Credit Constraints, Heterogeneous Firms, and International Trade*

Kalina Manova†
Stanford University and NBER

Published in *The Review of Economic Studies* (2013) 80, p.711-744.

Abstract

Financial market imperfections severely restrict international trade flows because exporters require external capital. This paper identifies and quantifies the three mechanisms through which credit constraints affect trade: the selection of heterogeneous firms into domestic production, the selection of domestic manufacturers into exporting, and the level of firm exports. I incorporate financial frictions into a heterogeneous-firm model and apply it to aggregate trade data for a large panel of countries. I establish causality by exploiting the variation in financial development across countries and the variation in financial vulnerability across sectors. About 20%-25% of the impact of credit constraints on trade is driven by reductions in total output. Of the additional, trade-specific effect, one third reflects limited firm entry into exporting, while two thirds are due to contractions in exporters' sales. Financially developed economies export more in financially vulnerable sectors because they enter more markets, ship more products to each destination, and sell more of each product. These results have important policy implications for less developed nations that rely on exports for economic growth but suffer from weak financial institutions.

JEL codes: F10, F14, F36, G20, G28, G32.
Keywords: Credit constraints, financial development, heterogeneous firms, international trade, product variety, trade partners.

*I thank Philippe Aghion, Pol Antràs, Andrew Bernard, Doireann Fitzgerald, Elhanan Helpman, Dirk Jenter, Marc Melitz, Kjetil Storesletten, Luigi Zingales, and four anonymous referees for their comments, and seminar participants at Boston College, Brown, Columbia GSB, Cornell, Dartmouth, Harvard, Harvard Business School, Harvard Kennedy School of Government, IMF, Kellogg Northwestern, London School of Economics, New York Federal Reserve Bank, MIT Sloan School of Management, Pennsylvania State, Stanford, Syracuse, Toronto, University of Illinois at Urbana-Champaign, University of North Carolina at Chapel Hill, University of California at Davis, San Diego and Santa Cruz.

†Kalina Manova, Department of Economics, Stanford University, 579 Serra Mall, Stanford, CA 94305, manova@stanford.edu.

1 Introduction

Conducting international trade requires routine access to external capital. Well-functioning financial institutions are thus necessary to support the global exchange of goods and services. Indeed, countries with strong financial institutions have been shown to enjoy a comparative advantage and export relatively more in financially vulnerable sectors.[1] Little is known, however, about the exact mechanisms through which credit frictions affect trade. First, weak financial institutions hinder growth and general economic activity.[2] Their consequences for cross-border flows might therefore simply reflect disruptions to overall production. Second, the finance, macro and development literatures have emphasized the variation in financial constraints across firms.[3] Since firm heterogeneity is a key determinant of aggregate exports and the adjustment to trade reforms, it could importantly shape the impact of credit conditions on trade.[4]

This paper examines *how* financial market imperfections distort international trade. I decompose their effect into three channels and quantify the contribution of each one: the selection of heterogeneous firms into domestic production, the selection of domestic manufacturers into exporting, and the level of firm exports. I find that only 20%-25% of the impact of credit constraints on trade is driven by reductions in aggregate output. In other words, financial frictions reduce foreign exports disproportionately more than domestic production. This corroborates the notion that exporters depend more on external financing than domestic producers because of additional costs related to trade, greater transaction risks, and higher working capital needs due to longer shipping times. Consistently, recent evidence suggests that trade flows were significantly more sensitive than GDP to credit tightening during the 2008-2009 financial crisis (Chor and Manova 2012). These results have important policy implications for less developed economies, many of which rely heavily on trade for economic growth but suffer from inefficient capital markets.

Having isolated the trade-specific effect of financial frictions, I then separate it into distortions to the extensive and intensive margins of exports. I conclude that one third of the trade-specific effect reflects reduced firm entry into exporting, and that two thirds are due to lower firm-level sales abroad. This indicates that companies face binding constraints in the financing of both their fixed and variable export costs: While the former drive the decision to service a market, the latter affect the size of foreign shipments. Reallocations along these two margins matter for the short-run and long-term response of heterogeneous firms to trade reforms, exchange rate movements and other cost or demand shocks. Credit conditions could thus affect how economies adjust to such shocks at different horizons.

[1] See Beck (2002, 2003), Becker and Greenberg (2007), Svaleryd and Vlachos (2005), and Hur et al. (2006). For convenience, I jointly refer to sectors with high requirements for external capital and to sectors with few collateralizable assets as financially vulnerable sectors.

[2] For example, Rajan and Zingales (1998), Braun (2003) and Fisman and Love (2007) show that financially developed countries grow relatively faster in financially more vulnerable sectors.

[3] Prior evidence suggests that smaller firms are more credit constrained (e.g. Beck et al. 2005, Forbes 2007).

[4] Melitz (2003), Bernard et al. (2003), Eaton et al. (2004, 2011) and Bernard et al. (2011) provide classic treatments of firm heterogeneity in trade.

I identify the impact of financial market imperfections by exploiting the variation in financial development across 107 countries and the variation in financial vulnerability across 27 sectors from 1985 to 1995. Strong financial institutions might evolve in response to increased cross-border activity.[5] They are also correlated with other country characteristics that can independently boost export performance. The level effect of financial development on trade is thus subject to concerns with endogeneity and reverse causality. For technological reasons innate to the manufacturing process, however, producers in certain industries incur higher up-front costs and require more external capital. Sectors also differ in firms' endowments of tangible assets that can serve as collateral in raising outside finance. Consequently, companies are much more vulnerable to financial frictions in some sectors than others.

I therefore study how interactions of country measures of financial development (private credit, contract repudiation, accounting standards, risk of expropriation) and sector indicators of financial vulnerability (external finance dependence, asset tangibility) affect export activity. This allows me to include an extensive set of fixed effects and to establish a causal effect of credit constraints on trade. To guard against omitted variable bias, I also condition on other determinants of comparative advantage such as factor endowments, overall development (GDP per capita), and the broader institutional environment (general rule of law, corruption).

To guide the empirical analysis, I incorporate credit constraints into a heterogeneous-firm trade model. In the model, companies' need for external capital and ability to pledge collateral depend on the sector in which they are active. Contracts between entrepreneurs and investors are more likely to be enforced in countries at higher levels of financial development. Since more productive suppliers have bigger sales, they can offer lenders greater returns and secure more funding. More efficient firms are hence more likely to become exporters and earn higher revenues conditional on trading. As a result, the productivity cut-off for exporting in financially vulnerable industries is lower when the exporting nation is financially more advanced. In addition, firm-level exports and aggregate trade flows are systematically higher in such sectors and economies. Financial frictions thus interact non-trivially with firm heterogeneity and generate distortions absent from the representative-firm models in the prior literature on trade and finance.[6]

Using model-consistent estimation, I show empirically that credit constraints impede global trade flows through three channels. I first document that financially developed economies export significantly more in sectors intensive in external capital and intangible assets. This pattern in part reflects the industrial composition of overall output. I isolate the additional effect of financial frictions on trade above and beyond that on output by explicitly controlling for the

[5] Braun and Raddatz (2008) and Do and Levchenko (2007), for example, find that trade openness can stimulate financial development.

[6] A number of studies have proposed that financial development becomes a source of comparative advantage in the presence of credit constraints (Kletzer and Bardhan 1987, Beck 2002, Matsuyama 2005, Becker and Greenberg 2007, Ju and Wei 2011). These Ricardian, representative-firm models, however, deliver the counterfactual prediction that either all or no producers in a given sector export. While Chaney (2005) also examines heterogeneous firms, he does not explicitly model financial contracts or sector differences.

number of domestic producers in each exporting country and sector.

This additional, trade-specific distortion in turn operates through two channels: restricted firm entry into foreign markets and constrained firm sales abroad. In the absence of systematic cross-country data at the micro level, I quantify these two mechanisms with a two-stage structural estimation procedure in the spirit of Helpman, Melitz and Rubinstein (2008). In the first stage, I estimate the effect of financial development on the probability of bilateral exports. I also consider the number of countries' export destinations and the number of products shipped to each market as alternative indicators of the extensive margin of trade. In the second stage, I estimate the effect of financial development on the value of bilateral trade. The predicted probability of exporting from the first stage serves as a control for firm selection into exporting. The residual effect of financial conditions in this regression measures reductions in average firm exports, i.e. disruptions along the intensive margin of trade. I find that financially developed countries export more in financially vulnerable sectors because they enter more foreign markets, ship more products to each destination, and sell more of each product.

My results imply that financial frictions have sizeable real effects on international flows. Moreover, credit conditions are as important for trade patterns as traditional Heckscher-Ohlin sources of comparative advantage. The impact of a one-standard-deviation improvement of financial institutions is comparable to that of a similar rise in human capital, and substantially bigger than that of a commensurate increase in the stock of physical capital. Historically, financial development alone explains 22% of the observed growth in trade between 1985 and 1995, while factor accumulation accounts for only 12%.

Most directly, this paper contributes to the growing literature at the intersection of international trade and finance. Unlike earlier studies, I provide a comprehensive analysis of the mechanisms throuch which financial frictions distort aggregate export flows. Subsequent work has extended this line of inquiry to the micro level. Firm evidence for the UK, Belgium, China, Italy and Japan, for example, indicates that credit constraints restrict companies' export product scope, number of destinations, and value of foreign sales (Greenaway et al. 2007, Muûls 2008, Manova et al. 2009, Minetti and Zhu 2011, Amiti and Weinstein 2011). New theoretical models seek to explain why trade is more sensitive to financial market imperfections than domestic production (Ahn 2011, Feenstra et al. 2011). Scholars are also studying to what extent trade credit between sellers and buyers, as well as foreign direct and portfolio investments, can compensate for weak financial institutions (Manova 2008, Manova et al. 2009, Antràs and Foley 2011).

More generally, the paper adds to the large of body of work on the real effects of financial frictions. Credit constraints have been shown to distort economic growth, investment, and volatility (King and Levine 1993, Banerjee and Newman 1993, Kiyotaki and Moore 1997, Aghion et al. 2010). They also shape multinational firm activity and cross-border capital flows (Chor et al. 2007, Antràs et al. 2009, Antràs and Caballero 2009).

Finally, this paper is part of a larger agenda to assess the role of different institutional frictions for international trade. Instead of financial market imperfections, others have explored

the impact of labor market rigidities and limited contract enforcement (Helpman and Itskhoki 2010, Cuñat and Melitz 2012, Nunn 2007, Levchenko 2007). The broad message of this literature is that strong institutions endow countries with comparative advantage in industries reliant on these institutions. This suggests that frictions in the reallocation of resources across sectors, as well as across firms within sectors, can potentially explain why countries trade less than traditional Ricardian or Heckscher-Ohlin models would predict (Trefler 1995). They might also account for the sluggish response of export flows to trade liberalizations. Lastly, while firm heterogeneity can be irrelevant for aggregate welfare in a world with frictionless capital and labor markets (Arkolakis et al. 2012), it could be very consequential under inefficient resource allocation. These questions constitute a promising avenue for future research.

The remainder of the paper is organized as follows. Section 2 discusses why exporters require external financing and motivates the theoretical model developed in Section 3. Section 4 derives a model-consistent estimation approach, while Section 5 introduces the data used for the analysis. Sections 6 and 7 present the empirical results. The last section concludes.

2 Why and how exporters use external finance

Domestic producers and exporters routinely rely on external capital because they have to incur substantial upfront costs that cannot be financed out of retained earnings or internal cash flows from operations. These outlays are usually fixed, such as expenditures on R&D and product development, marketing research, advertising, and investment in fixed capital equipment. Most variable expenses such as intermediate input purchases, advance payments to salaried workers, and land or equipment rental fees are also often sustained before production and sales take place.

Exporting is associated with additional upfront expenditures that make production for foreign markets even more dependent on external financing than manufacturing for the home country. Sunk and fixed costs of international trade include learning about the profitability of potential export markets; making market-specific investments in capacity, product customization and regulatory compliance; and setting up and maintaining foreign distribution networks. Variable trade costs comprise shipping, duties and freight insurance. As with domestic operations, most of these expenses have to be incurred before export revenues are realized. Moreover, cross-border shipping and delivery usually take 30-90 days longer to complete than domestic orders (Djankov et al. 2010). This further aggravates exporters' working capital requirements relative to those of domestic producers.

