Local Credit and International Trade

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1 Introduction

Imperfect credit markets are known to restrict growth and hamper development. Studies show that cross-country differences in financial access have significant effects on trade and production,[1] but less is known about variation in credit constraints *within* countries. Theoretical and empirical work has shown that bank-to-firm distance remains an important driver of credit constraints,[2] meaning that *local* financial development is an important determinant of firm-level outcomes, especially in developing countries.[3] This effect varies by firm size, particularly at the margins: smaller firms are more sensitive to distance-driven credit constraints.[4] However, just as firm behavior is driven by access to finance, banks expand into areas that are more likely to to credit. My modeling strategy reflects this: I include increasing returns and firm heterogene-

high finance costs will have less exporters and exports.

2.1 Consumer demand

Consumers in a destination country, d, derive utility from consuming agricultural goods, A, and goods from $k \in K$ manufacturing sectors, M, in the following way:

$$U = \prod_{k=1}^{K} M^{\mu_k} A^{1-\sum \mu_k} \qquad M = \left[\int_{Z_k} m(z)^{\frac{\sigma-1}{\sigma}} dz \right]^{\frac{\sigma}{\sigma-1}} \tag{1}$$

where μ_k is the share of sector k goods in utility, $z_k \in Z_k$ is the measure of available manufacturing varieties in sector k, and $\sigma > 1$ is the elasticity of demand for a given variety, assumed to be the same across sectors.

The geography of trade is as follows. I assume there are $D + 1$ countries in the world with exogenous populations N_d. One of those countries can be subdivided into o' sub-regions, which means there are $D + o'$ exporter and importer regions in the world.

From equation (1), consumers in region d demand variety z_k goods produced in origin region $o \in D + o'$ based on the following function

$$m_{kod}(z) = \mu_k Y_d p_{od}(z)^{-\sigma} P_{kd}^{\sigma-1} \tag{2}$$

where $p_{od}(z)$ is the F.O.B. price, and Y_d and $P_{kd}^{1-\sigma} = \int_{Z_k} p_{od}^{1-\sigma} dz$ are destination income and sector k ideal price index, respectively. Income in d comprises labor income $w_d N_d$ and aggregate profits made by producers in that region Π_d.

2.2 Production

I assume that the agricultural good is produced in a perfectly competitive market with a constant returns to scale technology in every region using $\frac{1}{w_o}$ units of labor and can be traded costlessly. I set the price of this good to 1 and allow it to function as the numéraire. Wages in region o equalize across sectors and are therefore pinned down by the agricultural wage w_o:

To export to a destination country d; a manufacturing firm in region o must pay a fixed cost f_{od}^x of the numéraire and a variable iceberg trade cost $\tau_{od}^x \geq 1$, where τ_{od}^x is the amount that must be shipped for one good to arrive in d. Without loss of generality, I assume $\tau_{oo}^x = 1$ and $f_{oo}^x < f_{od}^x$ for all $d \neq o$.

Following Melitz [2003], the manufacturing sector comprises firms that differ in a stochastic productivity parameter ϕ drawn from cumulative distribution function given by $G(\phi)$ that is identical across regions and sectors. This is modeled as marginal-cost reducing productivity parameter that appears in the following per unit cost function for a firm of productivity ϕ in region o exporting to destination d. This cost function is the same across sectors, but differs by origin and destination pair:

$$c_{od}(\phi) = w_o \tau_{od}^x$$

2.3 Credit constraints and the productivity cutoff

Firms are credit constrained in that they cannot finance all costs internally. As in Manova [2013], I assume that firms must finance fixed export costs[7] with external capital at the endogenous price $R_{ko} = 1 + r_{ko}$. Without loss of generality, I assume that all fixed costs must be financed externally.[8] This means that a firm of type ϕ receives the following profits from exporting:

$$\pi_{kod}(\phi) = \mu_k \sigma^{-\sigma} Y_d \left[\frac{w_o \tau_{od}}{(\sigma - 1)\phi P_{kd}} \right]^{1-\sigma} - R_o f_{od}^{x} \tag{5}$$

The presence of the fixed cost means that firms will not sell goods to d if they cannot make positive profits. Thus, I define the lowest level of productivity a firm can have to make non thus receive an equal fraction as income.

