t} - \sum_{j=L,H} \left[\int_{i \in \mathcal{S}_{j,t}} p_{h,t}(i) y_{h,t}(i) di + \tau \bar{p}_M y_{j,M,t} \right]$$

subject to

$$y_{T,t} = y_{L,t}^{1-\omega} y_{H,t}^{\omega},\ y_{j,t} = \left[\int_{i \in \mathcal{S}_{j,t}} y_{h,t}(i)^{\frac{\sigma-1}{\sigma}} di + y_{j,M,t}^{\frac{\sigma-1}{\sigma}} \right]^{\frac{\sigma}{\sigma-1}} \quad \text{for } j = L, H;$$

where $p_{T,t}$ and $y_{T,t}$ denote the price and quantity of the tradable good; $y_{L,t}$ and $y_{H,t}$ denote the sectoral tradable good composites; and ω denotes the contribution of capital-intensive varieties to the production of tradable goods. The quantity of each variety $i \in \mathcal{S}_{j,t}$ demanded by tradable good producers is given by the demand functions $y_{h,t}(i) = \left[\frac{p_{h,t}(i)}{p_j} \right]^{-\sigma} y_{j,t}$, where $p_{L,t} \equiv \frac{y_{L,t}}{(1-\omega) p_{T,t} y_{T,t}}$ and $p_{H,t} \equiv \frac{y_{H,t}}{\omega p_{T,t} y_{T,t}}$.[13]

2.5 Producer of final goods

Finally, a representative producer of final goods purchases tradable and non-tradable goods, and aggregates them to produce a final good. To do so, it operates a constant-returns-to-scale Cobb-Douglas production technology $y_t = \left(y_{T,t}^F\right)^{1-\Phi} \left(y_{N,t}^F\right)^{\Phi}$, where $y_{T,t}^F$ and $y_{N,t}^F$ denote the amount of tradable and non-tradable goods used in the production of final goods, respectively.[14] Given prices $p_{T,t}$ and $p_{N,t}$ charged by producers of tradable and non-tradable goods, the producer of final goods chooses the bundle of these goods that maximizes

[13]While there is no market for sectoral tradable goods in this economy, prices $p_{L,t}$ and $p_{H,t}$ would hold in equilibrium in an alternative formulation with producers of tradable sectoral goods that aggregate domestic and imported varieties to sell a tradable sectoral good to tradable-good producers. Allocations are identical under both formulations; see Online Appendix for details.

[14]The technology to aggregate tradable and non-tradable goods follows Alessandria and Choi (2014b) and Ruhl (2008), among others.

its profits. Then, the final-good producer's problem is given by:

$$\max_{y_t, y^F_{T,t}, y^F_{N,t}} p_t y_t - p_{T,t} y^F_{T,t} - p_{N,t} y^F_{N,t}$$
$$\text{subject to} \quad y_t = \left(y^F_{T,t}\right)^{1-\Phi} \left(y^F_{N,t}\right)^{\Phi}$$

where p_t and y_t denote the price and quantity of the final good, respectively.

2.6 Individuals' problem: Recursive formulation

Consider an individual after the following period's productivity level is realized but before occupation decisions are made. Let $g(a, e, z)$ denote the value function of this individual; with net worth a, export status e (equal to one if exported in the previous period, and zero otherwise), and productivity level z. The individual first chooses whether to be a worker, a labor-intensive entrepreneur, or a capital-intensive entrepreneur:

$$g(a, e, z) = \max_{m \in \{W, L, H\}} g_m(a, e, z)$$

where $g_m(a, e, z)$ denotes the value function conditional on occupation $m \in \{W, L, H\}$. If the individual chooses to be a worker, its value is given by:

$$g_W(a, e, z) = \max_{d} v_W(d, z)$$
$$\text{subject to} \quad pa = -\frac{pd}{1+r}$$

where $v_W(d, z)$ denotes the value function of a worker that begins the period with debt level d (savings, if negative) and productivity level z. This value function is given by:

$$v_W(d, z) = \max_{c, a'} \frac{c^{1-\gamma}}{1-\gamma} + \beta \mathbb{E}_z \left[g(a', 0, z')\right]$$
$$\text{subject to} \quad pc + pa' + pd = w, \quad a' \geq 0$$

If the individual chooses to be an entrepreneur that operates technology

$j \in \{L, H\}$, the value function is equal to:

$$g_j(a, e, z) = \max_{k,d,e'} v_j(k, d, e', e, z)$$
$$\text{subject to} \quad pa = pk + wF\mathbb{I}_{\{e'=1\}} + wS\mathbb{I}_{\{e=0,e'=1\}} - \frac{pd}{1+r}, \quad pd \leq \theta pk$$

where $v_j(k, d, e, e', z)$ denotes the value function of an entrepreneur with current and previous export decisions e' and e, who operates technology $j \in \{L, H\}$, and begins the period with capital stock k, debt level d, and productivity level z. This function is given by:

$$v_j(k, d, e', e, z) = \max_{c,a',n,h,p_h,y_h,p_f,y_f} \frac{c^{1-\gamma}}{1-\gamma} + \beta\mathbb{E}_z\left[g(a', e', z')\right]$$

subject to

$$pc + pa' + pd = p_h y_h + p_f y_f \mathbb{I}_{\{e'=1\}} - wn - p_T h - wM\mathbb{I}_{\{j=H\}} + (1-\delta)pk,$$

$$y_h + \tau y_f = z\left(k^{\alpha_j} n^{1-\alpha_j}\right)^{1-\varphi} h^{\varphi}, \quad y_h = \left(\frac{p_h}{p_j}\right)^{-\sigma} y_j, \quad y_f = \left(\frac{p_f}{\bar{p}^*}\right)^{-\sigma} \bar{y}^*, \quad a' \geq 0$$

2.7 Equilibrium

Let $\mathcal{S} := \mathcal{A} \times \mathcal{E} \times \mathcal{Z}$ denote the individuals' state space, where $\mathcal{A} = \mathbb{R}^+$, $\mathcal{E} = \{0, 1\}$, and $\mathcal{Z} = \mathbb{R}^+$ denote the set of possible values of net worth, export status, and productivity, respectively. Finally, let $s \in \mathcal{S}$ denote an element of the state space.

Then, a *recursive stationary competitive equilibrium* of this economy consists of prices, policy functions, value functions, and a measure $\phi : \mathcal{S} \to [0, 1]$ over individuals' states such that:

1. Policy and value functions solve the individuals' problem
2. Policy functions solve the nontradable-good producer's problem
3. Policy functions solve the tradable-good producer's problem
4. Policy functions solve the final-good producer's problem

5. Labor market clears:

$$\int_{\mathcal{S}} \left[n(s) + M\mathbb{I}_{\{m(s)=H\}} + S\mathbb{I}_{\{e=0,e'(s)=1\}} + F\mathbb{I}_{\{e'(s)=1\}}\right] \phi(s)ds + n_N = \int_{\mathcal{S}} \mathbb{I}_{\{m(s)=W\}}\phi(s)ds$$

6. Nontradable-goods market clears: $y_N = y_N^F$

7. Tradable-goods market clears: $y_T = y_T^F + \int_{\mathcal{S}} h(s)\phi(s)ds$

8. Final-goods market clears: $y = \int_{\mathcal{S}} [c(s) + x(s)]\, \phi(s)ds$

9. Measure ϕ is stationary

3 Mechanism

I now investigate the channels through which financial frictions distort international trade flows in this economy. While recent studies have examined the extent to which financial frictions distort allocations in economies closed to international trade (see, for instance, Buera, Kaboski, and Shin, 2011; and Midrigan and Xu, 2014), the degree to which international trade flows might be relatively more distorted than production for the domestic market is much less understood. Therefore, I restrict attention to the effect of financial frictions on industry-level and aggregate trade shares rather than on the level of trade. Consistent with measurement throughout the rest of the paper, I refer to trade shares in the labor- and capital-intensive tradable sectors as "industry-level trade shares," and to the trade share across all tradable goods as the "aggregate trade share."[15]

The ratio of aggregate exports to aggregate domestic sales of tradable goods, the aggregate trade share,[16] in this economy is given by:

$$\frac{\text{Exports}}{\text{Domestic sales}} = \left(\frac{D_L}{D_L + D_H}\right) \times \frac{X_L}{D_L} + \left(\frac{D_H}{D_L + D_H}\right) \times \frac{X_H}{D_H}$$

[15] See the Online Appendix for derivations of all the expressions presented in this section.