To meet these liquidity needs, exporters typically access trade finance from banks and other financial institutions or trade credit from their business partners. These financial arrangements are backed by collateral in the form of tangible assets and potentially inventories. Exporters also normally purchase insurance contracts in response to the increased risk of cross-border activities compared to domestic sales. For these reasons, a very active market operates for the financing and insurance of international transactions, reportedly worth \$10-\$12 trillion in 2008. Up to 90%

of world trade has been estimated to rely on some form of trade finance (Auboin 2009).

The presence of well-developed financial markets and strong banking institutions in the exporter's country are crucial for firms' ability to finance their international activities. In the case of trade finance, this is mainly because it is easier for firms to establish banking relationships at home than abroad. As for trade credit, the foreign buyer raises funds in his own country but the exporter's bank still plays an important role in the transaction.[7]

These considerations motivate the way in which I model the effects of credit constraints on international trade flows.

3 A model of credit constraints in trade

3.1 Set up

I incorporate credit constraints and firm heterogeneity into a static, partial equilibrium model à la Melitz (2003). A continuum of firms produce differentiated goods in each of J countries and S sectors. Consumers exhibit love of variety: The utility of country i is a Cobb-Douglas aggregate $U_i = \prod_s C_{is}^{\theta_s}$ over sector-specific CES consumption indices $C_{is} = \left[\int_{\omega\in\Omega_{is}} q_{is}(\omega)^{\alpha}\, d\omega\right]^{\frac{1}{\alpha}}$, where Ω_{is} is the set of available products and $\varepsilon = 1/(1-\alpha) > 1$ is the elasticity of substitution. The share of each sector in total expenditure Y_i is $\theta_s \epsilon (0,1)$ and $\sum_s \theta_s = 1$. If $P_{is} = \left[\int_{\omega\in\Omega_{is}} p_{is}(\omega)^{1-\varepsilon}\, d\omega\right]^{\frac{1}{1-\varepsilon}}$ is the ideal price index, i's demand for a variety with price $p_{is}(\omega)$ is thus $q_{is}(\omega) = \frac{p_{is}(\omega)^{-\varepsilon}\theta_s Y_i}{P_{is}^{1-\varepsilon}}$.

3.2 Domestic producers

Firms in country j pay a sunk entry cost $c_{js}f_{ej}$ before drawing a productivity level $1/a$ from a cumulative distribution function $G(a)$ with support $[a_L, a_H]$, $a_H > a_L > 0$. Manufacturing 1 unit of output costs $c_{js}a$, where c_{js} is the cost of a cost-minimizing bundle of inputs specific to each country and sector. Since c_{js} captures differences in aggregate productivity, factor prices and factor intensities across countries and sectors, $G(a)$ does not depend on j and s.

To focus on the effect of credit constraints on exports above and beyond that on domestic production, I assume that firms finance their domestic activities with cash flows from operations. I also assume that there are no fixed costs to servicing the home market. Hence all firms that enter the industry produce domestically. The consequences of financial frictions for trade would not change qualitatively if these assumptions were relaxed. The empirical analysis explicitly accounts for the potential impact of credit constraints on firms' selection into domestic production.

[7] See the International Trade Administration's *Trade Finance Guide* for more institutional details. Empirically, access to finance in the importing country matters, but is an order of magnitude less important. When I include both the importer's and the exporter's level of financial development in the regressions below, the coefficients on the latter are 2-3 times bigger. The two also appear to be complements rather than substitutes.

3.3 Credit-constrained exporters

Firms in country j can export to i by paying a fixed cost $c_{js}f_{ij}$ each period, where $f_{ij} > 0$ for $i \neq j$ and $f_{jj} = 0$. Exporters also incur iceberg trade costs so that $\tau_{ij} > 1$ units of a product need to be shipped for 1 unit to arrive.

Firms face liquidity constraints in financing their foreign sales. While variable costs can be funded internally, a fraction $d_s \epsilon (0,1)$ of the fixed trade cost is borne up-front and has to be covered with outside capital.[8] Producers in country j and sector s thus have to borrow $d_s c_{js} f_{ij}$ to service country i. To do so, they must pledge collateral. A fraction $t_s \epsilon (0,1)$ of the sunk entry cost goes towards tangible assets that can be used as collateral.[9,10] d_s and t_s vary across sectors for technological reasons and are exogenous from the perspective of individual firms.

Countries differ in their level of financial contractibility. An investor can expect to be repayed with probability $\lambda_j \epsilon (0,1)$, which is exogenous to the model and determined by the strength of j's financial institutions.[11] With probability $(1-\lambda_j)$ the financial contract is not enforced, the firm defaults, and the creditor seizes the collateral $t_s c_{js} f_{ej}$. To continue operations and be able to borrow in the future, the firm then needs to replace this collateral.

Financial contracting proceeds as follows. In the beginning of each period, every firm makes a take-it-or-leave-it offer to a potential investor. This contract specifies the amount the firm needs to borrow, the repayment F in case the contract is enforced, and the collateral in case of default. Revenues are then realized and the investor receives payment at the end of the period.

Firms from country j choose their export price and quantity in market i to maximize profits

$$\max_{p,q,F} \pi_{ijs}(a) = p_{ijs}(a) q_{ijs}(a) - q_{ijs}(a) \tau_{ij} c_{js} a - (1-d_s) c_{js} f_{ij} - \lambda_j F(a) - (1-\lambda_j) t_s c_{js} f_{ej} \quad (1)$$

$$\text{subject to} \quad (1.1)\ q_{ijs}(a) = \frac{p_{ijs}(a)^{-\varepsilon} \theta_s Y_i}{P_{is}^{1-\varepsilon}},$$

$$(1.2)\ A_{ijs}(a) \equiv p_{ijs}(a) q_{ijs}(a) - q_{ijs}(a) \tau_{ij} c_{js} a - (1-d_s) c_{js} f_{ij} \geq F(a), \text{ and}$$

$$(1.3)\ B_{ijs}(a) \equiv -d_s c_{js} f_{ij} + \lambda_j F(a) + (1-\lambda_j) t_s c_{js} f_{ej} \geq 0.$$

The expression for profits reflects the fact that the firm finances all its variable costs and a fraction $(1-d_s)$ of its fixed costs internally, pays the investor $F(a)$ when the contract is enforced (with probability λ_j) and replaces the collateral in case of default (with probability $(1-\lambda_j)$). In the absence of credit constraints, exporters maximize profits subject to demand (1.1). With

[8] The underlying assumption is that firms cannot use profits from past periods to finance future operations, for example because they have to distribute all profits to shareholders due to principal-agent problems. Alternatively, d_s is the fraction of outlays that needs to be financed externally after all retained earnings have been used up.

[9] The model's qualitative results would not change if the fixed costs of exporting were collateralizable instead.

[10] Firms might invest in tangible assets to increase their capacity for raising outside finance. This will be costly if firms' asset structure deviates from the first-best.

[11] Endogenous default would reinforce the predictions of the model. First, default is likely costlier in countries with superior financial contractibility. Second, firms would be more likely to become insolvent in response to exogenous shocks if they are less productive, use more external finance, or have less collateral. Third, these effects would be magnified in a dynamic model where firms can retain earnings or financiers reward good credit history.

external financing, two additional conditions bind firms' decisions. In case of repayment, entrepreneurs can offer at most their net revenues $A_{ijs}(a)$ to the creditor. Also, investors only fund the firm if their net return $B_{ijs}(a)$ exceeds their outside option, here normalized to 0.[12]

With competitive credit markets, investors always break even in expectation. This implies that producers adjust their payment $F(a)$ so as to bring the financier to his participation constraint, i.e. $B_{ijs}(a) = 0$.[13] If the liquidity constraint (1.2) does not bind, firms become exporters with the same optimal export quantities, prices, revenues and profits as in Melitz (2003):

$$p_{ijs}(a) = \frac{\tau_{ij} c_{js} a}{\alpha}, \qquad q_{ijs}(a) = \left(\frac{\tau_{ij} c_{js} a}{\alpha}\right)^{-\varepsilon} \frac{\theta_s Y_i}{P_{is}^{1-\varepsilon}}, \tag{2}$$

$$r_{ijs}(a) = \left(\frac{\tau_{ij} c_{js} a}{\alpha P_{is}}\right)^{1-\varepsilon} \theta_s Y_i, \qquad \pi_{ijs}(a) = (1-\alpha)\left(\frac{\tau_{ij} c_{js} a}{\alpha P_{is}}\right)^{1-\varepsilon} \theta_s Y_i - c_{js} f_{ij}.$$

3.4 Selection into exporting

Since net revenues $A_{ijs}(a)$ increase with productivity, the liquidity constraint (1.2) is binding for firms with productivity below a certain cut-off $1/a_{ijs}$. Plugging $B_{ijs}(a) = 0$ and the optimal price and quantity from (2) into (1.2), this threshold is given by the condition

$$r_{ijs}(a_{ijs}) = \left(\frac{\tau_{ij} c_{js} a_{ijs}}{\alpha P_{is}}\right)^{1-\varepsilon} \theta_s Y_i = \varepsilon \left\{ \left(1 - d_s + \frac{d_s}{\lambda_j}\right) c_{js} f_{ij} - \frac{1-\lambda_j}{\lambda_j} t_s c_{js} f_{ej} \right\}. \tag{3}$$

With perfect financial contractibility ($\lambda_j = 1$), the cut-off for exporting $1/a^*_{ijs}$ satisfies $r_{ijs}\left(a^*_{ijs}\right) = \varepsilon c_{js} f_{ij}$ as in Melitz (2003). Figure 1A plots export profits as an increasing function of productivity and illustrates the wedge between the thresholds for exporting with and without credit constraints. While potential export profits are nonzero for all firms with efficiency above $1/a^*_{ijs}$, only those more productive than $1/a_{ijs} \geq 1/a^*_{ijs}$ successfully obtain outside finance and sell abroad.[14] Intuitively, all companies in a given sector have the same financing needs and collateralizable assets, but more efficient firms earn higher revenues and can offer investors greater returns in case of repayment. Some low-productivity firms have sales that are too low to incentivize a financier: Even if they offered all net revenues, he would not break even. Financial frictions thus lead to inefficiently low trade participation.

Condition (3) implies that the export cut-off varies systematically across countries and sectors:

Proposition 1 *(Cut-off) All else constant, the productivity cut-off for exporting is higher in financially more vulnerable sectors and lower in financially more developed countries* ($\frac{\partial(1/a_{ijs})}{\partial d_s} > 0$, $\frac{\partial(1/a_{ijs})}{\partial t_s} < 0$, $\frac{\partial(1/a_{ijs})}{\partial \lambda_j} < 0$). *Financial development lowers this cut-off relatively more in financially more vulnerable sectors* ($\frac{\partial^2(1/a_{ijs})}{\partial \lambda_j \partial d_s} < 0$, $\frac{\partial^2(1/a_{ijs})}{\partial \lambda_j \partial t_s} > 0$).

Proof. *See Appendix A.* ■

[12] This assumption is made for simplicity. If investors can earn a world-market net interest rate r, the right hand side of (1.3) would be $r d_s c_{js} f_{ij}$ and the model's predictions qualitatively unchanged.

[13] $F(a)$ is independent of a when firms only borrow for their fixed trade costs, but depends on a in the more general case when firms require external finance for their variable costs as well (see Section 3.5 and Appendix A).

[14] $1/a^*_{ijs} < 1/a_{ijs}$ requires that $d_s f_{ij} > t_s f_{ej}$, i.e. firms' funding needs exceed their collateral.

Intuitively, investors are more willing to fund firms when default is less likely (λ_j higher), when the required loan is smaller (d_s lower), and when the collateral is bigger (t_s higher). Financiers are especially sensitive to the size of the loan and the collateral when financial contractibility is low. Thus, producers in financially advanced economies find it relatively easier to export in financially vulnerable industries than producers in countries with weak financial systems.

In a general equilibrium model, the level effect of financial development would be ambiguous, but its differential impact across sectors would still hold. The sunk cost of entry would pin down a free-entry condition that imposes zero expected profits. Improvements in λ_j could no longer reduce $1/a_{ijs}$ in all sectors, since that would create positive expected profits. Instead, financial development would lower the cut-off for exporting in the financially most vulnerable sectors while raising it in the least vulnerable sectors. For this reason, I emphasize the differential effects of financial development across industries in the results below.