The amount of finance required by firms is equal to the total amount of fixed entry costs they much pay. In particular, aggregate loan demand from sector k firms in region o is given by the total fixed costs paid by exporters in that sector. It therefore depends on how many markets each firm is productive enough to enter:

$$L_{ko} = w_o N_o \sum_d f^x_{od} \big(1 \quad G(\phi^?_{kod})$$

bank companies. Prices are set sector by sector to maximize the following variable profit function:

$$\pi^b_{ko} = \frac{L_{ko}}{J^b_o}(\delta_k R_{ko} - C_o(1 + r^d)) \tag{8}$$

For a given default rate δ_k and the (endogenous) elasticity of demand $\eta = -\frac{dL}{dR}\frac{R}{L}$, banks choose the optimal loan price as a markup[10] over the cost of funds and monitoring:

$$R_{ko} = \frac{1}{\delta_k}\frac{\eta}{\eta - 1}C_o(1 + r^d) \tag{9}$$

To generate an expression for loan demand, I assume that manufacturing firm-level productivity ϕ follows the Pareto distribution as is typical in the heterogeneous firm trade literature. Specifically, $G(\phi) = 1 - \phi^{-\gamma}$ where $\gamma > \sigma - 1 > 0$ is an inverse measure of the heterogeneity of firms in the manufacturing sector. This assumption is an approximation of the empirical size distribution of firms and allows for a closed form solution to the loan demand equation and its elasticity [11].

This assumption means that the probability of exporting is $1 - G(\phi^?_{kod}) = \phi^{?\,-\gamma}_{kod}$ and the loan demand and elasticity are given by

$$L_{ko} = \left[(\frac{\sigma}{\mu})^{\frac{1}{\sigma-1}}\frac{\sigma}{\sigma - 1}\right]^{-\gamma} w_o^{1-\gamma} N_o\,[R_{ko}]^{-\frac{\gamma}{\sigma-1}} \sum_d \tau_{od}^{x\,-\gamma} f_{od}^{x1-\frac{\gamma}{\sigma-1}}\, P_d Y_d^{\frac{1}{\sigma-1}\,\gamma} \tag{10}$$

$$\eta = \frac{\gamma}{\sigma - 1} \tag{11}$$

$$R_{ko} = \frac{1}{\delta_k}\frac{\gamma}{\gamma - \sigma + 1}C_o(1 + r^d) \tag{12}$$

[10] Following Bremus et al. [2013] and De Blas and Russ [2013] we can also think of $\frac{\eta}{\eta-1}$ as an upper bound on

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This elasticity of loan demand is purely driven by the extensive margin of exporting. Intuitively, the markup is decreasing in γ because a more homogeneous manufacturing sector has average lower productivity, therefore more firms are sensitive to increases in the financing of fixed costs. The markup is increasing in σ; the elasticity of demand for manufactured goods, because a high level of σ indicates that the manufacturing sector is more competitive. Higher competition means only the most productive firms export, and, as they are further down their average cost curves, they are less sensitive to financing costs.

2.5 Endogenous access to finance

In this section, I augment the above financial sector to include multi-branch banking in a given region. First, I assume there is a convex cost to branch banking that varies based on a region-specific constant β_o. Second, I assume that banks can increase their share of the market by building bank branches in a simple way: market share is $\frac{b_o}{J_o^b}$ where b_o is branches per bank in region o[13]. Empirical work on bank branching decisions in the U.S. give evidence that increasing branch network size is a tool used by companies to increase market share[14].

Taking the above loan demand and pricing as given, I can express the banks aggregate profit's as a function of branching as follows:

$$\Pi_o^b = b_o \pi_o^b \quad \beta_o b_o^2 = b_o \frac{L_o}{J_o^b} \frac{C_o(1 + r^d)}{\sum_k \delta_k} \left(\frac{\sigma \quad 1}{\gamma \quad \sigma \quad 1} \right) \quad \beta_o b_o^2 \qquad (13)$$

where L_o is total loan demand in region o.

Conditional on loan demand, banks choose the number of branches where the marginal benefit of branching is equal to the cost of branching: $\pi_o^b = \beta b_o$, generating the following expression for bank branching behavior:

[12] See Appendix A.1 for this derivation.

[13] Recall that I am analyzing a symmetric equilibrium so b_o will be the same across bank companies.