[16] The ratio of exports to domestic sales is a monotonic function of the ratio of exports to total sales, which is sometimes referred to as the "trade share": $X/D = (\frac{1}{X/Y} - 1)^{-1}$, where X, D, and Y denote exports, domestic sales, and total sales. Thus, I refer to them interchangeably.

where D_j and X_j denote the level of domestic sales and exports, respectively, in industry $j \in \{L, H\}$.[17] Therefore, to understand the impact of financial frictions on the aggregate trade share, it is key to investigate their effect on industry-level trade shares, $\frac{X_j}{D_j}$.

The ratio of exports to domestic sales in industry $j \in \{L, H\}$ is given by:

$$\frac{X_j}{D_j} = \frac{\bar{y}^*}{y_j} \times \left(\frac{\bar{p}^*}{p_j}\right)^{\sigma} \times \widehat{\tau}_j^{1-\sigma}, \tag{1}$$

where $\widehat{\tau}_j$ is an endogenous object that captures the impact of trade-related costs and distortions on firms' decisions and the trade share; I refer to it as a "trade wedge" and describe it below in more detail. On the one hand, financial frictions affect the trade share by distorting sectoral quantities and prices: they increase the trade share by reducing the domestic demand for sectoral goods y_j, and have an ambiguous impact on it by distorting domestic prices p_j.[18] On the other hand, financial frictions distort export decisions, increasing the trade wedge and leading to a lower trade share. To the extent that the latter effect dominates, financial frictions reduce the ratio of exports to domestic sales.

Given that distortions to sectoral prices and quantities have already been examined in detail in previous studies, I focus on the determinants of trade-specific distortions. To do so, I study the forces that determine the trade wedge $\widehat{\tau}_j$, for $j \in \{L, H\}$:

$$\widehat{\tau}_j^{1-\sigma} = \left(\frac{E_j}{S_j}\right) \times \left[\frac{\frac{1}{E_j}\int_{\mathcal{X}_j}\left[z(s)\left(\frac{r+\delta}{r+\delta+\mu(s)\frac{1+r-\theta}{1+r}}\right)^{\alpha_j(1-\varphi)}\right]^{\sigma-1}\phi(s)ds}{\frac{1}{S_j}\int_{\mathcal{S}_j}\left[z(s)\left(\frac{r+\delta}{r+\delta+\mu(s)\frac{1+r-\theta}{1+r}}\right)^{\alpha_j(1-\varphi)}\right]^{\sigma-1}\phi(s)ds}\right] \times \tau^{1-\sigma}, \tag{2}$$

where μ is the Lagrange multiplier on the entrepreneurs' borrowing constraint; $\mathcal{X}_j$ is the set of firms that export in sector j; E_j denotes the measure of exporters in sector j; and S_j is the measure of entrepreneurs in sector j.[19]

[17] Where $D_j = \int_{\mathcal{S}_j} p_h(s)y_h(s)\phi(s)ds$, $X_j = \int_{\mathcal{S}_j} p_f(s)y_f(s)\phi(s)ds$, $\mathcal{S}_j = \{s \in \mathcal{S} | m(s) = j\}$.

[18] The impact of financial frictions on domestic prices depends on the net impact on firms' marginal costs from lower factor prices and capital misallocation.

[19] This decomposition is closely related to the empirical decomposition of the aggregate

The first term consists of the share of firms that export. As I discuss below, financial frictions reduce the share of firms that export, which leads to a higher trade wedge $\widehat{\tau}_j$ and a lower trade share. The second term measures the relative production scale between exporters in industry j and all entrepreneurs that operate in industry j.[20] While the optimal scale of entrepreneurs is increasing in productivity, their scale of production is decreasing in the magnitude of the Lagrange multipliers. Then, to the extent that financial frictions reduce the average scale of exporters (the numerator) relative to that of all firms that sell in the domestic market (the denominator), they increase the trade wedge $\widehat{\tau}_j$ and, thus, reduce the trade share. The last term consists of the variable trade cost τ and is, thus, unaffected by the extent of financial development.[21]

3.1 Financial frictions reduce relative scale of exporters

I now argue that financial frictions indeed reduce the scale of exporters relative to all domestic producers, decreasing the second term of Equation 2.

Financial frictions distort the production decisions of entrepreneurs by reducing the scale at which they operate the firm. If $\theta < 1 + r$, entrepreneurs with net worth a cannot operate the firm with a capital stock higher than $\frac{1+r}{1+r-\theta}\left[a - \frac{w}{p}F\mathbb{I}_{\{e'=1\}} - \frac{w}{p}S\mathbb{I}_{\{e=0,e'=1\}}\right]$, leading firms with low net worth to hold sub-optimal levels of capital.[22] In contrast, if θ is sufficiently higher than $1+r$, firms can operate with a capital stock that is as high as desired, regardless of their net worth a. The left panel of Figure 1 illustrates the relationship between net worth a and the total amount of output produced by exporters and non-exporters, conditional on states (e, z) and industry j: the solid and dashed lines illustrate the case with $\theta = 0$ and $\theta = \infty$, respectively, while keeping all

ratio of exports to total sales conducted by Alessandria and Choi (2014a). $\mathcal{X}_j$, E_j, and S_j are given by $\mathcal{X}_j := \{s \in \mathcal{S}_j | e'(s) = 1\}$, $E_j := \int_{\mathcal{S}_j} \mathbb{I}_{\{e'(s)=1\}}\phi(s)ds$, and $S_j := \int_{\mathcal{S}} \mathbb{I}_{\{m(s)=j\}}\phi(s)ds$.

[20] Scale is given by the average productivity across firms, adjusted by the extent to which the financial constraints bind.

[21] However, the impact of variable trade costs on allocations does depend on the degree of financial development: with financial frictions, higher variable trade costs reduce the extent to which firms can overcome distortions on export decisions by accumulating internal funds.

[22] I focus on the reformulated problem of individuals derived in the Online Appendix, which separates dynamic from static decisions and casts the problem with net worth $a = k + \frac{w}{p}F\mathbb{I}_{\{e'=1\}} + \frac{w}{p}S\mathbb{I}_{\{e=0,e'=1\}} - \frac{d}{1+r}$ as an endogenous state variable in place of k and d.