Trade occurs only if there are at least some firms with productivity above the $1/a_{ijs}$ threshold. Since firms manufacture differentiated goods, the lower this cut-off is, the greater the measure of exporters and the number of products sold abroad. Proposition 1 thus implies that credit conditions affect both the probability ρ_{ijs} and product variety X_{ijs} of bilateral trade flows:

Corollary 2 *(Nonzero) Financial development increases the probability that country j exports to country i relatively more in financially more vulnerable sectors ($\frac{\partial^2 \rho_{ijs}}{\partial \lambda_j \partial d_s} > 0$, $\frac{\partial^2 \rho_{ijs}}{\partial \lambda_j \partial t_s} < 0$).*

Corollary 3 *(Product variety) Financial development increases the number of products country j exports to country i relatively more in financially more vulnerable sectors ($\frac{\partial^2 X_{ijs}}{\partial \lambda_j \partial d_s} > 0$, $\frac{\partial^2 X_{ijs}}{\partial \lambda_j \partial t_s} < 0$).*

In reality, manufacturers can export to multiple destinations. Firms therefore choose their number of trade partners in addition to the price and quantity in each country to maximize their global profits. Appendix A shows how this affects the maximization problem (1). Companies have to use their limited collateral to fund all of their cross-border sales. All exporters optimally add destinations in the same decreasing order of profitability (determined by Y_i, P_{is}, τ_{ij}, and f_{ij}) until they exhaust their financial resources. Whenever the modified liquidity constraint (1.2) does not bind, sellers set their first-best price, quantity, revenue and profit in each market they enter. For any given number of destinations I, however, there is a corresponding productivity cut-off $1/a_{js,I}$ below which (1.2) binds. In the aggregate, a country exports to I markets only if at least one firm is above this threshold. Appendix A shows that $1/a_{js,I}$, and by extension countries' number of trade partners I_{js}, depend on credit conditions just like $1/a_{ijs}$ above.

Proposition 4 *(Trade partners) Financial development increases the number of country j's export destinations relatively more in financially more vulnerable sectors ($\frac{\partial^2 I_{js}}{\partial \lambda_j \partial d_s} > 0$, $\frac{\partial^2 I_{js}}{\partial \lambda_j \partial t_s} < 0$).*

Proof. *See Appendix A.* ■

3.5 Level of firm exports

In addition to restricting export entry, credit constraints can also distort the level of firm exports if companies require external finance for both fixed and variable costs. Appendix A examines the case when producers in sector s need to raise outside capital for a fraction d_s of all costs associated with foreign sales. As illustrated in Figure 1B, now two cut-offs characterize manufacturers' trade activity. While all suppliers with productivity above $1/a_{ijs}^L$ sell abroad, only those with productivity above a higher cut-off $1/a_{ijs}^H > 1/a_{ijs}^L$ export at the price and quantity levels that obtain in the absence of credit constraints. Firms with productivity below $1/a_{ijs}^H$ would not earn sufficient revenues to repay the investor if they exported at first-best levels. Instead, they choose to export lower quantities in order to reduce the amount of external capital they need for variable costs. This allows them to meet the investor's participation constraint with a lower repayment $F(a)$. In this way, firms with intermediate productivity levels earn some export profits, albeit lower than the first-best.

Export conditions in financially more vulnerable sectors are now better in financially more developed countries because (a) more firms become exporters, (b) more of these exporters trade at first-best levels, and (c) constrained exporters with $\frac{1}{a}\epsilon\left[1/a_{ijs}^L, 1/a_{ijs}^H\right)$ have foreign revenues closer to the first-best.[15] Proposition 5 summarizes (b) and (c) since (a) restates Proposition 1:

Proposition 5 *(Firm exports) Financial development (weakly) increases the level of firms' exports from country j to country i relatively more in financially more vulnerable sectors ($\frac{\partial^2 r_{ijs}}{\partial\lambda_j\partial d_s} > 0$, $\frac{\partial^2 r_{ijs}}{\partial\lambda_j\partial t_s} < 0$).*

Proof. *See Appendix A.* ■

3.6 Aggregate exports

Aggregating across firms, total exports from country j to country i in sector s are $M_{ijs} = \left(\frac{\tau_{ij}c_{js}}{\alpha P_{is}}\right)^{1-\varepsilon}\theta_s Y_i N_{js}\left[\int_{a_L}^{a_{ijs}^H} a^{1-\varepsilon}dG(a) + \int_{a_{ijs}^H}^{a_{ijs}^L}\beta_{ijs}(a)a^{1-\varepsilon}dG(a)\right]$, where N_{js} is the exogenous measure of active producers. The first term in the brackets corresponds to companies trading at first-best levels, while the second captures the reduced revenues of constrained exporters ($0 < \beta_{ijs}(a) < 1$). Given Propositions 1 and 5, it immediately follows that financially developed countries have a comparative advantage in financially vulnerable sectors:

Proposition 6 *(Trade volumes) Financial development increases the value of country j's exports to country i relatively more in financially more vulnerable sectors ($\frac{\partial^2 M_{ijs}}{\partial\lambda_j\partial d_s} > 0$, $\frac{\partial^2 M_{ijs}}{\partial\lambda_j\partial t_s} < 0$).*

Proof. *See Appendix A.* ■

[15] The impact of financial development on $1/a_{ijs}^L$ across sectors at different levels of external finance dependence is theoretically ambiguous. This occurs because more productive firms can offer greater revenues in case of repayment, but they also require more external capital for their variable costs since they operate at a larger scale. Appendix A presents the condition necessary for $\frac{\partial^2\left(1/a_{ijs}^L\right)}{\partial\lambda_j\partial d_s} < 0$. Given my empirical results, as well as evidence in the corporate finance literature that larger firms are less credit constrained, I assume that this condition holds.

4 Empirical specification

The model delivers a number of testable predictions for the effect of financial development on countries' export activity. This section derives an estimation procedure for these predictions.

4.1 Selection into exporting

Consider first the probability that bilateral trade will occur. It is convenient to define a latent variable Z_{ijs} as the ratio of the productivity of the most efficient firm, $1/a_L$, to the productivity cut-off for exporting, $1/a^L_{ijs}$:

$$Z_{ijs} = \frac{(1-\alpha)\left(1-d_s+\frac{d_s}{\lambda_j}\right)^{1-\varepsilon}\left(\frac{\alpha P_{is}}{\tau_{ij}c_{js}}\right)^{\varepsilon-1}\theta_s Y_i a_L^{1-\varepsilon}}{\left(1-d_s+\frac{d_s}{\lambda_j}\right)c_{js}f_{ij}-\frac{1-\lambda_j}{\lambda_j}t_s c_{js}f_{ej}} = \left(\frac{a^L_{ijs}}{a_L}\right)^{\varepsilon-1}. \tag{4}$$

Note that whenever $a^L_{ijs} > a_L$ and $Z_{ijs} > 1$, there will be firms productive enough to export from country j to country i in sector s and we will observe trade flows.

Following Helpman, Melitz and Rubinstein (2008) (henceforth HMR), I assume that both variable and fixed export costs are characterized by i.i.d. unmeasured trade frictions, which are country-pair specific and normally distributed. In particular, $\tau_{ij}^{\varepsilon-1} = D_{ij}^{\mu}e^{-u_{ij}}$, where $u_{ij} \tilde{} N\left(0,\sigma_u^2\right)$ and D_{ij} is the distance between i and j, and $f_{ij} = \exp\left(\varphi_j+\varphi_i+\kappa_1\varphi_{ij}-\kappa_2\nu_{ij}\right)$, where $\nu_{ij} \tilde{} N\left(0,\sigma_\nu^2\right)$. In this formulation, φ_j indicates the fixed cost of exporting from country j to any destination, φ_i measures the fixed cost any exporter pays to enter i, and φ_{ij} represents any additional country-pair specific fixed trade cost. I let production costs be decomposable into country and sector specific terms, $c_{js} = c_j c_s$.

I assume that the terms in λ_j, d_s, and t_s in (4) can be expressed as a function of observed country measures of financial development $FinDevt_j$ and sector indicators of external finance dependence $ExtFin_s$ and asset tangibility $Tang_s$:

$$\frac{\left(1-d_s+\frac{d_s}{\lambda_j}\right)^{1-\varepsilon}}{\left(1-d_s+\frac{d_s}{\lambda_j}\right)f_{ij}-\frac{1-\lambda_j}{\lambda_j}t_s f_{ej}} = \\ = \exp(\varphi'_j+\varphi'_i+\varphi'_s-\kappa\varphi_{ij}+\nu_{ij}+\gamma_1 FinDevt_j\cdot ExtFin_s-\gamma_2 FinDevt_j\cdot Tang_s).$$

Here φ'_j, φ'_i, and φ_{ij} contain the exporter, importer and country-pair specific terms in f_{ij}. The φ'_j also captures the exporter-specific sunk cost f_{ej} and the main effect of $FinDevt_j$, while φ'_s reflects the variation in $ExtFin_s$ and $Tang_s$ across sectors.

To test Proposition 1 and Corollary 2, I rewrite (4) in log-linear form and estimate

$$\begin{aligned} z_{ijs} = \gamma_0 &+ \gamma_1 FinDevt_j\cdot ExtFin_s-\gamma_2 FinDevt_j\cdot Tang_s+ \\ &+(\varepsilon-1)\,p_{is}-\mu d_{ij}-\kappa\varphi_{ij}+\phi_j+\phi_i+\phi_s+\eta_{ij}, \end{aligned} \tag{5}$$

where $z_{ijs} \equiv \ln Z_{ijs}$, $p_{is} \equiv \ln P_{is}$, $d_{ij} \equiv \ln D_{ij}$ and $\eta_{ij} \equiv u_{ij} + \nu_{ij} \tilde{} N\left(0, \sigma_u^2 + \sigma_\nu^2\right)$. $\phi_j = -\varepsilon \ln c_j + \varphi'_j$, $\phi_i = \ln Y_i + \varphi'_i$, and $\phi_s = -\varepsilon \ln c_s + \varphi'_s$ are exporter, importer and sector fixed effects.

Let T_{ijs} be an indicator variable equal to 1 when j exports to i in sector s in the data. Although z_{ijs} is unobserved, (5) can be estimated with a Probit specification because $z_{ijs} > 0$ whenever $T_{ijs} = 1$ and $z_{ijs} = 0$ otherwise. The conditional probability of exporting ρ_{ijs} is thus:

$$\begin{aligned} \rho_{ijs} = \Pr\left(T_{ijs} = 1\right) = \Phi(&\gamma_0^* + \gamma_1^* FinDevt_j \cdot ExtFin_s - \gamma_2^* FinDevt_j \cdot Tang_s + \\ &+ (\varepsilon - 1)^* p_{is} - \mu^* d_{ij} - \kappa^* \varphi_{ij} + \phi_j^* + \phi_i^* + \phi_s^*). \end{aligned} \tag{6}$$

Starred coefficients indicate that the original coefficient has been divided by $\sigma_\eta = \sqrt{\sigma_u^2 + \sigma_\nu^2}$ so that Φ be the c.d.f. of the unit-normal distribution.

4.2 Product variety and trade partners

I next test Corollary 3 for the product variety of countries' exports. The measure of firms from j selling to i in sector s is $X_{ijs} = N_{js} G\left(a_{ijs}^L\right)$. I assume that $\ln G\left(a_{ijs}^L\right)$ can be decomposed and $x_{ijs} \equiv \ln X_{ijs}$ expressed as follows:

$$\begin{aligned} x_{ijs} = \xi_0 &+ \xi_1 FinDevt_j \cdot ExtFin_s - \xi_2 FinDevt_j \cdot Tang_s + \\ &+ \xi_3 n_{js} + \xi_4 p_{is} - \xi_5 d_{ij} - \xi_6 \varphi_{ij} + \xi_j + \xi_i + \xi_s + \iota_{ij}, \end{aligned} \tag{7}$$

where $n_{js} \equiv \ln N_{js}$, and ξ_j, ξ_i, and ξ_s represent exporter, importer and sector fixed effects. There is a close resemblance between the estimating equations for x_{ijs} and z_{ijs} because both are driven by the selection of firms into exporting through the productivity cut-off $1/a_{ijs}^L$. However, while (6) analyzes zero versus positive trade flows with Probit, (7) examines the extensive margin of positive exports with OLS. Note also that the mass of domestically active firms N_{js} only enters the equation for product variety.

The last implication of the model for the extensive margin of trade concerns countries' trade partner intensity I_{js}. I test Proposition 4 with the following reduced-form estimating equation:

$$I_{js} = \mu_0 + \mu_1 FinDevt_j \cdot ExtFin_s - \mu_2 FinDevt_j \cdot Tang_s + \mu_j + \mu_s + \epsilon_{js}, \tag{8}$$

where μ_j and μ_s capture exporter and sector fixed effects.