[14] Dick [2007] and Cohen and Mazzeo [2010] show that bank branching can function as a means of quality-induced product differentiation and advertising, both towards the goal of increasing market share.

$$b_o \;=\; \frac{J_o^b}{2\beta_o L_o}\frac{\sum_k \delta_k}{(1 + r_d)C_o}(\frac{\gamma}{\sigma \quad 1} \quad 1) \tag{14}$$

This says that branches are increasing proportionally with firm entry, but decreasing with firm level variable profits. This is due to the convexity of costs and the symmetry of the banking equilibrium: bank competitors cannibalize each others profits when they build branches.

To endogenize access to finance, I assume a simple externality in the banking sector: as bank branches relative to the population increases monitoring costs go down:

$$C_o \;=\; C\left(\frac{B_o}{N_o}\right) \tag{15}$$

where B_o is the total number of bank branches in the region: $J_o^b b_o$. This function means financing costs are decreasing in bank branches, $C^0 < 0$, which is a simplification of results from the the theoretical and empirical literature on the relationship between banks and credit access. In e□ect, I am parameterizing C_o as a decreasing function of "operational distance" to banking services.

Assuming free entry in the banking sector, the total number of banks that enter is given by

$$J_o^b \;=\; \frac{L_o C_o(1 + r^d)}{\sum_k \delta_k}(\frac{\sigma \quad 1}{\gamma \quad \sigma \quad 1}) \tag{16}$$

First, note that in equilibrium total bank branches depend only on the branching cost parameter $\beta_o, b_o \;=\; \frac{1}{2\beta_o}$ This is due to the aforementioned cannibalization and symmetry. However, aggregate branching is a□ected by bank entry: $B_o \;=\; J_o^b \frac{1}{2\beta_o}$. The endogeneity of financial sector entry is revealed here: bank companies enter regions with more loan demand. As they enter they build bank branches and increase access to finance for firms.

To guarantee an equilibrium in the presence of this externality, I make the additional assumption that $\frac{@C(\,)^{1 \quad \frac{\gamma}{\sigma \quad 1}}}{@J_o^b}\frac{1}{J_o^b} < 1$. In essence, this means bank profits continue to decrease in bank entry even as marginal lending costs decrease.[15]

[15] This will hold true for most empirically relevant applications, because population size is large relative to bank

Per firm profits are increasing in financing costs and default risk. Intuitively, this is because as the credit constraint becomes more binding, less firms enter and thus the median producer is more productive and makes higher profits.

Using the price index, the productivity cutoff, and the aggregate export equation I can solve for equilibrium income. In Appendix A.2, I show that the profit share of aggregate regional income depends on a weighted average of expenditure shares, which I define as $\bar{\lambda}_d = \sum_l \frac{X_{dl}}{Y_l}$.[18]. Equilibrium income is then given by

$$Y_d = w_d L_d \frac{\sigma}{\sigma - \bar{\lambda}_d} \tag{21}$$

3 Model Predictions

This model is simple, but it generates important results for how finance effects city-level exports. In this section, I go over predictions from the model that show how the intensive and extensive margins of trade respond to local access to finance.

3.1 Bilateral exports

Combining the banking and goods sectors generates a gravity-style trade equation that captures typical bilateral trade features as well as financial sector variables:

$$X_{kod} = \frac{\sigma - \bar{\lambda}_o}{\sigma} Y_o Y_d \sigma_X \left(\frac{w_o}{\Theta_d}\right)^{-\gamma} \left(\frac{1}{\delta_k} C\left(\frac{B_o}{N_o}\right)\right)^{1-\frac{\gamma}{\sigma-1}} \tau_{od}^{X\,-\gamma} f_{od}^{X\,1-\frac{\gamma}{\sigma-1}} \tag{22}$$

$$X_{od} = X_{kod} \sum_k \delta_k^{\frac{\gamma+1-\sigma}{\sigma-1}} \tag{23}$$

[18]

$$\bar{\lambda}_d \equiv \sum_l \frac{X_{dl}}{Y_d} = w_d N_d \sum_l \left[\left(\frac{\sigma}{\mu}\right)^{\frac{1}{\sigma-1}} \frac{\sigma}{\sigma-1}\right]^{-\gamma} \frac{\sigma-1}{\gamma-\sigma-1} \left(\frac{w_d \tau_{dl}^X}{\Theta_l \sigma_p}\right)^{-\gamma} \left(\frac{\gamma}{\gamma-\sigma+1} C_d (1+r^d) f_{dl}^X\right)^{1-\frac{\gamma}{\sigma-1}} \sum_k \delta_k^{\frac{\gamma}{\sigma-1}-1} \tag{20}$$