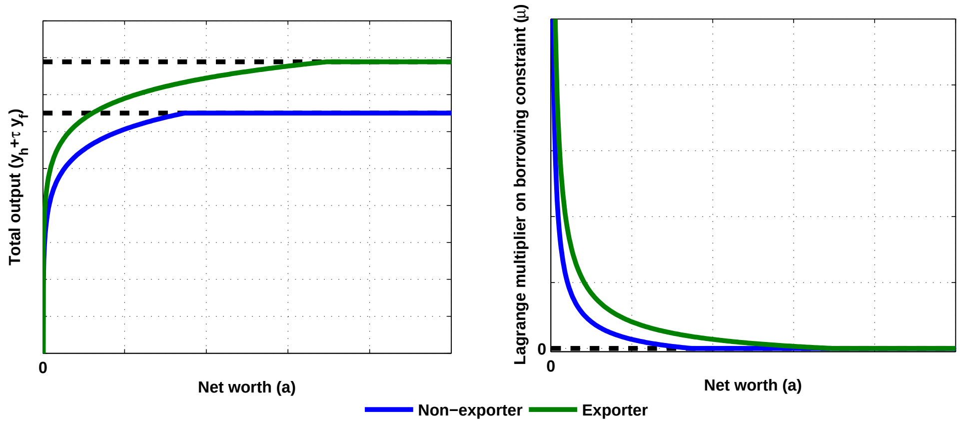

Figure 1: Total output and Lagrange multipliers

aggregate prices and quantities fixed.

The impact of financial constraints on firms' production decisions depends on their net worth and desired scale of operation. In particular, productive firms that sell to multiple markets have a relatively higher optimal scale than unproductive ones that only sell domestically. Therefore, conditional on a given level of net worth a in a given industry j, the model implies that the financial constraint of the former will be relatively more binding, as the gap between their effective and optimal scale of operation is relatively larger. The right panel of Figure 1 shows that, indeed, conditional on states (a, e, z) in industry j, exporters have higher Lagrange multipliers than non-exporters.

3.2 Financial frictions reduce the share of exporters

I now argue that financial frictions also reduce the share of firms that export, leading to a decrease in the first term of Equation 2.

On the one hand, firms with sufficiently low net worth cannot afford to finance the sunk export entry cost using the external and internal funds available. On the other hand, the distortions to the production scale of firms reduce the returns to exporting, leading firms with intermediate levels of net worth to avoid paying the entry and fixed export costs even if they can afford them. Thus, in either case, financial frictions induce productive firms with low net

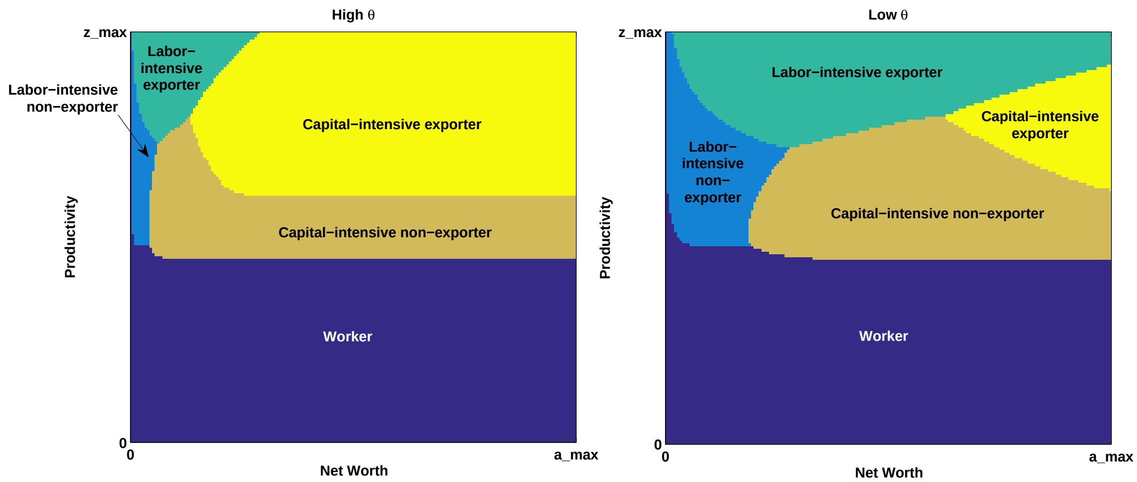

Figure 2: Occupation and Export Entry Decisions

worth to avoid exporting, reducing the share of exporters.

To illustrate the impact of these forces on firms' decision to export, Figure 2 contrasts the optimal occupation and exporting decisions between economies at different levels of financial development: an environment with tight financial frictions (low θ), and one with developed financial markets (high θ; but, as in the quantitative analysis, lower than $1 + r$). To focus on the impact of financial frictions on export decisions, I keep all aggregate prices and quantities unchanged across the two economies.[23]

In both economies, productivity is an important determinant of the decision to be an entrepreneur and to export. However, in the economy with tight financial frictions these decisions are significantly more affected by the level of net worth. In particular, high-productivity but low-net-worth entrepreneurs choose to export if they have access to developed financial markets but, instead, decide to only sell domestically if financial frictions are tight. Then, financial frictions reduce the share of firms that choose to export within a given industry.

As observed in Figure 2, financial frictions also distort the intensive and

[23] To ease the exposition, I restrict attention to individuals that did not export in the previous period ($e = 0$), and partition the rest of the state space according to their occupation-exporting choices.

extensive margins of exports by affecting the individuals' choice between being a worker or an entrepreneur, and the entrepreneurs' choice between the labor- and capital-intensive technologies. Individuals only choose to be entrepreneurs, and entrepreneurs only choose the capital-intensive technology, if net worth is sufficiently high, since these choices require high levels of net worth to operate at a profitable scale. In the next section, I examine the overall impact of these additional channels by investigating the quantitative effect of financial frictions on international trade at the industry and aggregate levels.

4 Quantitative analysis

In this section, I quantify the extent to which financial frictions distort international trade flows in this economy. To do so, I begin by estimating the parameters of the model to match key features of firm-level data. I then use the estimated model as a laboratory to study the impact of financial frictions on international trade at the industry and aggregate levels. In Section 5, I contrast my findings with estimates from the data.

4.1 Estimation

4.1.1 Data

I estimate the parameters of the model to match salient features of data from Chilean manufacturing firms over the period 1995 to 2007. The data were collected by the Chilean National Institute of Statistics (INE) as part of its Annual Census of Manufactures (ENIA). The census collects longitudinal data on all plants with more than ten workers and provides information on foreign and domestic sales, factor inputs, and other variables.[24] The dataset that I study contains information on 9,606 different firms over the 13-year period

[24] I exclude firms with negative or missing total sales. I interpret negative values of domestic sales, exports, or any of the production inputs as missing. I also exclude observations from the following Chile-specific International Standard Industrial Classification (ISIC) rev. 3 categories given their large dependence on natural resource extraction: category 2720 (manufactures of basic precious and non-ferrous metals; in particular, this category includes copper) and category 2411 (manufactures of basic chemicals except for fertilizers and nitrogen compounds; in Chile, this category includes petroleum refineries). The results are robust to the inclusion of these industry categories.

from 1995 to 2007, with 60,969 firm-year observations in total and 4,690 firms on average per year.