4.3 Trade volumes

Finally, I examine the predictions of the model for the value of firm-level exports and aggregate bilateral flows. Total exports from country j to country i in sector s can be expressed as

$$M_{ijs} = \left(\frac{\tau_{ij} c_{js}}{\alpha P_{is}}\right)^{1-\varepsilon} \theta_s Y_i N_{js} V_{ijs} E_{ijs}, \tag{9}$$

$$\text{where } V_{ijs} = \begin{cases} \int_{a_L}^{a_{ijs}^L} a^{1-\varepsilon} dG(a) & \text{for } a_{ijs}^L \geq a_L \\ 0 & \text{otherwise} \end{cases},$$

$$\text{and } E_{ijs} = \left[\frac{\int_{a_L}^{a_{ijs}^H} a^{1-\varepsilon} dG(a) + \int_{a_{ijs}^H}^{a_{ijs}^L} \beta_{ijs}(a) a^{1-\varepsilon} dG(a)}{\int_{a_L}^{a_{ijs}^L} a^{1-\varepsilon} dG(a)} \right].$$

Note that V_{ijs} is nonzero if and only if the cut-off for exporting falls within the support of the productivity distribution function. When $1/a_{ijs}^L$ is too high, no firm enters the foreign market and $M_{ijs} = 0$. V_{ijs} is thus a direct measure of the selection of firms into exporting. On the other hand, E_{ijs} reflects the effect of credit constraints on average firm sales.

I follow HMR in assuming that firm productivity has a truncated Pareto distribution with support $[a_L, a_H]$: $G(a) = \left(a^k - a_L^k\right) / \left(a_H^k - a_L^k\right)$, where $a_H > a_L > 0$ and $k > \varepsilon - 1$. V_{ijs} can then be rewritten as $V_{ijs} = \frac{k a_L^{k-\varepsilon+1}}{(k-\varepsilon+1)\left(a_H^k - a_L^k\right)} W_{ijs}$ with $W_{ijs} = \max\left\{ \left(a_{ijs}^L / a_L\right)^{k-\varepsilon+1} - 1, 0 \right\}$. Invoking the assumptions $c_{js} = c_j c_s$ and $\tau_{ij}^{\varepsilon-1} = D_{ij}^{\mu} e^{-u_{ij}}$, in log-linear form (9) becomes

$$m_{ijs} = \varsigma_0 + n_{js} + w_{ijs} + e_{ijs} + (\varepsilon - 1) p_{is} - \mu d_{ij} + \varsigma_j + \varsigma_i + \varsigma_s + u_{ij}, \tag{10}$$

where $m_{ijs} \equiv \ln M_{ijs}$, $n_{ijs} \equiv \ln N_{ijs}$, $w_{ijs} \equiv \ln W_{ijs}$, and $e_{ijs} \equiv \ln E_{ijs}$. $\varsigma_j = -(\varepsilon - 1) \ln c_j$, $\varsigma_i = y_i$, and $\varsigma_s = -(\varepsilon - 1) \ln c_s + \ln \theta_s$ are exporter, importer and sector fixed effects, respectively.

Financial frictions can restrict bilateral trade through three channels: the selection of firms into production (n_{js}), the selection of producers into exporting (w_{ijs}), and firm-level exports (e_{ijs}). While Section 3 has focused on the latter two channels, in a fuller model firms would require external funding both for their local and for their foreign sales. The productivity cut-off for domestic production would then depend on financial market conditions just as the threshold for exporting. Both would be systematically lower in financially developed countries, especially in financially vulnerable sectors. In other words, financially advanced economies can export more in such industries because (i) they support more domestic producers, (ii) more of these producers become exporters, and (iii) those who do so sell more abroad.

The prior literature has confounded these three effects by performing reduced-form analyses that do not control for the the mass of active firms n_{js}. It is therefore not clear whether these earlier findings reflect an effect of credit constraints specific to trade activity or a general impact on production. Previous studies have also examined only positive trade flows and ignored the consequences of financial frictions for the selection of firms into exporting w_{ijs}.

In order to decompose the effect of capital market frictions into these three mechanisms, I first regress m_{ijs} on $FinDevt_j \cdot ExtFin_s$, $FinDevt_j \cdot Tang_s$ and all variables in (10) except for n_{js}, w_{ijs}, and e_{ijs}. This provides an estimate for the overall impact of credit constraints on trade. I then isolate the trade-specific component of this effect by explicitly controlling for n_{js}. This constitutes a test of Proposition 6.

Since cross-country data are not available for w_{ijs} and e_{ijs}, I next adopt a two-stage structural procedure in the spirit of HMR. In the first stage, I obtain the predicted probability of exporting $\widehat{\rho}_{ijs}$ from the Probit specification in (6), and derive an estimate for the latent variable $z_{ijs}^* \equiv z_{ijs}/\sigma_\eta$ as $\widehat{z}_{ijs}^* = \Phi^{-1}\left(\widehat{\rho}_{ijs}\right)$. I construct a consistent estimate for w_{ijs} from

$W_{ijs} = \max\left\{\left(Z^*_{ijs}\right)^{\delta} - 1, 0\right\}$, where $\delta = \sigma_\eta\left(k - \varepsilon + 1\right)/\left(\varepsilon - 1\right)$. In the second stage, I include both n_{js} and the imputed measure of w_{ijs} in the regression for m_{ijs}. Any residual impact of the financial variables on m_{ijs} then reflects distortions to firm-level exports e_{ijs} as per Proposition 5. Fixed export costs φ_{ij} directly affect only the extensive margin of trade, enter only the first stage, and provide the exclusion restriction necessary for the identification of the second stage.

The error term u_{ij} in (10) is correlated with w_{ijs} because the error term in the equation for z_{ijs} (5) is $\eta_{ij} \equiv u_{ij} + \nu_{ij}$. Positive correlation between trade barriers d_{ij} and u_{ij} may also generate sample selection bias: Country pairs with high observable trade costs d_{ij} that trade with each other likely have low unobserved costs, i.e. high u_{ij}. The consistent estimation of (10) thus requires controlling for firm selection into exporting conditional on positive trade, $E\left[w_{ijs}|., T_{ijs} = 1\right]$, as well as the standard Heckman correction for sample selection, $E\left[u_{ij}|., T_{ijs} = 1\right] = corr\left(u_{ij}, \eta_{ij}\right)\left(\sigma_u/\sigma_\eta\right)\overline{\eta}^*_{ij}$. Both terms depend on $\overline{\eta}^*_{ij} \equiv E\left[\eta^*_{ij}|., T_{ijs} = 1\right]$, for which a consistent estimate is given by the inverse Mills ratio, $\widehat{\overline{\eta}}^*_{ij} = \phi\left(\widehat{z}^*_{ijs}\right)/\Phi\left(\widehat{z}^*_{ijs}\right)$. Hence $\widehat{\overline{z}}^*_{ijs} = \widehat{z}^*_{ijs} + \overline{\eta}^*_{ij}$ and $\widehat{\overline{w}}^*_{ijs} = \ln\left\{\exp\left(\delta\widehat{\overline{z}}^*_{ijs}\right) - 1\right\}$ are consistent estimates for $E\left[z_{ijs}|., T_{ijs} = 1\right]$ and $E\left[w_{ijs}|., T_{ijs} = 1\right]$, respectively. Including $\widehat{\overline{\eta}}^*_{ij}$ and $\widehat{\overline{w}}^*_{ijs}$ in the second stage thus produces consistent estimates and accounts for the selection of firms into exporting.

The exact construction of $\widehat{\overline{\eta}}^*_{ij}$ and $\widehat{\overline{w}}^*_{ijs}$ depends on two assumptions: the joint normality of the unobserved trade costs u_{ij} and ν_{ij}, and the Pareto distribution of firm productivity. In robustness checks, I first drop the second assumption and use a polynomial in the estimated latent variable $\widehat{z}^*_{ijs}$ instead of $\widehat{\overline{w}}^*_{ijs}$. I then relax both assumptions and control directly for the predicted probabilities of exporting $\widehat{\rho}_{ijs}$. These robustness checks leave my results unchanged.

5 Data

The empirical analysis requires three key ingredients: measures of countries' financial development, proxies for sectors' financial vulnerability, and data on trade activity across countries and sectors. I discuss these in detail here and describe all other control variables in Appendix B.

5.1 Financial development across countries

My main measure of financial development is the amount of credit by banks and other financial intermediaries to the private sector as a share of GDP (private credit), which I obtain from Beck et al. (2000). Conceptually, establishing a credit constraints channel necessitates an indicator of financial contractibility or, more generally, of the capacity of the environment to provide external financing. While direct measures are not available, the size of the financial system is an objective and outcome-based variable that reflects the actual use of external funds. This makes it an appropriate proxy for the economy's potential to support financial relationships. Private credit has been used extensively in the finance and growth literature, as well as in most papers on finance and trade.

Private credit varies significantly in the panel. Panel A in Appendix Table 1 lists the 107 countries in the sample and gives the mean and standard deviation of their private credit over the 1985-1995 period. The bottom two rows summarize the cross-sectional variation of the country averages, as well as the panel-wide variation in the annual data. In the median country (India), private credit was 25.6% of GDP over this period and fluctuated between 21.9% and 31.1%. In the cross-section, private credit spans the 2.3% (Uganda) to 163% (Japan) range, and in the panel as a whole it varies from 0.4% (Guinea-Bissau, 1989) to 179% (Japan, 1995) with a mean of 39.7% and standard deviation of 34.9%.

For robustness, I also use indices for the repudiation of contracts, accounting standards, and the risk of expropriation from La Porta et al. (1998). While these indicators do not directly measure the probability that financial contracts are enforced, they reflect the general contractual environment in a country, which applies to financial contracting as well. These proxies are available for a subset of countries and do not vary over time (see Panel B).

5.2 Financial vulnerability across sectors

The industry measures of financial vulnerability follow closely their definitions in the model and are standard in the literature. They come from Braun (2003), and are based on data for all publicly listed US-based companies from Compustat's annual industrial files. External finance dependence is the share of capital expenditures not financed with cash flows from operations. Asset tangibility records the share of net property, plant and equipment in total book-value assets.[16] Both measures are averaged over 1986-1995 for the median firm in each industry, and appear very stable over time when compared to indices for 1976-1985 and 1966-1975.

While the measure of external finance dependence is not available specifically for expenditures related to international trade, it is an appropriate proxy for three reasons. First, firms need to incur the same production costs in manufacturing for the foreign market as in manufacturing for the home country. Second, products that entail a lot of R&D, marketing research and distribution costs at home plausibly also require similarly large fixed costs for product customization, marketing and distribution networks in foreign markets. Both of these factors imply that whatever forces a firm in a particular industry to fund its domestic operations with outside capital will also force it to use external funds for its sales abroad. Finally, the empirical measure is based on large US companies that are typically big exporters. It thus reflects their total requirement for external finance and not just that for their domestic activities.

Constructing the industry measures from US data is motivated by two considerations. First, the United States have one of the most advanced and sophisticated financial systems. This makes it reasonable that the measures reflect firms' optimal choice over external financing and asset

[16] A firm's book value includes a number of other assets that are arguably less tangible and can either not be liquidated or be liquidated at a significant loss by an outside investor in case of default. Such softer assets comprise goodwill, research and development, the associated human capital, organizational capital, and even accounts receivables, cash, inventory and related investments.

structure. Second, using the US as the reference country is convenient because of limited data for many other countries, but it also ensures that the measures are not endogenous to financial development. In fact, if some of the very external capital intensive industries in the US use more internal financing in countries with worse credit markets, the coefficient on $FinDevt_j \cdot ExtFin_s$ would be underestimated. Similarly, if companies compensate with more tangible assets for a lower level of financial development, $FinDevt_j \cdot Tang_s$ would be underestimated.

While identification does not require that industries have exactly the same level of financial vulnerability in every country, it does rely on the ranking of sectors remaining relatively stable across countries. Rajan and Zingales (1998) and Braun (2003) argue that the measures they construct capture a large technological component that is innate to the manufacturing process in a sector and are thus good proxies for ranking industries in all countries. They point out that the measures vary substantially more across sectors than among companies within an industry.

The financial vulnerability measures for the 27 sectors in my sample are listed in Appendix Table 2. A sector is defined as a 3-digit category in the ISIC industry classification system. Most US firms finance between half a percent (non-ferrous metals) and 96% (professional and scientific equipment) of their capital expenditures with external funds, for an average of 25%. The industries with the lowest levels of tangibility are pottery, china, and earthenware; leather products; and wearing apparel. Assets are hardest in petroleum refineries; paper and products; iron and steel; and industrial chemicals. Identifying both interaction terms in the estimating equations is possible because the two industry variables are only weakly correlated at -0.04.