Prediction 1: Regions with higher access to banking, $\frac{B_o}{N_o}$, will have higher bilateral exports. There are two channels at work here. First, higher financing costs mean less firms are productive enough to enter a given export market. The elasticity of exporting firms to bank costs is $-\frac{\gamma}{\sigma-1} < 0$. However, higher financing costs mean that the average productivity of exporting firms is higher and therefore their profits are higher. The elasticity of average-firm level revenues to financing costs is 1. In total, for a given trade pair, the elasticity of trade to exporter monitoring costs is $1 - \frac{\gamma}{\sigma-1} < 0$ given the assumption that $\gamma > \sigma - 1$.

(6) Industry-level bilateral trade is decreasing in default-risk, $1 - \delta_k$: Looking at the combined expression $\frac{1}{\delta_k} C\left(\frac{B_o}{N_o}\right)$ gives me my second prediction:

Prediction 2: The relative effect of bank access on bilateral trade is higher in financially risky industries, $\frac{\partial X_{kod}}{\partial \delta_k \partial \frac{B_o}{N_o}} < 0$.[20] This says that for a financially risky sector ($1 - \delta_k$ high), the decrease in monitoring costs via $\frac{B_o}{N_o}$ will have a larger effect than on a sector with low default risk.

3.2 Extensive margin of trade

Combining the trade and goods sectors generates the following expression for number of bilateral exporters in a given sector:

$$V^x_{kod} = \sigma_J \frac{\sigma - \bar{\lambda}_o}{\sigma} Y_o Y_d \left[\frac{w_o \tau^x_{od}}{\Theta_d^{\gamma} \sigma_p^{\gamma}}\right]^{-\gamma} \left(\frac{1}{\delta_k} C_o\right)^{-\frac{\gamma}{\sigma-1}} f^{x\ -\frac{\gamma}{\sigma-1}}_{od} \tag{24}$$

$$V^x_{od} = V^x_{kod} \sum_k \delta_k^{\frac{\gamma}{\sigma-1}} \tag{25}$$

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The interpretation of this equation is nearly identical to that intensive margin equation above.

[20] $\frac{\partial X_{kod}}{\partial \delta_k \partial \frac{B_o}{N_o}} = \left(\frac{\gamma}{\sigma-1} - 1\right) \frac{X_{kod}}{C_o \delta_k} C^0$. By assumption $C^0 < 0$ and $\frac{\gamma}{\sigma-1} > 1$ so $\frac{\partial X_{kod}}{\partial \delta_k \partial \frac{B_o}{N_o}} < 0$

[21] $\sigma_J \equiv \left(\frac{\sigma}{\mu}\right)^{\frac{1}{\sigma-1}} \left\{\frac{\sigma}{\sigma-1}\right\}^{-\gamma} \left\{\frac{\gamma}{\gamma-\sigma+1}(1 + r^d)\right\}^{\frac{\gamma}{\sigma-1}}$

The number of bilateral exporters is a function of country sizes, exporter firm characteristics, bilateral trade costs, and the costs of export financing.

I use data on bilateral exports of HS4-level commodities aggregated to either the ISIC 3 digit industry level or the aggregate city level. Table 1 summarizes the data. The median Brazilian exporting city exports $8.2 million in goods to 12 foreign export partners. I use two different distance measures. The first is the greatest circle distance from the city to the capital of the destination country. However, Brazilian municipal trade data is based on the location of the Brazilian company that exports, not necessary the location where the good was produced. To

Table 1: Summary Statistics

4.2 Endogeneity and commercial bank branching

In this section, I formally define the bank-branch externality and discuss show how to deal with potential endogeneity.

First, I give an explicit functional form to the marginal cost function: $C(\frac{B_0}{N_0}) = \exp(\frac{B_0}{N_0})$: This says that the marginal cost reducing externality is highly convex on its own. However, note that $\frac{@C()^{1 \frac{\gamma}{\sigma\ 1}}}{@J_o^b}\frac{1}{J_o^b} = (\frac{1}{2\beta_o})(\frac{\gamma}{\sigma\ 1} \quad 1)\exp\left(\frac{J_o^b}{N_o}(\frac{1}{2\beta_o})(\frac{\gamma}{\sigma\ 1} \quad 1)\right) = J_o^b N_o$. As the number of bank companies in a region is generally much smaller than the population, this expression will be less than one, avoiding a corner solution.