4.1.2 Parameterization

To choose the parameters of the model, I begin by partitioning the parameter space into two groups. The first group of parameters is set to standard values from the literature, and to values estimated directly from the data. The second group of parameters is estimated jointly following a simulated method of moments (SMM) approach to match key features of Chilean manufacturing firms. The parameter values are presented in Table 1,[25] while the moments targeted and their model counterparts are presented in Table 2.[26]

The set of predetermined parameters consists of the preference parameters γ and σ, the depreciation rate δ, the interest rate r, the share φ of intermediate inputs used in the production of domestic varieties, the share Φ of non-tradable goods used in the production of final goods, and the share ω of capital-intensive goods used in the production of tradables. The coefficient of relative risk aversion γ is set to 1, which implies a unitary intertemporal elasticity of substitution and a period utility function given by $\ln c$. The elasticity of substitution across varieties σ is set to 4, and the rate of capital depreciation δ is set to 0.06. These values are well within the range of values previously used in the literature to parameterize similar economic environments.[27] I set the interest rate to 5.54%, to match the average real interest rate in Chile over

[25] I report standard errors for the estimated parameters in the Online Appendix.

[26] I solve the model through value function iteration, approximating the idiosyncratic productivity process following Tauchen (1986). I compute the statistics of the model that are only a function of the current period's state variables using the stationary distribution of individuals, following the approach of Heer and Maussner (2005). I compute the rest of the moments by Monte Carlo simulation, as the average across 250 simulated panels of 200,000 individuals followed over 13 years; the baseline parameterization features approximately 5,000 firms per year on average. Further details on the numerical solution of the model are provided in the Online Appendix.

[27] See Buera, Kaboski, and Shin (2011) and Midrigan and Xu (2014) for economic environments that use similar values of the coefficient of relative risk aversion and the rate of capital depreciation. The intertemporal elasticity of substitution falls within the range estimated by Guvenen (2006) and Blundell, Meghir, and Neves (1993), while the elasticity of substitution across varieties is in the range estimated by Broda and Weinstein (2006) and Simonovska and Waugh (2014).

the period 1995-2007, as reported by the IMF's International Financial Statistics. I set the share of intermediate inputs φ in the production of domestic varieties to equal the average ratio of expenditures on intermediate inputs to total sales across Chilean manufacturing firms over the period 1995-2007; this value is well within the range estimated by Jones (2013) using industry-level data for 35 countries. Finally, I choose Φ to equal the average ratio of non-manufacturing absorption to aggregate absorption in Chile over the period 1995-2007, which I compute from the OECD's input-output tables for Chile.

The set of estimated parameters consists of β, θ, α_L, α_H, M, τ, S, F, σ_z, ρ_z, and $\bar{y}^*$. I estimate them jointly, following the simulated method of moments, to minimize the objective function MWM', where W is the identity matrix and M is a row vector whose elements are given by the log-difference between each target moment and its model counterpart.

Given I target moments from data on Chilean manufactures, I measure these moments in the model by restricting attention to the set of all producers of tradable goods. In particular, I target: (1) the ratio between the average sales at age five and the average sales at age one, among new firms that survive for at least five years; (2) the ratio of aggregate credit to aggregate value added in manufactures; (3) the ratio between the aggregate capital stock and the aggregate wage bill in manufactures; (4) the ratio between the average capital per worker across capital-intensive industries and the average capital per worker across labor-intensive industries; (5) the ratio between the average number of workers across capital-intensive industries and the average number of workers across labor-intensive industries; (6) the ratio of aggregate exports to aggregate total sales in manufactures; (7) the share of firms that export; (8) the rate at which firms stop exporting, conditional on continuing to produce for the domestic market (the export exit rate); (9) the ratio between the average sales of exporters and the average sales of non-exporters; (10) the rate at which firms stop operating (the firms' exit rate);[28] and (11) the ratio between Chile's absorption and the rest of the world's. All target moments $(1)-(10)$ are

[28]In the model, I measure the firms' exit rate as the share of entrepreneurs in period t who become workers in period $t+1$.

Table 1: Parameterization

Predetermined parameters		
Risk aversion	γ	1
Substitution elasticity	σ	4
Depreciation rate	δ	0.06
Interest rate	r	0.055
Share of intermediate inputs	φ	0.56
Share of non-tradables	Φ	0.75
Estimated parameters		
Discount factor	β	0.901
Borrowing constraint	θ	0.154
Labor-intensive capital share	α_L	0.177
Capital-intensive capital share	α_H	0.705
Capital-intensive fixed cost	M	0.570
Iceberg trade cost	τ	4.404
Sunk export entry cost	S	0.216
Fixed export cost	F	1.796
Productivity dispersion	σ_z	0.124
Productivity persistence	ρ_z	0.986
Size of the rest of the world	$\bar{y}^*$	25.824

computed using the Chilean firm-level dataset described above. To compute (2), I also use the total stock of credit outstanding in the manufacturing sector, as reported by the Superintendencia de Bancos e Instituciones Financieras de Chile. To compute (11), I approximate relative differences in absorption using GDP data from the World Bank.

Moments (4) and (5) capture capital-intensity and scale differences across industries in the data, helping to discipline the degree of heterogeneity across the industries in the model. To compute these moments, I first rank the industries in the data based on their capital-intensity. To do so, I compute each firm's average capital per worker (in constant 1995 prices), and compute each industry's capital per worker as the median across all firms within the industry.[29] Industries with capital per worker above the 90$^{\text{th}}$ percentile are defined

[29] I restrict attention to industries based on the ISIC rev. 2 industry classification to map the quantitative analysis of this section with the empirical analysis conducted in Section 5. I exclude observations from ISIC rev. 2 category 3511 (industrial chemicals) through the rest of the analysis as its capital per worker is an outlier relative to the rest of the industries; it

Table 2: Moments

Moment	*Data*	*Model*
Average sales (age 5/age 1)	1.568	1.866
Credit / Value added	0.191	0.190
Capital stock / Wage bill	4.815	4.832
Capital per worker (capital-intensive/labor-intensive)	10.536	10.827
# of workers (capital-intensive/labor-intensive)	1.980	1.560
Exports / Sales	0.218	0.216
Share of exporters	0.197	0.195
Export exit rate	0.117	0.117
Average sales (exporters/non-exporters)	8.329	8.480
Exit rate	0.119	0.126
Absorption / World absorption	0.25%	0.25%

Note: Data moments computed using data on Chilean manufacturing firms. Model moments measured across producers of tradable goods. See Section 4.1.2 for details.

as capital-intensive, while those below the 10$^{\text{th}}$ percentile are defined as labor-intensive.[30] In the model, I compare the capital per worker and number of workers between the two industries, where these industry-level statistics are computed as in the data. Given that I also target the ratio of aggregate capital to the aggregate wage bill in manufactures, the model implies a realistic aggregate production technology of manufactures while also featuring substantial heterogeneity in the technologies operated at the firm- and industry-level.

Finally, I assume that all differences across industries are technological and not driven by differences in demand; thus, I set $\omega = \frac{1}{2}$.[31] The remaining parameters are normalized: the price of imported goods $\bar{p}_M$, the average level of productivity μ_z, and the price level $\bar{p}^*$ are all set to one.

I find that the model accounts reasonably well for the target moments, as well as for salient features of the dynamics and cross-sectional features of firms not targeted in the estimation; see the Online Appendix for details.

is more than five times as large as the industry with the second-highest capital per worker.

[30] The quantitative implications of the model are robust to parameterizations based on alternative classifications.

[31] I also implicitly assume that the demand from the rest of the world is not sector-specific.

4.1.3 Identification

While all the estimated parameters simultaneously affect all the target moments, I now provide a heuristic argument to map the former to the latter.