5.3 Trade activity across countries and sectors

I apply the model to bilateral exports for 107 countries and 27 sectors in 1985-1995.[17] I obtain trade flows at the 4-digit SITC Rev.2 industry level from Feenstra's *World Trade Database* and use Haveman's concordance tables to aggregate the data to 3-digit ISIC sectors. In the absence of cross-country data at the firm level, I measure the extensive margin of countries' exports with the number of 4-digit SITC product groups traded within a 3-digit ISIC sector. In robustness tests, I also examine the number of 10-digit HS products shipped, available specifically for US imports from the *US Imports, Exports and Tariff Data*.

The value of exports, number of trade partners, and product variety differ greatly across countries and sectors in the data. Importantly, this variation exhibits some systematic patterns. Appendix Table 3 reports broad summary statistics for these three outcomes in the cross-section for the latest year in the panel, 1995. Financially developed economies typically outperform exporters with less evolved financial institutions. As Figure 2 shows, countries with higher levels of private credit export more in the average sector and destination (correlation coefficient 0.66). Such nations also ship a wider range of products (corr coeff 0.71) to more markets (corr coeff 0.74). Indeed, Figure 2 would look very similarly if it instead plotted exporters' number of trade

[17] All results also hold in the cross-section for individual years.

partners or number of bilaterally traded products against financial development.

While these patterns suggest that export activity depends on the exporter's financial development, they ignore the variation across sectors. Compare then two countries, Italy and Argentina, which are at the 70th and 40th percentile by private credit respectively. In Figure 3, I order sectors by external finance dependence and plot the value of Italy's and Argentina's average bilateral exports by sector. Italy, the financially advanced nation, sells more than Argentina in almost all sectors, but this advantage is more pronounced in financially vulnerable industries. Similar relationships hold for these two countries' number of destinations and export product variety (figures available on request).

While suggestive, these graphs and summary statistics do not account for differences across countries and sectors unrelated to financial frictions. The regression analysis in the next section confirms that the same patterns obtain in a large panel after controlling for total output, factor endowments, overall development, and other institutions.

6 The effect of credit constraints on trade vs. production

The empirical analysis proceeds in two steps. This section first establishes that financial frictions restrict trade flows, and that this distortion exceeds any disruptions to total output. Section 7 then decomposes the trade-specific effect of credit constraints into reductions along the extensive and intensive margins of exports.

6.1 Isolating a trade-specific effect

I begin by showing that financially developed countries indeed have a comparative advantage in financially vulnerable sectors. To this end, I regress (log) bilateral exports on the exporter's level of private credit and its interactions with the industry measures of external finance dependence and asset tangibility. As reported in Column 1 of Table 1, financially advanced economies export relatively more in sectors that require more outside capital and in sectors with few collateralizable assets. This result obtains controlling for the market size (GDP) of the two trade partners and the distance between them. This specification can be seen as a reduced-form version of equation (10).[18] It includes exporter, importer and sector fixed effects as prescribed by the model, as well as year fixed effects to capture common time trends in the panel. I cluster errors by exporter-importer pair, since the error term in (10) reflects unobserved variation in bilateral trade costs.

Column 2 isolates the effect of financial frictions on trade above and beyond that on overall production, by explicitly controlling for the (log) number of establishments in the exporting country by year and sector, n_{js} in (10). 75%-80% of the total effect of credit market imperfections on exports is independent of their effect on output. The prior literature has thus overestimated the impact of financial frictions specific to trade by about 25%. This is one of the first pieces of

[18] Because the importer's GDP varies over time, it is not subsumed by the importer fixed effects. One can rewrite (10) to also include the exporter's GDP. Bilateral distance proxies for the iceberg trade cost in the model.

evidence that this impact is large and not driven by cross-border sales scaling proportionately with domestic activity. I have confirmed that, as expected, more establishments are active in financially developed countries, especially in financially vulnerable sectors (available on request). This finding is in itself new and consistent with earlier work on finance and growth.

Given the importance of accounting for the effect of credit constraints on general economic activity, the analysis of trade patterns in the remainder of the paper always conditions on the (log) number of domestic producers. Of note, all results are robust to alternatively controlling for (log) output by country, year and sector (see Column 3). While this is not called for by the model, it provides a more conservative estimation approach that might or might not emerge from other theoretical frameworks.[19]

The model also posits that the estimation of bilateral exports control for the sector-specific price index in the importing country, something no prior study on trade and finance has done. In the absence of a direct measure for p_{is}, I use three different proxies. In Column 4, I include the importer's CPI and its interactions with a full set of sector dummies. In Column 5, I condition instead on the importer's (log) total consumption by sector, computed as the sum of domestic production and net imports. In the last column, I employ importer-sector fixed effects. The choice of p_{is} proxy affects my results minimally, and below I present only estimates using the importer's CPI interacted with sector dummies.

The effect of credit constraints on bilateral exports is highly statistically and economically significant. For example, if the Philippines, the country at the first quartile of the distribution of private credit, were to improve its financial system to the level at the third quartile (Italy), its textile exports (highly dependent on external finance, 3rd quartile) would rise 19 percentage points more than its mineral products exports (intensive in internal funding, 1st quartile). Similarly, exports of low tangibility sectors (other chemicals, 1st quartile) would grow by 17 percentage points more than exports of high tangibility sectors (wood products, 3rd quartile).[20]

While establishing causality has typically been difficult in the finance and trade (and finance and growth) literature, the results presented here do suggest a causal effect of credit constraints on trade patterns. Reverse causality could arise because an increase in relative foreign demand for sectors intensive in external funds might lead to both higher exports from these industries and to more borrowing in the economy, as measured by private credit. This mechanism could generate the result that financially developed countries export relatively more in external capital dependent sectors even in the absence of credit constraints.

The same argument, however, cannot explain the significant effect of the interaction of private credit with asset tangibility. If credit markets were frictionless, the availability of collateralizable assets would not matter for a sector's ability to raise outside capital. Holding financial dependence constant, the sectoral composition of export demand would then not affect private credit. The result that financially underdeveloped countries export less in sectors with fewer tangible

[19] All results in the paper are also robust to controlling for the exporter's output *growth* by year and sector.
[20] Comparative statics based on Column 4 in Table 1.

assets is thus strong evidence of a credit constraints channel.[21] Finally, below I document similar patterns using time-invariant measures of contractibility (contract repudiation, accounting standards and expropriation risk). This further helps with establishing causality as these variables do not respond to variation in export demand the way private credit might.

6.2 Sensitivity analysis and economic magnitudes

The estimated trade-specific effect of financial frictions is robust to a series of specification checks. Columns 1 and 2 in Table 2 confirm that the two interaction terms identify distinct economic mechanisms and enter with the same magnitude and significance when included one at a time.[22] The remainder of the table accounts for traditional sources of comparative advantage by controlling for the interaction of countries' (log) per capita endowments of natural resources, physical and human capital with sectors' respective factor intensities. I also ensure that the impact of financial development is independent of the effects of other institutions that are positively correlated with private credit. In particular, I control for the interactions of the exporter's overall rule of law and level of corruption with the industry measures of financial vulnerability. Finally, I interact these industry measures with per capita GDP to isolate an effect of financial development separate from that of overall development.

I find that financially advanced economies export relatively more in sectors intensive in outside finance and intangible assets even after accounting for all of these alternative sources of comparative advantage. The effects are also robust to the choice of financial contractibility measure. Using indices of contract repudiation, accounting standards and the risk of expropriation produces similarly significant results. These findings present strong support for Proposition 6.[23]

Table 2 implies that credit constraints have sizeable economic effects not only in absolute terms, but also relative to traditional Heckscher-Ohlin sources of comparative advantage. The impact of a one-standard-deviation improvement in financial development is of the same magnitude as that of a one-standard-deviation rise in human capital endowments and substantially larger than that of a one-standard-deviation increase in the stock of physical capital.

These results are summarized in the top row of Table 7, which shows how much of the variation in the data can be explained by financial development. Each cell reports on a different comparative static exercise. The relevant trade outcome and hypothetical change are indicated in the row and column headings, respectively. For example, Column 1 shows that a one-standard-deviation expansion in a country's private credit would increase its exports in the sector at the 75th percentile of the distribution by external finance dependence by 15 percentage points

[21] To establish causality, prior researchers have instrumented for private credit with legal origin. All of my results hold with this IV approach. However, legal origin has been shown to impact institution formation and the economy more broadly, which in turn are likely to affect sectors differentially. It is thus not obvious that this instrument meets the exclusion restriction.

[22] All other results in the paper are also robust to including only one of the two interaction terms at a time.

[23] In unreported results, I have confirmed that my findings are not driven by financially underdeveloped countries having systematically different real exchange rates. See Russ and Valderrama (2009) on the link between financial development and real exchange rates in general equilibrium.

more than its exports in the sector at the 25th percentile. Exports in the sector at the 25th percentile of the distribution by asset tangibility would similarly grow 14 percentage points more than exports in the sector at the 75th percentile (Column 2). The corresponding numbers for the effects of a one-standard-deviation improvement in contract enforcement are 20 and 30 percentage points, respectively (Columns 3 and 4). By comparison, the impact of a one-standard-deviation increase in physical (human) capital stocks on exports of the sector at the 75th percentile of the distribution by physical (human) capital intensity is 9 percentage points smaller (32 percentage points bigger) than that on exports of the sector at the 25th percentile (Columns 5 and 6).[24]

My findings also suggest that financial development can account for a large share of the growth in global trade between 1985 and 1995. Using my estimates and data on the actual change in countries' private credit, I predict how countries' worldwide exports by sector would have evolved over this period as a result of financial development, holding all other variables fixed at their 1985 levels. In Table 8, I regress the actual on the predicted value of exports and the actual on the predicted change in exports. As the R-squared in Columns 1 and 4 show, financial development alone can explain 22% of the growth in trade flows and 85% of the variation in export levels across countries and sectors in 1995.[25]

To put this into perspective, note that it is roughly twice the predictive power of factor accumulation. I repeat the exercise above, this time using data on the actual change in countries' factor endowments to project the evolution of trade flows. Holding the level of private credit and all other variables fixed at their 1985 levels, I find that changes in exporters' natural resources, physical and human capital can account for only 12% of the change in trade flows and 65% of the variation in export levels in 1995 (Columns 2 and 5). When both the predicted values based on financial development and on factor accumulation enter the regression, the point estimates and significance of the former remain unchanged. By contrast, the latter is either insignificant (Column 3) or its beta coefficient is half that on financial development (Column 6). These results also hold when I condition on country fixed effects (available on request).

7 Decomposing the trade-specific effect of credit constraints

7.1 The extensive margin of trade: selection into exporting

I next decompose the trade-specific effect of credit constraints into the component due to firm selection into exporting and that due to average firm-level exports. To do so, I implement the two-stage estimation procedure outlined in Sections 4.1 and 4.3.

This approach requires the use of an empirical proxy for the fixed costs of international trade, which affect firms' export status but not the level of their foreign sales. In the absence

[24] The counter-intuitive results for countries' physical capital are due to the negative coefficient on its interaction with sectors' physical capital intensity. This interaction turns positive for some trade outcomes below.

[25] This difference in R-squared is mostly due to the fact that export patterns typically changed little between 1985 and 1995 relative to export levels in 1985.

of direct trade cost measures, I exploit data on the regulation costs of firm entry from Djankov et al. (2002).[26] This choice is motivated by the presumption that countries which set high regulatory barriers to companies' domestic activity also impose high fixed costs on firms' cross-border operations. Entry costs are measured by the number of days, the number or procedures, and the monetary cost to an entrepreneur of legally starting a business (relative to GDP per capita). For each of these variables, I take the (log) average value for the exporting and importing country. I thus obtain three proxies for the fixed cost of exporting unique to every country pair. As the results below confirm, higher regulatory hurdles indeed deter countries from engaging in international trade. Moreover, by their nature, such barriers capture only the fixed cost of doing business and thus meet the exclusion restriction of no direct effect on the variable costs of trade and the scale of firm exports.[27]

According to Corollary 2, financially developed countries enjoy greater capacity to export bilaterally, especially in financially vulnerable sectors. I test this prediction by estimating equation (6) with a Probit specification. As the outcome measure, I use an indicator variable equal to 1 if country j exports to country i in sector s and year t. I condition on exporter, importer, sector and year fixed effects, and control for both partners' GDP and the sector price index in the importing country. Since variable as well as fixed trade costs affect companies' export status, I include both bilateral distance and the three regulatory cost measures in the regression. In the absence of comprehensive cross-country data at the firm level, this specification also implicitly tests how credit constraints affect the productivity cut-off for exporting (Proposition 1).