Once this functional form has been established, there are still potential endogeneity issues in any attempt to estimate the effect of bank access on export behavior. $\frac{B_o}{N_o}$ can be correlated with the error term due to reverse causality: exporters drive loan demand and loan demand drives bank entry. To control for this, I need a predictor for $\frac{B_o}{N_o}$ that is uncorrelated with the error term.

To do this, I use a three stage estimation approach. Stage zero is a reduced-form extension of the structural banking model. First, note the symmetric, simultaneous equilibrium in the banking sector says number of bank branches per person reduces to $\frac{B_o}{N_o} = h\left(\frac{1}{\sum_k \delta_k}(1 + r^d)\frac{1}{2}\beta_o \frac{1}{N_o}\sum_d J_{od}^X f_{od}^X \frac{1}{\sum_k \delta_k}(1 + r^d)\frac{1}{2}\beta_o{}^{1}\right)$[23]. The primary exogenous, region-varying parameter here is the β_o the branching cost parameter.

To estimate this equation, I start from the bank company level and assume β_{ob} varies by banking company, b. In particular, I treat this variable as in information-based entry cost. Building branches is effectively expanding market reach and thus involves gathering new clients. These costs can thought of as the adverse selection issues encountered on expanding into a market as available clients may be the worst (Dell'Ariccia et al. [1999], Dell'Ariccia [2001]). In the context of relationship lending this parameter could measure the "time, effort, and resources that it takes to build lending relationships and for the losses that a bank might incur" upon entry (Hauswald and Marquez [2006]).

[23] $h()$ is the product log function

Table 2: Company-level determinants of commercial bank branch presence

	(1)	(2)	(3)	(4)	(5)
Ln HQ Distance	-0.00392***	-0.00392***	-0.00408***	-0.00358***	-0.00408***
	(0.000121)	(0.000121)	(0.000180)	(0.000130)	(0.000180)
Ln Bank Credit		0.000148***	0.000148***	0.000148***	0.000148***
		(0.0000107)	(0.0000107)	(0.0000107)	(0.0000107)
Ln GDP per capita				0.00110***	0.000648**
				(0.000169)	(0.000267)
Gov’t Branches				-0.0000228***	-0.000147***
				(0.00000541)	(0.0000232)
Company FE	Yes	Yes	Yes	Yes	Yes
City FE	No	No	Yes	No	Yes
Year FE	Yes	Yes	Yes	Yes	Yes
R^2	0.110	0.110	0.115	0.110	0.115
Observations	2588608	2588608	2588608	2588608	2588608

* p <

a given city:

$$REMOTE_o = \sum_{b_h} \left(\frac{SIZE_b}{\sum_b SIZE_b} d_{ob_h} \right) \tag{28}$$

where size can stand in for various bank company characteristics such as assets, credit operations, or branch network.[26]

For robustness, I use a third measure of bank branching costs. Brazil in the 1980s and early 1990s experienced hyperinflation that lead to a proliferation of banks and bank branches to capitalize o□ of price-change arbitrage (Assunçao 20122Tc876 Td [(b)]IZE

$$\ln X_{od} = \zeta_{x1} \ln \tilde{J}_o + \zeta_{x2} \ln Y_o + \zeta_{x3} \ln Y_d + \zeta_{x4} \tilde{\tau}_{od} + \zeta_{x5} \frac{B_o}{Y_o} + \psi_d + \varepsilon_{od} \qquad (9)$$

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where $\ln \tilde{J}_o = \ln^{\sigma}$

Table 3: The effect of bank access on bilateral exports

	OLS	2SLS		
Dep. Var.: LnXod		Predicted Branch share	Credit Remoteness	1995 Branches

and the coefficients on bank access remain positive and significant. Conditional on distance, foreign demand, exporter size and firm levels, a one standard increase in bank access increases bilateral exports by at least 12.6%.