The discount factor β determines the amount of net worth held by individuals when they become entrepreneurs, affecting the extent to which they are constrained upon entry and their growth thereafter. Similarly, the borrowing constraint parameter θ determines the amount that firms borrow and, thus, the amount of credit in the economy.

The capital shares α_L and α_H affect the aggregate capital to wage-bill ratio as well as the relative capital per worker across industries. Given these technological differences, the fixed cost M to operate in the capital-intensive sector affects the relative scale of firms across industries.

The iceberg trade cost τ and the size of the rest of the world $\bar{y}^*$ play a key role in determining the aggregate ratio of exports to total sales as well as the size of the domestic economy relative to the rest of the world.[32] The sunk export entry cost S affects the export entry threshold and, thus, the share of firms that export; similarly, the fixed export cost F affects the export exit threshold and, thus, the rate at which firms stop exporting.

Finally, the dispersion σ_z and persistence ρ_z of idiosyncratic productivity determine the size of exporters relative to non-exporters as well as the firms' exit rate, respectively.

4.2 The experiment: Financial development

To study the impact of financial development on international trade flows, I contrast the stationary equilibrium allocations of the estimated model with those of two economies at different levels of financial development. In the first economy, I consider an environment in which firms have no access to external finance; to do so, I set θ to zero, while keeping all other parameters unchanged. In the second economy, I set θ to match the highest ratio of credit to value

[32] I interpret τ broadly, as a residual that may capture channels not modeled explicitly which account for the amount of trade observed in the data. In particular, it may capture more than technological trade costs; for instance, it may reflect policy distortions or demand-side factors that affect international trade (Fieler 2011) but which are not modeled explicitly.

added observed in cross-country data, which I interpret as an economy with highly developed financial markets.[33] Specifically, I choose θ to target Japan's average ratio of private credit to value added, equal to 1.63, as reported by Manova (2013), based on data from 1985-1995. The value of θ required to match this moment, while keeping all other parameters unchanged, is 0.953.

I refer to the implications of the model for the labor- and capital-intensive tradable sectors as "industry-level," and to the implications across all producers of tradable goods as "aggregate-level."

4.3 Industry-level implications

I first ask: to what extent do financial frictions affect the share of output traded internationally across industries that differ in their dependence on external finance?

I report the industry-level implications of the counterfactual experiment in Panel A of Table 3. The columns of the table report the equilibrium outcomes corresponding to the different economies under study. I label the economy with $\theta = 0$ as "No credit," the baseline model with $\theta = 0.154$ as "Baseline," and the economy with $\theta = 0.953$ as "High credit." Rows 1 to 4 of this panel report equilibrium outcomes corresponding to each of the two types of entrepreneurs, or industries, in the economy.

I find that, as the financial constraint is relaxed, exports increase relative to domestic sales in the capital-intensive industry — the ratio between them increases from 0.35 in the economy without credit, to 0.54 in the high-credit environment. In contrast, I find that the ratio of exports to domestic sales decreases sharply in the labor-intensive industry — from 0.21 in the economy with no credit, to 0.03 in the economy with developed financial markets.

The response of industry-level trade shares to an increase in θ depends on the relative magnitude of two opposing forces. On the one hand, financial development increases the amount that firms can borrow, allowing them to

[33]While the frictionless benchmark is given by $\theta = \infty$, I restrict attention to degrees of financial development feasible to the most advanced economies. Thus, I study the impact of improving financial markets to the level of developed economies, rather than to an abstract frictionless counterpart.

Table 3: Financial development and international trade

		No credit	*Baseline*	*High credit*
A. Industry-level implications				
Exports / Domestic sales	Labor-intensive	0.21	0.18	0.03
	Capital-intensive	0.35	0.37	0.54
Share of exporters	Labor-intensive	0.11	0.10	0.02
	Capital-intensive	0.45	0.50	1.00
Average sectoral productivity (H/L)		1.22	1.28	1.72
B. Aggregate implications				
Agg. credit / Agg. value added		0.00	0.19	1.63
Agg. exports / Agg. domestic sales		0.28	0.28	0.29
C. Prices				
Real wage (w/p)		0.99	1.00	1.04
Real exchange rate (p^*/p)		1.01	1.00	0.92
Relative price of tradables (p_T/p_N)		1.03	1.00	0.85
Relative sectoral price (p_H/p_L)		1.02	1.00	0.89

Notes: Prices are reported such that their baseline value is equal to 1. Sectoral productivities are computed as the average value of z across the entrepreneurs in each sector.

operate at a higher scale and to afford the export entry cost, thereby increasing the returns to exporting and the trade share. On the other hand, the higher scale of firms increases the demand for labor and, thus, the equilibrium wage (see Panel B of Table 3), reducing the returns to exporting and the trade share. Then, the overall effect of financial development on industry-level trade shares depends on the relative magnitude of these two opposing forces: to the extent that the former dominates, the trade share increases — and vice-versa.

Production decisions are relatively more distorted by financial frictions among firms in the capital-intensive industry since they have a higher optimal capital stock. Thus, capital-intensive firms experience a relatively larger increase in the incentives to trade when financial markets develop, which leads to an increase in the share of exporters. Similarly, access to external finance enables high-productivity entrepreneurs to operate the capital-intensive technology closer to its optimal scale, increasing the relative productivity of the entrepreneurs that choose to operate in the capital-intensive sector. In contrast, the higher labor costs that result from financial development have a higher impact on the labor-intensive industry, given its higher use of labor in production. Therefore, firms in the capital-intensive industry experience a relatively larger net increase in the incentives to trade than labor-intensive producers, explaining the differential response of industry-level trade shares.

These findings show that financial development leads to a large reallocation of trade shares across industries. In Section 5, I study the extent to which these industry-level implications are quantitatively consistent with empirical estimates of these effects.

4.4 Aggregate implications

Next, I ask: to what extent do financial frictions affect the share of output that is traded internationally at the aggregate level?

To answer this question, I compute the aggregate trade share for each of the economies studied in the previous subsection. I report these results in Panel B of Table 3. As before, each column reports the equilibrium outcomes corresponding to the different economies.

On the one hand, as financial frictions are relaxed from the economy without credit to its financially-developed counterpart, firms increase the amount borrowed and the aggregate ratio of credit to value added increases sharply, from 0.00 to 1.63. On the other hand, financial development leads to a small increase in the aggregate trade share, from 0.28 to 0.29. With financial development, higher factor input prices partially offset the increased incentives to trade internationally that result from better access to external finance. Then, while financial frictions lead to a strong reallocation of industry-level trade flows, their impact on aggregate trade flows is considerably milder.

These findings also stand in contrast to the strong empirical relationship between trade and finance previously documented in the literature at the industry-level. While such evidence may suggest that financial frictions have a sizable impact on international trade flows at the aggregate level, my findings show that this is not necessarily the case.

4.5 Welfare gains

I now investigate the welfare implications of financial development. To do so, I restrict attention to comparing the well-being of individuals in the stationary equilibrium of the economy without credit relative to individuals in the stationary equilibrium of the economy with developed financial markets. Following Lucas (1987), I measure the welfare change as the consumption-equivalent change across all individuals. In particular, I ask: If one were to take the place of a randomly-chosen individual of the economy with no credit, what proportional state-independent lifetime increase Δ of consumption would one need to be offered to remain indifferent from becoming a randomly-chosen individual of the economy with developed credit markets?