Table 3 presents strong empirical support for Corollary 2. Financially advanced nations are more likely to enter a given market, and this effect is stronger in sectors that require more outside finance or have fewer tangible assets. This result is independent of other sources of comparative advantage, such as factor endowments, the overall level of development, and other institutions. It is also robust to the choice of financial contractibility measure.

The effects of credit constraints on firm selection into exporting are not only statistically highly significant, but also of considerable economic magnitude. The comparative statics in the second row of Table 7 illustrate this both in absolute terms and relative to the economic significance of factor-endowment differences across countries. A one-standard-deviation rise in contract enforcement is associated with a 19% higher probability of exporting in a sector reliant on outside finance (75th percentile) relative to a sector with little need for external capital (25th percentile). The corresponding differential effect across sectors at different levels of asset tangibility is 17%. The estimated impact of a one-standard-deviation improvement in private credit is somewhat smaller. These effects are on par with those of a one-standard-deviation rise in a country's human capital endowment, which would boost the probability of exporting by 15% more in a human-capital intensive sector (75th percentile) relative to a human-capital

[26] Since historical data are not available, I use regulation cost data for 1999.

[27] Very similar results obtain if I instead use an indicator variable equal to 1 when at least one of the two trade partners is an island as the exclusion restriction (available on request).

scarce industry (25th percentile). By contrast, the impact of a comparable change in physical capital stocks is only a fifth as large.

7.1.1 Product variety

I next examine the consequences of financial frictions for the product composition of countries' sales abroad. Although the measure of exporting firms is not readily observed, the number of varieties shipped contains information about the extensive margin of trade conditional on positive flows. It thus complements the preceding analysis of the probability of exporting as both shed light on the underlying cut-off for exporting. In the model, both outcomes reflect the fact that financial frictions interact with firm heterogeneity and intensify the selection of only the most productive firms into exporting.

I estimate equation (7) with the (log) number of 4-digit SITC product groups sold bilaterally within a 3-digit ISIC sector as the outcome variable. Since a 4-digit product category itself encompasses an unobserved range of goods, using this measure likely underestimates the true impact of credit constraints on product scope. Consistently with Corollary 3, I find that financially advanced economies export a wider range of products in industries intensive in outside finance and intangible assets (Panel A of Table 4). These effects are not driven by other sources of comparative advantage such as factor endowments, overall development or other institutions. In addition, the findings obtain controlling for the number of active establishments in the exporting country and sector, the importer's price index, the market size of and distance between the two trade partners, and a full set of exporter, importer, sector and year fixed effects.

The economic significance of credit constraints is considerable, as can be seen in Table 7: A one-standard-deviation increase in the index of contract repudiation, for example, would boost the average country's export product scope by 8-10 percentage points more in a financially vulnerable industry (3rd quartile) relative to a less vulnerable industry (1st quartile). A one-standard-deviation growth in human capital would have comparable reallocation effects across sectors at different levels of human capital intensity, while the impact of a similar change in physical capital would be about two-thirds smaller.

These conclusions are robust to measuring product variety at a finer level of disaggregation. In Panel B of Table 4, I restrict the analysis to exports specifically to the US, for which it is possible to count the number of 10-digit HS products traded within a 3-digit ISIC sector. I continue to observe that financially developed countries sell more products in financially vulnerable sectors, although the interaction with asset tangibility is often imprecisely estimated.[28]

Although I do not observe the number of trading firms, the number of products shipped appears to capture well the extensive margin of trade: When I repeat the analysis of product variety controlling for firm selection into exporting with the predicted probability of trade from Table 3, the impact of credit constraints is substantially diminished (available on request).

[28] All interaction terms in Panel B of Table 4 are statistically significant when the dependent variable is the number of 10-digit products exported within a sector to the US instead of the natural logarithm of that number.

7.1.2 Trade partners

The large effects of financial frictions on the probability of bilateral trade naturally imply that economies with stronger financial institutions will be able to penetrate more foreign markets, especially in financially vulnerable industries. Studying the number of countries' export destinations is thus yet another way of gauging the impact of credit constraints on the extensive margin of trade. To this end, Table 5 explores the variation in trade partner intensity across exporting nations and sectors in the full sample (Panel A) and among observations with at least one destination (Panel B). In line with Proposition 4, I find that financially developed countries enter significantly more markets in sectors intensive in outside capital and intangible assets. This result obtains after conditioning on exporter, sector and year fixed effects and including the full set of controls as before. The latter are based on the exporters' factor endowments, other institutions, overall development and market size. The estimates are also robust to alternative measures of financial contractibility.[29]

Financial frictions have sizeable economic effects on countries' trade partner intensity (Table 7). A one-standard-deviation improvement in contract enforcement would allow an economy to add 5-6 more destinations in a financially vulnerable sector (3rd quartile) relative to a less dependent industry (1st quartile). These magnitudes are big given that the average number of export markets in the sample is 32. They are comparable to the effects of human capital accumulation, and much larger than those of physical capital accretion.[30]

7.2 The intensive margin of trade: level of firm exports

Finally, I estimate the effect of credit constraints on average firm exports predicted by Proposition 5. This requires including a measure of firm selection into exporting w_{ijs}, as well as the standard Heckman correction for sample selection in the specification for bilateral trade flows. I therefore obtain the predicted probability of exporting $\widehat{\rho}_{ijs}$ from each Probit regression in Table 3 and estimate the latent variable $\widehat{z}^*_{ijs} = \Phi^{-1}\left(\widehat{\rho}_{ijs}\right)$. I also compute the disturbance term conditional on positive bilateral exports, $\widehat{\overline{\eta}}^*_{ij} = \phi\left(\widehat{z}^*_{ijs}\right)/\Phi\left(\widehat{z}^*_{ijs}\right)$.[31] Since the model predicts that w_{ijs} conditional on positive trade is a nonlinear function of the imputed variables, $\widehat{\overline{w}}^*_{ijs} \equiv \ln\left\{\exp\left[\delta\left(\widehat{z}^*_{ijs} + \widehat{\overline{\eta}}^*_{ij}\right)\right] - 1\right\}$, I estimate (10) with the Maximum Likelihood Estimator.

Panel A of Table 6 presents the results from the second stage MLE. Exporting firms from financially developed countries earn significantly larger foreign revenues on average, and this effect is magnified in financially vulnerable sectors. In view of the model, this suggests that

[29] The regressions in Table 5 cluster errors by export country since the unit of observation is exporter-sector-year.

[30] In the Melitz (2003) model, the productivity cut-off for exporting falls with the size of the destination market. This generates a pecking order of export destinations. The working paper version of this article shows that financial frictions exacerbate this pecking order. While all exporters can enter large markets, financially advanced economies can also service smaller destinations, particularly in financially vulnerable sectors.

[31] For less than 1% of all observations $\widehat{\rho}_{ijs}$ is indistinguishable from 1 or 0. In order to infer $\widehat{z}^*_{ijs}$, I set $\widehat{\rho}_{ijs} = 0.9999999$ ($\widehat{\rho}_{ijs} = 0.0000001$) for all observations with $\widehat{\rho}_{ijs}$ above (below) this cut-off.

financial development allows more firms to export at first-best levels and/or increases the sales of firms operating at second-best. These results lend support to Proposition 5. As anticipated, both $\widehat{\overline{w}}^*_{ijs}$ and $\widehat{\overline{\eta}}^*_{ij}$ enter positively and significantly.

I gauge the relative importance of credit constraints for the extensive and intensive margins of trade by comparing the coefficient estimates in the second stage to OLS estimates of the same regression without the $\widehat{\overline{w}}^*_{ijs}$ and $\widehat{\overline{\eta}}^*_{ij}$ corrections (results not reported). I find that 30%-40% of the trade-specific effect of financial development on export volumes results from fewer firms becoming exporters, whereas 60%-70% is due to depressed firm-level exports. The exact decomposition varies across specifications and depends on the sector measure of financial vulnerability (see Appendix Table 4). These results indicate that firms face substantial credit constraints in the financing of both fixed and variable export costs.

My findings are not sensitive to the assumptions made in the construction of $\widehat{\overline{\eta}}^*_{ij}$ and $\widehat{\overline{w}}^*_{ijs}$. In Panel B of Table 6, I first drop the assumption of a Pareto distribution for firm productivity. Since I can no longer construct a precise estimate for $\widehat{\overline{w}}^*_{ijs}$, I include a cubic polynomial in the estimated latent variable $\widehat{z}^*_{ijs}$ in the second stage. Because all regressors now enter linearly, I estimate the second stage with OLS. This modification leaves all results both qualitatively and quantitatively unchanged.

I then also relax the assumption of the joint normality of the unobserved fixed and variable trade costs, u_{ij} and ν_{ij} in the model. This implies that the disturbance term $\widehat{\overline{\eta}}^*_{ij}$ and the latent variable $\widehat{z}^*_{ijs}$ cannot be exactly imputed from the predicted probability of exporting $\widehat{\rho}_{ijs}$. I control instead directly for these $\widehat{\rho}_{ijs}$'s by grouping them into 50 bins and using dummies for each bin in an OLS second stage regression. As the evidence in Panel C shows, the same robust results obtain in this very flexible specification.

Financial frictions lead to economically large distortions in (average) firm exports (last row of Table 7). Strenghtening contract enforcement by one standard deviation would result in 15% higher firm exports in a sector reliant on outside finance (75th percentile) relative to a sector with little need for external capital (25th percentile). This number reaches 25% when comparing sectors at different levels of asset tangibility. For reference, a one-standard-deviation rise in a country's human capital endowment would expand the intensive margin of trade by 30% more in a human-capital intensive sector (75th percentile) relative to a human-capital scarce industry (25th percentile). A similar change in physical capital stocks would have only minimal effects.

8 Conclusion

Conducting international trade requires routine access to external capital. Well-functioning financial markets are thus necessary to support the global exchange of goods and services. This paper provides an overall treatment of the effect of credit constraints on export flows by decomposing it into different components. To this end, I develop a heterogeneous-firm model with cross-country differences in financial development and cross-industry variation in financial vul-

nerability. Applying this model to a large panel of bilateral trade for 27 industries in 1985-1995, I show that financial frictions impede firm selection into production, producers' entry into exporting, and exporters' foreign sales. As a result, weak financial institutions lead to fewer destination markets, reduced export product variety, and lower aggregate trade volumes. These distortions are amplified in financially vulnerable sectors that need more outside capital and that have fewer collateralizable assets.

My results shed light on the mechanisms through which credit constraints hinder global trade. First, I document that exports are affected disproportionately more than overall economic activity. Only 20%-25% of the disruptions to trade flows are channeled through reductions in total output. This highlights the sensitivity of international trade to financial shocks, as evidenced by the 2008-2009 global financial crisis.

Second, I establish that the trade-specific effect of credit constraints operates through both the extensive and the intensive margins of trade. This implies that exporters face binding liquidity constraints with respect to funding both their fixed and variable costs. Financial underdevelopment could therefore play an important role in the adjustment to trade reforms, exchange rate movements, and other cost or demand shocks. When financial capital is limited or inefficiently allocated, the presence of heterogeneous firms could likely also affect the welfare gains from trade. The policy implications of these potential consequences make them an important area for future research.

References

[1] Aghion, P., Angeletos, G.-M., Banerjee, A. and K. Manova (2010). "Volatility and Growth: Credit Constraints and the Composition of Investment." *Journal of Monetary Economics* 57, p.246-65.

[2] Ahn, J. (2011). "A Theory of Domestic and International Trade Finance." IMF Working Paper No. 11/262.

[3] Amiti, M. and D. Weinstein (2011). "Exports and Financial Shocks." *Quarterly Journal of Economics* 126, p.1841-77.

[4] Antràs, P. and R. Caballero (2009). "Trade and Capital Flows: A Financial Frictions Perspective." *Journal of Political Economy* 117(4), p.701-44.

[5] Antràs, P., Desai, M. and F. Foley (2009). "Multinational Firms, FDI Flows and Imperfect Capital Markets." *Quarterly Journal of Economics* 124(3), p.1171-219.

[6] Antràs, P. and F. Foley (2011). "Poultry in Motion: A Study of International Trade Finance Practices." NBER Working Paper 17091.