In place of firm-level data, I can analyze the bilateral number of varieties exported which corresponds to the number of exporters in my model. Taking logs of (25) and including the financial access externality I have a firm-level flavored bilateral gravity equation:

$$\ln V_{od} = \zeta_{v1} \ln \tilde{J}_o + \zeta_{v2} \ln Y_o + \zeta_{v3} \ln Y_d + \zeta_{v4} \tilde{\tau}_{od} + \zeta_{v4} \frac{B_o}{N_o} + \psi_d + \epsilon_{od} \tag{30}$$

This is almost identical to the aggregate bilateral equation, however $\tilde{\tau}_{od}$ is now given as $\ln \tilde{\tau}_{od} = \quad \gamma \ln \tau^x_{od} \quad \frac{\gamma}{\sigma\ \ 1} \ln f^x_{od}$ and $\zeta_{v4} = \frac{\gamma}{\sigma\ \ 1}$.

The estimation procedure here replicates the discussion of the intensive margin above. The estimates here are presented in Table 4 and the coefficient on bank access remains positive and significant. The estimated increase in exported varieties due to a one standard deviation increase in bank access ranges from 9.7% to 50.6%.

4.4 Industry-level trade

At the industry-level, my empirical strategy relies on the relationship between sector-specific default rates and bank access. Following Manova [2013], I define two industry-specific measures: asset tangibility and financial dependence using indexes calculated by Braun [2005]. I apply these to Brazilian city-level data at the ISIC 3-digit level.

Financial dependence is a measure of how reliant firms are on external funds. This measure is based on the percentage of capital expenditures financed internally. In particular, it is capital expenditures less cash flows from operations divided by total capital expenditure. This value is negative if cash flows are higher than capital expenditure, i.e. there are enough internal funds to finance operations. This has been used in many studies of financial development to tease out causal effects: Rajan and Zingales [1998] show that better financial markets increase growth

Table 4: The effect of bank access on number of exported bilateral varieties

	OLS			2SLS		
Dep. Var.: LnVod				Predicted Branch share	Credit Remoteness	1995 Branches
Bank Access	0.168***	0.199***	0.222***	0.856***	0.873***	0.385***
	(0.00725)	(0.00780)	(0.00838)	(0.0252)	(0.0232)	(0.0728)
LnDist	-0.252***	-0.661***	-0.651***	-0.656***	-0.656***	-0.652***
	(0.0351)	(0.00645)	(0.00637)	(0.00663)	(0.00665)	(0.00638)
LnDist to Santos			0.581***	1.393***	1.415***	0.791***
			(0.0400)	(0.0480)	(0.0468)	(0.101)
LnExporter GDP	0.273***	0.159***	0.176***	0.171***	0.170***	0.174***
	(0.00389)	(0.00353)	(0.00376)	(0.00399)	(0.00401)	(0.00370)
LnPop Density	0.0792***	0.0662***	0.0435***	0.00754**	0.00658*	0.0342***
	(0.00280)	(0.00271)	(0.00335)	(0.00366)	(0.00366)	(0.00543)
Distance Measure	City	Port	Port	Port	Port	Port
CountryYearFE	Yes	Yes	Yes	Yes	Yes	Yes
YearFE	Yes	Yes	Yes	Yes	Yes	Yes
First Stage F				9128.1	10044.0	3095.8
R^2	0.363	0.478	0.480	0.408	0.404	0.475
Observations	207549	193138	193138	193138	193138	193138

* p < 0.1, ** p < 0.05, *** p < 0.001.

Notes: Dependent variable is the log of total number of HS4 level varieties exported from a given city to a destination country in a given year. Standard errors clustered at the exporter-importer level.Bank access is comercial bank branches per 10,000 people. City distance is the greatest circle distance from the city to the destination country capital. Port distance is the weighted greatest circle distance from a city's most used ports to the destiin sectors dependent on external finance. Here, I argue that perceived default risk, $1 \quad \delta_k$ is increasing in financial dependence. While my model requires that firms finance the entirety of their foreign fixed costs, banks realize that firms will be be□er able to pay back if they have cash on hand. In this index, for example, professional and scientific equipment is highly dependent on finance, while the tobacco sector relies on internal funds.

Asset tangibility is a way to capture whether or not firms have collateral for banks to take in the event of default. It is defined as the ratio of physical asset value to total value of a firm. Physical assets include property, buildings, and equipment, things that a bank could seize in the case of bankruptcy. A sector with a larger proportion of physical assets has high asset tangibility and is a lower default risk for banks, as they are able to recoup a portion of the firms assets in the case of default. An example of a highly tangible sector is the iron and steel industry, while footwear producers have less physical assets as a proportion of their total value.