To answer this question, I first compute the expected lifetime utility of becoming a randomly-chosen individual from the stationary equilibrium of the economy with developed credit markets $\int_{\mathcal{S}} g_{\theta_H}(a,e,z)\phi(s)ds$, where $g_{\theta}(a,e,z)$ denotes the value function of an individual with net worth a, export status e, productivity z, and collateral constraint parameter θ. Then, I compute the expected lifetime utility of becoming a randomly-chosen individual from the stationary equilibrium of an economy without credit markets $\int_{\mathcal{S}} g^{\Delta}_{\theta_L}(a,e,z)\phi(s)ds$, where $g^{\Delta}_{\theta}(a,e,z)$ denotes the value function of an individual in the stationary equilibrium of an economy with collateral constraint θ and period utility function $u(c) = \ln[(1+\Delta)c]$.

The welfare gains from financial development are given by the value of Δ that solves $\int_{\mathcal{S}} g_{\theta_H}(a,e,z)\phi(s)ds = \int_{\mathcal{S}} g^{\Delta}_{\theta_L}(a,e,z)\phi(s)ds$. Analogous to Mendoza, Quadrini, and Ríos-Rull (2007), Δ can be computed directly as:[34]

$$\Delta = e^{(1-\beta)\left[\int_{s\in\mathcal{S}} g_{\theta_H}(a,e,z)\phi(s)ds - \int_{s\in\mathcal{S}} g_{\theta_L}(a,e,z)\phi(s)ds\right]} - 1.$$

The first value in Table 4 reports the welfare gains from financial development $\Delta \times 100$ corresponding to the experiment conducted in the previous subsections. I find that if one were to become a randomly-chosen individual from the economy without credit, one would need to be offered a permanent

[34] See the Online Appendix for details.

Table 4: Gains from Financial Development

	Baseline	Financial autarky	Closed economy	Role of trade
Welfare	4.59%	4.24%	4.07%	0.17%
Consumption	2.95%	4.00%	3.51%	0.49%
Absorption	4.52%	4.56%	4.02%	0.54%

state-independent increase of consumption equal to 4.59% to remain indifferent from becoming a randomly-chosen individual from the economy with developed credit markets. Similarly, I find that real aggregate consumption and real aggregate absorption increase by 2.95% and 4.52%, respectively, between these economies.

4.5.1 Role of international trade

While financial development enables productive firms with low net worth to take advantage of exporting opportunities that may not have been profitable in the economy without credit, better financial markets also impact firms not directly involved in international trade (Buera and Shin 2011). Thus, I now investigate the role of international trade in accounting for the welfare gains from financial development.

To do so, one approach would be to recompute the results reported in the previous subsection for an economy closed to international trade but otherwise identical to the baseline. However, given that the economy cannot operate under international financial integration if closed to trade, I proceed in steps.

First, I contrast the implications of the baseline experiment with those from a counter-factual economy that operates under international financial autarky but is open to international trade ("financial autarky"). Then, I examine a counter-factual economy that operates under international financial autarky and is also closed to trade ("closed economy"). All parameters are otherwise identical to those in Table 1.[35] The second and third columns of Table 4 report the gains in these economies when moving from an environment without credit ($\theta = 0$) to an economy with developed credit markets ($\theta = 0.953$, as in the baseline experiment).

[35] Under international financial autarky, the interest rate r clears domestic financial markets: $\int_{\mathcal{S}} d(s)\phi(s)ds = 0$. The economy without trade is such that $\tau = S = F = p_M = \infty$.

I first find that the welfare gains from financial development under international financial autarky are lower than in the baseline model (4.24% vs. 4.59%, respectively). Moreover, I also find that access to international trade increases the gains from financial development: in the economy under international financial autarky and closed to trade the gains are lower than in its open-to-trade counterpart (4.07% vs. 4.24%, respectively). Thus, I conclude that the contribution of trade to the welfare gains from financial development is equal to 0.17% (that is, the difference between 4.24% and 4.07%).

Similarly, the second and third rows of the table show that the contribution of international trade to the change in consumption and absorption in response to financial development is equal to 0.49% and 0.54%, respectively.

4.6 Robustness

I now investigate the sensitivity of the quantitative findings reported in the previous subsections to alternative modeling assumptions and extensions of the model. To ease the exposition, I omit some details about the estimation and results; see the Online Appendix for a more exhaustive presentation.

4.6.1 Model with multiple export destinations

I consider an economy where firms can choose the set of export destinations rather than exporting to a unified world market. I assume that firms have access to N export markets, indexed by $i = 1, ..., N$. In each market, entrepreneurs face a destination-specific demand schedule $y_{f,i} = \left(\frac{p_{f,i}}{\bar{p_i}^*}\right)^{-\sigma} \bar{y_i}^*$, where $\bar{y_i}^*$ and $\bar{p_i}^*$ are exogenous parameters that denote the aggregate absorption and its associated price index in market i. While entrepreneurs need to pay a destination-independent sunk export entry cost S if they didn't export in the previous period, they are now subject to destination-specific fixed and variable export costs F_i and τ_i. All fixed and sunk costs are denominated in units of labor.

This extension of the model introduces an additional extensive margin of adjustment: financial development may now lead continuing exporters to expand their exports by increasing the number of export destinations. To quantify the potential importance of this channel, I consider an economy in which export destinations are given by the different continents of the world. I set $N = 4$ and explicitly model the entrepreneurs' decision to export to America, Europe, Asia-Oceania, and Africa. The extended model features 10 additional parameters, which I discipline by targeting 10 additional destination-specific moments: (1) the ratio between total exports to destination i and aggregate exports, (2) the share of exporters that export to destination i, and (3) the ratio between absorption and destination i's absorption.[36] Moments (1) and (2) are targeted for America, Europe, and Asia-Oceania, and computed using a transaction-level dataset with information on the universe of Chilean exports over the period 2003-2007; moment (3) is targeted for all destinations.

I find that the industry-level and aggregate implications of the model are not significantly affected by allowing exporters to endogenously choose the set of export destinations served. As we move from the economy without credit to its financially developed counterpart, the trade share in the capital-intensive industry increases from 0.37 to 0.54 (0.35 to 0.54 in the baseline). In contrast, the trade share decreases from 0.23 to 0.04 in the labor-intensive industry (0.21 to 0.03 in the baseline). Finally, the aggregate trade share increases from 0.296 to 0.297 (0.275 to 0.295 in the baseline).

4.6.2 Model with productivity-specific death rates

I consider an economy with productivity-specific death rates estimated to match the non-trivial rate of exit observed in the data among large firms (8.3% of firms with sales among the top third exit every year). I model the dependence of exit rates on productivity following Alessandria and Choi (2014b). New individuals are born with zero net worth, and assets of dead individuals are returned to surviving individuals through perfect annuity markets.

Accounting for the high exit rate among large firms may affect the estimated export costs, potentially affecting the quantitative implications of financial development. For instance, insofar a significant share of large exporters exit every period, it may suggest that the returns to paying the export entry costs are sufficiently high to compensate the future exit probability.

[36] Destination i's absorption is given by $\bar{p_i}^* \bar{y_i}^*$. As in the baseline, I approximate relative differences in absorption using GDP data from the World Bank.

I find that the industry-level and aggregate implications of the model are not significantly affected by accounting for the high exit rates among large firms. As we move from the economy without credit to its financially developed counterpart, the trade share in the capital-intensive industry increases from 0.32 to 0.46 (0.35 to 0.54 in the baseline). In contrast, the trade share decreases from 0.22 to 0.07 in the labor-intensive industry (0.21 to 0.03 in the baseline). Finally, the aggregate trade share increases from 0.270 to 0.273 (0.275 to 0.295 in the baseline).