[7] Arkolakis, C., Costinot, A. and A. Rodríguez-Clare (2012). "New Trade Models, Same Old Gains?" *American Economic Review* 102(1), p.94-130.

[8] Auboin, M. (2009). "Boosting the Availability of Trade Finance in the Current Crisis: Background Analysis for a Substantial G20 Package." CEPR Working Paper 35.

[9] Banerjee, A. and A. Newman (1993). "Occupational Choice and the Process of Development." *Journal of Political Economy* 101, p.274-98.

[10] Beck, T. (2003). "Financial Dependence and International Trade." *Review of International Economics* 11, p.296-316.

[11] Beck, T. (2002). "Financial Development and International Trade. Is There a Link?" *Journal of International Economics* 57, p.107-31.

[12] Beck, T., Demirgüç-Kunt, A. and R. Levine (2000). "A New Database on Financial Development and Structure." *World Bank Economic Review*, September 2000, p.597-605.

[13] Beck, T., Demirgüç-Kunt, A. and V. Maksimovic (2005). "Financial and Legal Constraints to Firm Growth: Does Size Matter?" *Journal of Finance* 60(1), p.137-77.

[14] Becker, B. and D. Greenberg (2007). "Financial Development, Fixed Costs and International Trade." *Harvard Business School mimeo.*

[15] Bernard, A., Eaton, J., Jensen, B. and S. Kortum (2003). "Plants and Productivity in International Trade." *American Economic Review* 93(4), p.1268-90.

[16] Bernard, A., Redding, S. and P. Schott (2011). "Multi-Product Firms and Trade Liberalization." *Quarterly Journal of Economics* (forthcoming).

[17] Braun, M. (2003). "Financial Contractibility and Asset Hardness." *University of California - Los Angeles mimeo.*

[18] Braun, M. and C. Raddatz (2008). "Trade Liberalization and the Politics of Financial Development." *Journal of Finance* 63(3), p.1469-1508.

[19] Caselli, F. (2005). "Accounting for Cross-Country Income Differences." In Aghion, P. and S. Durlauf (eds.) *Handbook of Economic Growth.*

[20] Chaney, T. (2005). "Liquidity Constrained Exporters." *University of Chicago mimeo.*

[21] Chor, D., Foley, F. and K. Manova (2007). "MNC Activity and Host Country Financial Development." *Stanford University mimeo.*

[22] Chor, D., and K. Manova (2012). "Off the Cliff and Back: Credit Conditions and International Trade during the Global Financial Crisis." *Journal of International Economics* 87, p.117-33.

[23] Cuñat, A. and M. Melitz (2012). "Volatility, Labor Market Flexibility, and the Pattern of Comparative Advantage." *Journal of the European Economic Association* 10, p.225-54.

[24] Djankov, S., Freund, C. and C. S. Pham (2010). "Trading on time." *The Review of Economics and Statistics* 92, p.166–73.

[25] Djankov, S., La Porta, R., Lopez-de-Silanes, F. and A. Shleifer (2002). "The Regulation of Entry," *Quarterly Journal of Economics* 117(1), p.1–37.

[26] Do, Q.-T. and A. Levchenko (2007). "Comparative Advantage, Demand for External Finance, and Financial Development." *Journal of Financial Economics* 86(3), p.796-834.

[27] Eaton, J., Kortum, S. and F. Kramarz (2011). "An Anatomy of International Trade: Evidence from French Firms." *Econometrica* 79(5), p.1453-98.

[28] Eaton, J., Kortum, S. and F. Kramarz (2004). "Dissecting Trade: Firms, Industries, and Export Destinations." *American Economic Review Papers and Proceedings* 94(2), p.150-54.

[29] Feenstra, R. (2000). World Trade Flows 1980-1997 CD-ROM.

[30] Feenstra, R., Li, Z. and M. Yu (2011). "Exports and Credit Constraints under Incomplete Information: Theory and Evidence from China." NBER Working Paper 16940.

[31] Fisman, R. and I. Love (2007). "Financial Development and Growth Revisited." *Journal of the European Economic Association* 5(2), p.470-9.

[32] Forbes, K. (2007). "One Cost of the Chilean Capital Controls: Increased Financial Constraints for Smaller Trade Firms." *Journal of International Economics* 71(2), p.294-323.

[33] Greenaway, D., Guariglia, A. and R. Kneller (2007). "Financial Factors and Exporting Decisions." *Journal of International Economics* 73(2), p.377-95.

[34] Haveman, J. Industry Concordances. http://www.macalester.edu/research/economics /PAGE/HAVEMAN/Trade.Resources/tradeconcordances.html.

[35] Helpman, E. and O. Itskhoki (2010). "Labor Market Rigidities, Trade and Unemployment." *Review of Economic Studies* 77 (3), p.1100–37.

[36] Helpman, E., Melitz, M. and Y. Rubinstein (2008). "Estimating Trade Flows: Trading Partners and Trading Volumes." *Quarterly Journal of Economics* 123, p. 441-87.

[37] Hur, J., Raj, M. and Y. Riyanto (2006). "Finance and Trade: A Cross-Country Empirical Analysis on the Impact of Financial Development and Asset Tangibility on International Trade." *World Development* 34(10), p. 1728-41.

[38] International Monetary Fund. *International Financial Statistics*. Washington, DC.

[39] King, R. and R.Levine (1993). "Finance and Growth: Schumpeter Might Be Right." *Quarterly Journal of Economics* 108, p.717–37.

[40] Kiyotaki, N. and J. Moore (1997). "Credit Cycles." *Journal of Political Economy* 105, p.211248.

[41] Kletzer, K. nad P. Bardhan (1987). "Credit Markets and Patterns of International Trade." *Journal of Development Economics* 27, p.57-70.

[42] Ju, J. and S.-J. Wei, (2011). "When Is Quality of Financial System a Source of Comparative Advantage?" *Journal of International Economics* 84(2), p.178-87.

[43] La Porta, R., Lopez-de-Silanes, F., Shleifer, A. and R. Vishny, (1998). "Law and Finance." *Journal of Political Economy* 106, p.1113-55.

[44] Levchenko, A. (2007). "Institutional Quality and International Trade." *Review of Economic Studies* 74(3), p.791-819.

[45] Manova, K. (2008). "Credit Constraints, Equity Market Liberalizations and International Trade." *Journal of International Economics* 76, p.33-47.

[46] Matsuyama, K. (2005). "Credit Market Imperfections and Patterns of International Trade and Capital Flows." *Journal of the European Economic Association* 3, p. 714-23.

[47] Manova, K, Wei, S.-J. and Z. Zhang (2009). "Firm Exports and Multinational Activity under Credit Constraints." NBER Working Paper 16905.

[48] Melitz, M. (2003). "The Impact of Trade on Intra-Industry Reallocations and Aggregate Industry Productivity." *Econometrica* 71(6), p.1695-725.

[49] Minetti, R. and S. C. Zhu (2011). "Credit Constraints and Firm Export: Microeconomic Evidence from Italy. *Journal of International Economics* 83, p.109-125.

[50] Muûls, M. (2008). "Exporters and Credit Constraints. A Firm Level Approach." *London School of Economics* mimeo.

[51] Nunn, N. (2007). "Relationship-Specificity, Incomplete Contracts, and the Pattern of Trade." *Quarterly Journal of Economics* 122(2), p.569-600.

[52] Rajan, R. and L. Zingales (1998). "Financial Dependence and Growth." *American Economic Review* 88, p.559-86.

[53] Russ, K. and D. Valderrama (2009). "Financial Choice in a Non-Ricardian Model of Trade." NBER Working Paper 15528.

[54] Svaleryd, H. and J. Vlachos (2005). "Financial Markets, the Pattern of Industrial Specialization and Comparative Advantage: Evidence from OECD Countries." *European Economic Review* 49, p.113-44.

[55] Trefler, D. (1995). "The Case of the Missing Trade and Other Mysteries." *American Economic Review* 85, p.1029-46.

[56] United Nations Industrial Development Organization (2006). *UNIDO Industrial Statistics Database at the 3-digit level of ISIC (Rev. 2)*. Vienna, Austria.

[57] U.S. Department of Commerce International Trade Administration (2008). *Trade Finance Guide: A Quick Reference for U.S. Exporters*.

[58] World Bank (1997). *Expanding the Measure of Wealth: Indicators of Environmentally Sustainable Development*. Washington, DC.

Figure 1. The Effects of Financial Constraints on Trade

This figure plots export profits as a function of productivity. It shows the wedge between the productivity cut-offs for exporting with and without credit constraints in the financing of fixed costs only (Figure 1A) and of both fixed and variable costs (Figure 1B). Figure 1B also shows the lower profits earned by firms with productivity below the cut-off for exporting at first-best levels.

Figure 1A

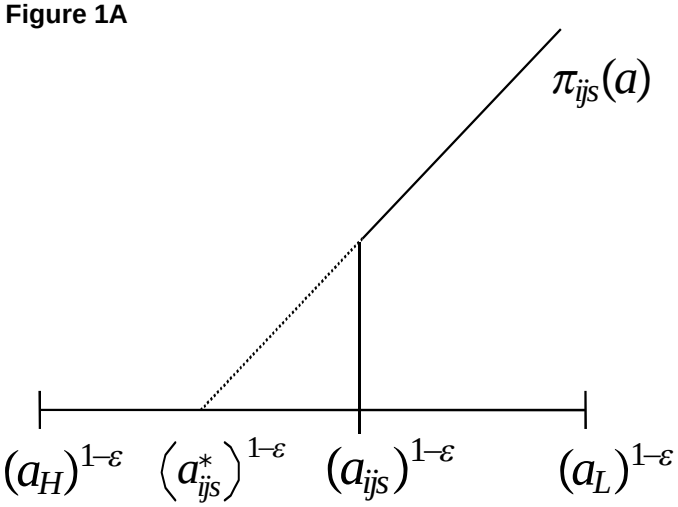

Figure 1B

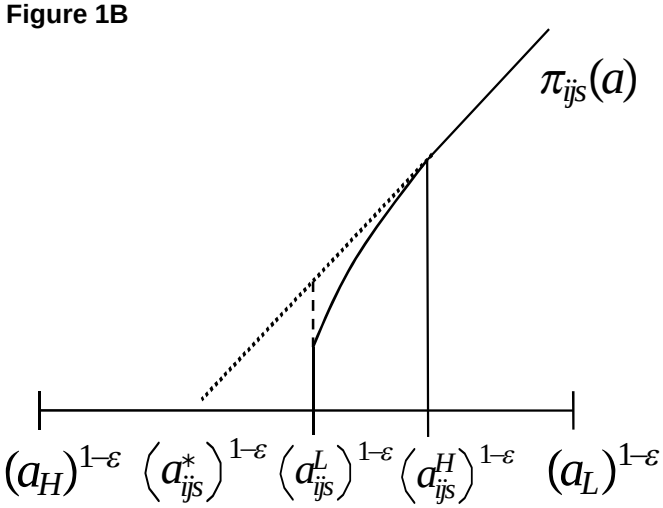

Figure 2. Bilateral Exports and Countries' Financial Development

This figure plots exporters' average (log) bilateral exports across destinations and sectors against exporters' private credit as a share of GDP, in 1995. Only exporter-importer-sector triplets with positive trade are included. Coeff=1.87***, R-squared=0.43.

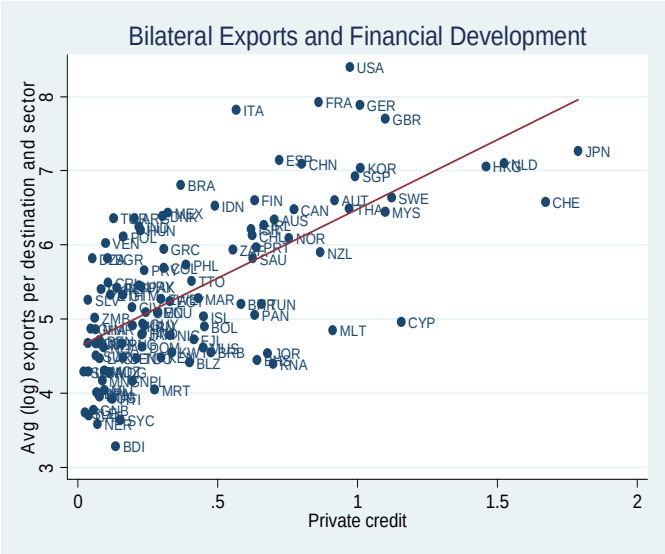

Figure 3. Bilateral Exports and Sectors' Financial Vulnerability

This figure plots average bilateral exports by sector against sectors' external finance dependence in 1995 for Italy (70th percentile by private credit, log GDP 20.87, log per capita GDP 9.92) and Argentina (40th percentile by private credit, log GDP 19.69, log per capita GDP 9.24).