I express the interaction of C_o with δ_k as a function of bank access, bank access interacted with assetwith or not firms794(firm)-3

Table 5: Industry-level exports, bank access, and financial vulnerability

	Log Industry Exports			Log Industry Varieties		
	(1)	(2)	(3)	(4)	(5)	(6)
Branches per 10k people	0.162**	0.368***	0.330***	0.0365**	0.0302	0.0480**

story. Brazil is a middle income country that has experienced relatively high levels of financial development. This has important implications for regional development policy: poorer regions might lag behind the rest of the country if they do not have access to the same levels of financing. Any welfare gains may be concentrated in wealthy cities close to bank headquarters. Future

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A Model Derivations

A.1 Expression for Loan Demand Elasticity and Markup

Loan demand is given by: $L_{ko} = \left[(\frac{\sigma}{\mu})^{\frac{1}{\sigma-1}} \frac{\sigma}{\sigma-1} \right]^{-\gamma} w_o^{1-\gamma} N_o [R_{ko}]^{\frac{-\gamma}{\sigma-1}} \left(\sum_d \tau_{od}^{x\,-\gamma} f_{od}^{x\,1-\frac{\gamma}{\sigma-1}} P_d Y_d^{\frac{1}{\sigma-1}} \right)^{\gamma}$.

Bank companies take aggregate prices indexes as given, so I absorb all variables not varying directly with the price of loans into the term Γ_1,[30] allowing me to write $L_{ko} = \Gamma_1 [R_{ko}]^{\frac{-\gamma}{\sigma-1}}$

Differentiating with respect to R_o finally gives us this result: $\eta = -\frac{dL}{dR} \frac{L}{R} = \frac{\gamma}{\sigma-1}$. Plugging this into $R_o = \frac{\eta}{\eta-1} \frac{C_o}{1-\delta_o}$ gives us $R_o = \frac{\gamma}{\gamma+1-\sigma} \frac{C_o}{1-\delta_o}$

A.2 Equilibrium Income

In this section, I show that the profit share of aggregate regional income depends on a weighted average of foreign import (home export) trade shares, that I define as $\bar{\lambda}_o = \sum_d \frac{X_{od}}{Y_d}$ resulting in an equilibrium income of $Y_o = w_o N_o \frac{\sigma}{\sigma - \bar{\lambda}_o}$.

First, recall that $Y_d = w_d N_d + \Pi_d$. Define $\pi_d = \frac{\Pi_d}{w_d N_d}$, then $Y_d = w_d N_d (1 + \pi_d)$. Next, note that I can write $\frac{X_{od}}{Y_d}$ as a function of exporting firms and per firm export trade shares. $\frac{X_{od}}{Y_d} = w_o N_o \lambda_{od}$ where $\lambda_{od} = \left[(\frac{\sigma}{\mu})^{\frac{1}{\sigma-1}} \frac{\sigma}{\sigma-1} \right]^{-\gamma} \frac{\sigma-1}{\gamma-\sigma-1} (\frac{w_o \tau_{od}^x}{\Theta_d \sigma_p})^{-\gamma} \left(\frac{\gamma}{\gamma-\sigma+1} C_o (1 + r^d) f_{od}^x \right)^{1-\frac{\gamma}{\sigma-1}} \sum_k \delta_k^{\frac{\gamma}{\sigma-1}-1}$, a function of parameters and trade costs.

$\bar{\lambda}_d = \sum_o \frac{X_{do}}{Y_d} = w_d N_d \sum_o \left[(\frac{\sigma}{\mu})^{\frac{1}{\sigma-1}} \frac{\sigma}{\sigma-1} \right]^{-\gamma} \frac{\sigma-1}{\gamma-\sigma-1} (\frac{w_d \tau_{do}^x}{\Theta_o \sigma_p})^{-\gamma} \left(\frac{\gamma}{\gamma-\sigma+1} C_d (1 + r^d) f_{do}^x \right)^{1-\frac{\gamma}{\sigma-1}} \sum_k \delta_k^{\frac{\gamma}{\sigma-1}-1}$

(1) Balanced Trade

Balanced trade says that aggregate exports equal aggregate imports. For country o: $\sum_d X_{od} = \sum_d X_{do}$.

$\sum_d w_o N_o \lambda_{od} Y_d = \sum_d w_d N_d \lambda_{do} Y_o$ (x) [illegible]

Combining the results from (1) and (2):

$\underline{1+\pi_o}$