4.6.3 Additional robustness

In the Online Appendix I also examine the sensitivity of the quantitative results to three additional versions of the model. First, I consider an economy in which export costs are not paid upfront but, instead, are paid after revenues are realized; making exporting a less finance-intensive activity. Second, I consider two economies with alternative intensities of the precautionary savings motive. Finally, I consider an economy under international financial autarky. I find that the industry-level and aggregate implications of the model are not significantly affected by these variations of the model.

5 Empirical evidence

In this section, I contrast the quantitative implications of the model with estimates from the data.

5.1 Industry-level estimates

I first ask: to what extent are the implications of the model consistent with the empirical relationship between financial development and international trade at the industry level?

To answer this question, I construct an empirical counterpart to the industry-level implications of the model. First, I use cross-country industry-level data to estimate the trade share of an industry in a given country and year as a function of two key variables: a measure of the country's level of financial development and its interaction with a measure of the industry's capital-intensity. Then, I use the estimated specification to compute the change in the trade share associated with a change in the level of financial development across industries with different degrees of capital-intensity. Finally, I contrast these empirical estimates with the implications of the model.

5.1.1 Empirical specification

Equations (1) and (2) of the model imply that the trade share of an industry that operates a production technology with capital-intensity $\alpha_j \in \{\alpha_L, \alpha_H\}$ in a given country can be expressed as:

$$\ln \frac{\text{Exports}_j}{\text{Domestic sales}_j} = \ln\left(\frac{\bar{p^*}^{\sigma}\bar{y}^*}{p^{\sigma}y}\right) + (1-\sigma)\ln\tau + \ln\left(\frac{p^{\sigma}y}{p_j^{\sigma}y_j}\right) + \ln\left(\frac{E_j}{S_j}\right) + \ln\left[\frac{\frac{1}{E_j}\int_{\mathcal{X}_j}\left[z(s)\left(\frac{r+\delta}{r+\delta+\mu(s)\frac{1+r-\theta}{1+r}}\right)^{\alpha_j(1-\varphi)}\right]^{\sigma-1}\phi(s)ds}{\frac{1}{S_j}\int_{\mathcal{S}_j}\left[z(s)\left(\frac{r+\delta}{r+\delta+\mu(s)\frac{1+r-\theta}{1+r}}\right)^{\alpha_j(1-\varphi)}\right]^{\sigma-1}\phi(s)ds}\right].$$

To obtain an empirical counterpart to this expression, I follow an approach analogous to Manova (2013) and Beck (2003). On the one hand, notice that the first two terms are identical across all industries within a given economy since they only depend on country-level characteristics (such as the level of financial development, the productivity distribution, and the variable trade cost). On the other hand, the rest of the terms are also a function of industry-level characteristics (such as their capital-intensity and the share of exporters).

Therefore, I estimate an industry's trade share in a given country as a function of the country's level of financial development, and its interaction with the industry's capital-intensity. As in Manova (2013), I also include country, industry, and year fixed effects, as well as additional variables, to control for systematic differences in industry-level trade shares unrelated to financial development and capital-intensity. Given that the borrowing constraint parameter θ in the model is not industry-specific, I also control for differences in asset tangibility across industries following Manova (2013) and Braun (2003).

Then, I estimate:

$$\ln \frac{\text{Exports}_{ijt}}{\text{Domestic sales}_{ijt}} = \alpha_i + \beta_j + \gamma_t + \frac{\text{Credit}_{it}}{\text{GDP}_{it}}\left[\omega_1 + \omega_2 \times \text{Capital-per-worker}_j + \omega_3 \times \text{Tangibility}_j\right] + \boldsymbol{\vartheta} \times \boldsymbol{X_{it}} + \varepsilon_{ijt},$$

where i, j, and t index countries, industries, and years, respectively; α_i, β_j, and γ_t are fixed effects corresponding to the different countries, industries, and years, respectively; $\frac{\text{Exports}_{ijt}}{\text{Domestic sales}_{ijt}}$ denotes the ratio of total exports to total domestic sales; $\frac{\text{Credit}_{it}}{\text{GDP}_{it}}$ denotes the ratio of credit to GDP, which is a widely-used outcome-based measure of financial development; Capital-per-worker$_j$ denotes a measure of industry j's capital per worker; Tangibility$_j$ denotes a measure of asset tangibility; $\boldsymbol{X_{it}}$ is a vector of additional control variables; and, finally, ε_{ijt} is an error term.

5.1.2 Data

The data used to estimate the specification above are based on the dataset from Manova (2013) for manufacturing industries across countries between 1985 and 1995.[37]

I compute industry-level trade shares as the ratio between exports and domestic sales. Exports are obtained from Feenstra's *World Trade Database* and aggregated to the 3-digit ISIC rev. 2 level using Haveman's concordance tables. Domestic sales are computed by subtracting exports from gross output, as measured by the United Nations Industrial Development Organization (UNIDO) at the 3-digit ISIC rev. 2 level; both exports and gross output are measured in current U.S. dollars.[38]

Country-level credit-to-GDP is obtained from Beck, Levine, et al. (1999) and covers the total amount of credit issued by banks and other financial intermediaries to the private sector. This variable ranges from 0.005 in Tanzania in 1988, to 1.79 in Japan in 1995 (as mentioned above, Japan's average over the whole sample is 1.63). The mean of this variable is 0.47, and its standard deviation is 0.36.

To measure the industries' technologically-driven capital-intensity while abstracting from potential distortions and other factors that may affect an industry's equilibrium capital-intensity, I follow an approach analogous to Rajan and Zingales (1998). To do so, I use firm-level data of publicly-listed U.S. companies from Compustat's annual industrial files over the period 1985-1995.

[37] This dataset is publicly available from the publisher's website.

[38] Observations with negative industry-level domestic sales are dropped; this is the case for 10.54% of all otherwise-valid observations. In the Online Appendix, I show that the estimation results are robust to accounting for these observations.

First, I compute each firm's capital per worker as its average value over the period. Then, I let each industry's capital per worker be given by the median capital per worker across all firms within the industry. This variable ranges from \$5.50 million U.S. dollars (at constant 1985 prices) per thousand workers for footwear products (except rubber or plastic), to \$50.40 million per thousand workers for miscellaneous petroleum and coal products. The mean of this variable is \$21.63 million per thousand workers, and its standard deviation is \$12.39 million per thousand workers.[39]

Analogous to Rajan and Zingales (1998), this measure is informative about the industries' technological capital-intensity in different countries under the following two assumptions: (*i*) given that the U.S. is one of the world's most financially developed economies and that large public firms are the least likely to face credit constraints, I assume that the capital-per-worker of large U.S. firms provides an undistorted measure of the industries' technological capital-intensity; and (*ii*) I also assume that differences in capital-per-worker across U.S. industries are representative of capital-intensity differences across industries in the rest of the world. While (*i*) has become a standard assumption following Rajan and Zingales (1998), there is also evidence in support of (*ii*): the correlation between industry-level capital per worker in the U.S. and Chile is 0.669, while their Spearman's rank correlation is 0.665.

Following Manova (2013), I use Braun (2003)'s measure of asset tangibility based on data for publicly-listed U.S. companies from Compustat's annual industrial files. At the firm-level, asset tangibility is measured as the share of net property, plant, and equipment in the book value of total assets; a firm's book value may include assets that cannot be seized by a bank as easily as physical capital and, thus, may not be accepted as collateral. Then, industry-level tangibility is defined as the median tangibility across all firms within an industry. This variable ranges from 0.07 in the pottery, china, and earthenware industry to 0.56 in the paper industry, with a mean value of 0.27 and a standard deviation of 0.12.

[39]To ensure comparability with the quantitative analysis conducted in the previous section, I exclude the same industries as in the Chilean firm-level dataset.

Table 5: Industry-level implications, regression estimates

	ln(Exports/Domestic sales)
Credit/GDP	-0.700
	(0.151)
Credit/GDP × Capital per worker	0.042
	(0.003)
Credit/GDP × Tangibility	-2.673
	(0.333)
R-squared	0.519
Number of observations	15,158

Note: Country, industry, and year fixed effects are included. I also control for GDP per capita (in logs). Heteroskedasticity-robust standard errors are reported in parentheses.

Finally, I control for GDP per capita (PPP-adjusted) from the Penn World Tables 6.3. Then, the dataset consists of an unbalanced panel with 106 countries and 25 sectors at the 3-digit ISIC rev. 2 level, from 1985 to 1995.[40]

5.1.3 Regression estimates

Table 5 reports the ordinary least squares (OLS) estimates of the empirical specification above. I only report the coefficients on the aggregate ratio of credit to GDP and its interactions since these are the main objects of interest.

To examine the empirical relationship between financial development and international trade across industries, I compute the partial derivative of the trade share (in logs) with respect to the credit-to-GDP ratio, which is given by $\omega_1 + \omega_2 \times \text{Capital-per-worker}_j + \omega_3 \times \text{Tangibility}_j$. The estimate of ω_2, which is positive and statistically significant, implies that capital-intensive industries have relatively higher trade shares in countries with better developed financial markets. These estimates are qualitatively consistent with the model's industry-level implications, as well as with the evidence documented by Manova (2013).

5.1.4 Model vs. empirical estimates

I now study the extent to which the model's industry-level implications are quantitatively consistent with the empirical estimates reported above.

[40] I examine the sources of missing observations in the Online Appendix; I show that the findings are robust to accounting for various sources of missing data.

To do so, I use the regression estimates to compute the trade share change in capital- and labor-intensive industries associated with the development of financial markets. In particular, I consider a change of the credit-to-GDP ratio from 0.00 to 1.63, the same change featured by the credit to value added ratio in the model between the no-credit and high-financial-development economies.

To construct an empirical counterpart to the change of the trade share in the model's capital-intensive industry, I evaluate the estimated regression at the average capital per worker across industries with capital per worker above the 90^{th} percentile: \$ 48.72 million U.S. dollars (at constant 1985 prices) per thousand workers. Similarly, I compute the empirical counterpart to the change of the trade share in the model's labor-intensive industry by evaluating the estimated regression at the average capital per worker across industries with capital per worker below the 10^{th} percentile: \$ 5.82 million U.S. dollars (at constant 1985 prices) per thousand workers. This mapping between the industries in the model and those observed in the data is consistent with the approach that I follow to estimate the model.[41]

Finally, I evaluate the estimated regression at its average value of tangibility, equal to 0.27. Thus, I estimate the relationship between financial development and international trade in industries with an average degree of net worth collateralizability.

Table 6 contrasts the log-change of industry-level trade shares, in response to financial development, between the data and the model. In particular, I restrict attention to financial development as a move from the economy without credit to the financially-developed economy. I find that the model can account for a large fraction of the trade share changes implied by the empirical specification estimated above.

On the one hand, both the model and the data imply that financial development is associated with a substantial increase of the ratio of exports to domestic sales in capital-intensive industries. In particular, it increases by

[41] Recall that I estimate differences between the capital- and labor-intensive industries of the model to match their empirical counterpart between the set of industries with capital per worker above the 90^{th} percentile and those below the 10^{th} percentile, respectively.

Table 6: Industry-level implications, model vs. data

$\Delta \ln \frac{\text{Exports}}{\text{Domestic sales}}$	*Data*	*Model*
Labor-intensive	-1.94	-1.85
Capital-intensive	0.97	0.44

0.97 and 0.44 log-points in the data and the model, respectively. On the other hand, I find that there is a sharp decrease of the trade share in labor-intensive industries: by -1.94 and -1.85 log-points in the data and the model, respectively. Thus, the model accounts for 45.4% and 95.4% of the log-changes of the trade share estimated from the data for capital- and labor-intensive industries.

I conclude that the model can quantitatively account for a large fraction of the empirical relationship between trade shares and financial development across industries. These findings provide further support to the implications of the model and to the importance of its underlying mechanisms.

5.2 Aggregate-level estimates

Finally, I ask: to what extent are the implications of the model consistent with the empirical relationship between financial development and international trade at the aggregate level?

To answer this question, I aggregate the cross-country industry-level dataset from Manova (2013) across all available industries, to obtain a panel where each observation corresponds to the manufacturing sector of a given country-year pair.[42] Then, I estimate a country-level empirical specification analogous to the one above, but excluding industry-level variables and industry fixed effects. Then, I estimate:

$$\ln \frac{\text{Exports}_{it}}{\text{Domestic sales}_{it}} = \alpha_i + \gamma_t + \omega \times \frac{\text{Credit}_{it}}{\text{GDP}_{it}} + \boldsymbol{\vartheta} \times \boldsymbol{X_{it}} + \varepsilon_{it},$$

where i and t index countries and years, respectively; α_i and γ_t are country and year fixed effects, respectively; $\frac{\text{Exports}_{it}}{\text{Domestic sales}_{it}}$ denotes the ratio of total

[42] For every country-year pair, I aggregate across all industries with non-missing observations of exports and output.

Table 7: Aggregate-level implications, regression estimates

	ln(Exports/Domestic sales)
Credit/GDP	0.172
	(0.235)
R-squared	0.892
Number of observations	823

Note: Fixed effects for each country and year are included. I also control for distance and GDP per capita. Heteroskedasticity-robust standard errors are reported in parentheses.

manufacturing exports to total manufacturing domestic sales; $\frac{\text{Credit}_{it}}{\text{GDP}_{it}}$ denotes the ratio of credit to GDP; $\boldsymbol{X_{it}}$ denotes a vector of additional control variables (distance and GDP per capita); and, ε_{it} is an error term.[43]

Table 7 reports the estimation results. I find that the coefficient on the credit-to-GDP ratio is positive but statistically insignificant. Consistent with the implications of the model, this implies that financial development is associated with a minor change of aggregate trade shares.

6 Conclusion

Recent studies have documented a strong empirical relationship between measures of access to external finance and the extent of international trade at both the firm and industry levels, suggesting that financial development has a significant impact on international trade in the aggregate. In this paper, I examine the extent to which this is the case using a quantitative general equilibrium model estimated to match salient features of firm-level data.

My findings show that, while financial frictions have a significant impact on international trade at the industry-level, they have a minor impact on it at the aggregate-level. I show that these findings are consistent with evidence from cross-country industry-level and aggregate data.

These results point to the importance of general equilibrium effects in interpreting firm- or industry-level evidence. While some distortions may play an important role when studying firms or industries in isolation, their importance at the aggregate level may be offset by changes in equilibrium prices.

[43]Distance is measured as the average distance between country i and its trade partners.

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