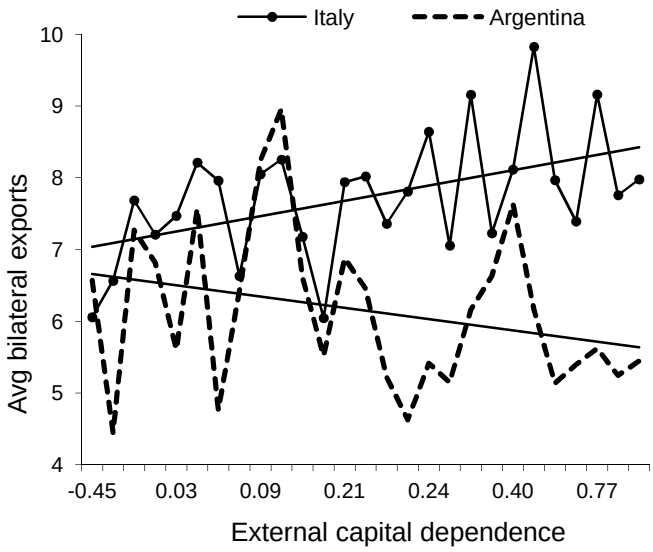

Table 1. Financial Constraints and Trade vs. Production

This table examines the effect of credit constraints on trade flows above and beyond that on overall production. The dependent variable is (log) exports from country *j* to country *i* in a 3-digit ISIC sector *s* and year *t*, 1985-1995. Financial development is measured by private credit. External finance dependence *Ext fin dep* and asset tangibility *Tang* are defined in the text. *(Log) # Establish* and *(Log) Output* are the (log) number of domestic establishments and (log) output in the exporting country by year and sector. The sectoral price index in the importing country is proxied by the importer's consumer price index (CPI) and its interactions with sector dummies in Column 4; the importer's consumption by sector in Column 5; and a full set of importer-sector fixed effects in Column 6. *LGDPE*, *LGDPI* and *LDIST* indicate the (log) real GDP of the exporting and importing country and the (log) distance between them. All regressions include a constant term, exporter, importer, sector, and year fixed effects, and cluster errors by exporter-importer pair. Importer-sector fixed effects replace the importer and sector fixed effects in Column 6. T-statistics in parenthesis. ***, **, and * indicate significance at the 1%, 5%, and 10% level.

Financial development measure: Private credit
Dependent variable: m_{ijst}, (log) bilateral exports by sector

	Total Effect of Credit Constraints	Cotrolling for Selection into Domestic Production		Proxy for p_{is}		
				CPI and Interactions with Sector FE	Importer's Consumption in Sector	Importer x Sector FE
Fin devt	0.167 (3.14)***	0.251 (4.25)***	0.022 (0.37)	0.225 (3.64)***	0.267 (4.54)***	0.306 (5.26)***
Fin devt x Ext fin dep	**1.752** **(43.29)***	**1.296** **(28.31)***	**1.489** **(30.47)***	**1.343** **(29.01)***	**1.253** **(26.36)***	**1.372** **(33.87)***
Fin devt x Tang	**-2.624** **(-24.65)***	**-2.130** **(-16.41)***	**-2.077** **(-17.75)***	**-2.204** **(-16.64)***	**-2.171** **(-16.45)***	**-2.434** **(-19.46)***
(Log) # Establish		0.318 (40.47)***		0.321 (39.89)***	0.323 (40.66)***	0.321 (42.34)***
(Log) Output			0.316 (18.52)***			
p_{is}				0.008 (6.86)***	0.169 (26.74)***	
LGDPE	0.957 (16.75)***	1.079 (16.17)***	0.667 (9.38)***	1.071 (16.05)***	1.082 (16.29)***	1.119 (16.64)***
LGDPI	0.949 (16.55)***	0.980 (14.41)***	0.946 (14.49)***	1.040 (16.36)***	0.711 (10.28)***	0.998 (14.57)***
LDIST	-1.374 (-79.05)***	-1.408 (-72.20)***	-1.410 (-74.24)***	-1.418 (-70.27)***	-1.414 (-71.74)***	-1.442 (-73.35)***
Controls:						
Exporter, Year FE	Y	Y	Y	Y	Y	Y
Importer, Sector FE	Y	Y	Y	Y	Y	N
Importer x Sector FE	N	N	N	N	N	Y
R-squared	0.57	0.57	0.59	0.58	0.58	0.60
# observations	861,380	621,333	703,743	579,485	589,205	621,333
# exporter-importer clusters	9,343	7,867	8,031	7,452	7,813	7,867
# exporters	107	95	94	95	95	95

Table 2. Financial Constraints and Trade vs. Production: Robustness

This table examines the robustness of the effect of credit constraints on trade flows above and beyond that on overall production. The dependent variable is the (log) value of exports from country *j* to country *i* in a 3-digit ISIC sector *s* and year *t*, 1985-1995. The measure of financial development is indicated by the column heading. External finance dependence *Ext fin dep* and asset tangibility *Tang* are defined in the text. All regressions control for the exporter's (log) number of domestic establishments; the importer's CPI and its interactions with sector dummies; the (log) real GDP of both trade partners and the (log) distance between them. Columns 3-6 also control for factor endowments (natural resources, physical and human capital) and their interactions with sector factor intensities; the exporter's GDP per capita *LGDPCE;* and the interactions of *LGDPCE*, rule of law and corruption with *Ext fin dep* and *Tang.* All regressions include a constant term, exporter, importer, sector, and year fixed effects, and cluster errors by exporter-importer pair. T-statistics in parenthesis. ***, **, and * indicate significance at the 1%, 5%, and 10% level.

Dependent variable: m_{ijst}, (log) bilateral exports by sector

Financial development measure:	Private Credit			Repudiation of Contracts	Accounting Standards	Risk of Expropriation
Fin devt	-0.439 (-8.62)***	0.743 (11.64)***	-0.019 (-0.24)			
Fin devt x Ext fin dep	**1.408 (30.06)*** **		**1.101 (15.38)*** **	**0.576 (19.34)*** **	**0.025 (11.46)*** **	**0.551 (14.38)*** **
Fin devt x Tang		**-2.472 (-18.37)*** **	**-1.334 (-6.64)*** **	**-1.488 (-15.78)*** **	**-0.071 (-11.12)*** **	**-1.474 (-12.58)*** **
(Log) # Establish	0.321***	0.360***	0.314***	0.302***	0.306***	0.305***
Importer's CPI	0.008***	0.008***	0.008***	0.008***	0.009***	0.008***
Physical capital per Worker, K/L			0.420***	0.375***	0.042	0.364***
Human capital per Worker, H/L			-1.350***	-1.323***	-1.003***	-1.308***
Natural resources per Worker, N/L			1.357***	1.533***	2.721***	1.577***
K/L x Industry K intensity			-1.491***	-1.470***	-0.848*	-1.362***
H/L x Industry H intensity			1.435***	1.398***	1.225***	1.385***
N/L x Industry N intensity			0.219***	0.207***	0.282***	0.204***
LGDPCE			-2.984***	-3.453***	-5.531***	-3.379***
LGDPCE x Ext fin dep			0.453***	0.054	0.491***	0.390***
LGDPCE x Tang			-0.471**	0.804***	-0.433*	0.024
Rule of law x Ext fin dep			0.060***	-0.041*	0.131***	-0.097***
Rule of law x Tang			0.244***	0.537***	-0.182**	0.673***
Corruption x Ext fin dep			-0.193***	-0.185***	-0.224***	-0.182***
Corruption x Tang			-0.139**	-0.083	0.294***	-0.089
Controls:	LGDPE, LGDPI, LDIST, CPI x Sector FE, Exporter, Importer, Year and Sector FE					
R-squared	0.58	0.58	0.59	0.59	0.61	0.59
# observations	579,485	579,485	428,444	436,931	396,112	436,931
# exporter-importer clusters	7,452	7,452	4,130	4,132	3,374	4,132
# exporters	95	95	40	40	32	40

Table 3. Financial Constraints and Firm Selection into Exporting

This table examines the effect of credit constraints on firm selection into exporting. The dependent variable is an indicator variable equal to 1 if country *j* exports to country *i* in a 3-digit ISIC sector *s* and year *t*, 1985-1995. The measure of financial development is indicated by the column heading. External finance dependence *Ext fin dep* and asset tangibility *Tang* are defined in the text. All regressions control for the average number of procedures and days it takes to establish a business in the exporting and importing countries, and the cost of doing so as a share of GDP per capita. All regressions include a constant term, exporter, importer, sector, and year fixed effects; the importer's CPI and its interactions with sector dummies; the (log) real GDP of both partners and the (log) distance between them; factor endowments, institutions, GDP per capita, and their interactions as in Table 2. Errors clustered by exporter-importer pair. T-statistics in parenthesis. ***, **, and * indicate significance at the 1%, 5%, and 10% level.

Dependent variable: T_{ijst}, indicator variable equal to 1 when positive bilateral exports in a sector

Financial development measure:	Private Credit	Repudiation of Contracts	Accounting Standards	Risk of Expropriation
Fin devt	-0.110 (-2.09)**			
Fin devt x Ext fin dep	**1.029** **(19.86)***	**0.320** **(19.51)***	**0.022** **(17.46)***	**0.435** **(21.06)***
Fin devt x Tang	**-0.823** **(-8.23)***	**-0.537** **(-14.00)***	**-0.028** **(-8.79)***	**-0.522** **(-11.08)***
Importer's CPI	0.007***	0.007***	0.007***	0.007***
LGDPE	4.682***	4.972***	7.388***	4.966***
LGDPI	0.369***	0.382***	0.403***	0.383***
LDIST	-1.076***	-1.086***	-1.161	-1.087***
(Log) # Procedures	-0.719***	-0.726***	-0.763***	-0.755***
(Log) # Days	0.057	0.047	-0.057	0.052
(Log) Cost	-0.207***	-0.214***	-0.153***	-0.209***
Controls:	LGDPE, LGDPI, LDIST, Exp, Imp, Year, Sector FE, CPI x Sector FE K, H, N, LGDPCE, Institutions and Interactions			
Pseudo R-squared	0.51	0.51	0.51	0.51
# observations	1,079,865	1,103,274	906,390	1,103,274
# exporter-importer clusters	3,965	3,965	3,259	3,965

Table 4. Financial Constraints and Export Product Variety

This table examines the effect of credit constraints on export product variety. The dependent variable in Panel A is the (log) number of 4-digit SITC products country *j* exports to country *i* in a 3-digit ISIC sector *s* and year *t*, 1985-1995. The dependent variable in Panel B is the (log) number of 10-digit HS products *j* exports to the U.S. in a 3-digit ISIC sector *s* and year *t*, 1989-1995. The measure of financial development is indicated by the column heading. External finance dependence *Ext fin dep* and asset tangibility *Tang* are defined in the text. All regressions include a constant term, exporter, importer, sector, and year fixed effects; the exporter's (log) number of domestic establishments; the importer's CPI and its interactions with sector dummies; the (log) real GDP of both partners and the (log) distance between them; and cluster errors by exporter-importer pair. In Panel B, bilateral distance, importer GDP, CPI, and importer fixed effects are dropped, and errors clustered by exporter. Columns 2-5 control for factor endowments, institutions, GDP per capita, and their interactions as in Table 2. T-statistics in parenthesis. ***, **, and * indicate significance at the 1%, 5%, and 10% level.

Financial development measure:	Private Credit		Repudiation of Contracts	Accounting Standards	Risk of Expropriation
Panel A. Dep variable: x_{ijst}, (log) # SITC-4 products exported bilaterally by sector					
Fin devt	-0.086	-0.089			
	(-3.83)***	(-3.17)***			
Fin devt x Ext fin dep	**0.405**	**0.335**	**0.176**	**0.008**	**0.190**
	(28.67)* **	**(16.37)*** **	**(18.45)*** **	**(11.74)*** **	**(16.32)*** **
Fin devt x Tang	**-0.455**	**-0.400**	**-0.272**	**-0.014**	**-0.268**
	(-10.46)* **	**(-6.07)*** **	**(-10.10)*** **	**(-7.14)*** **	**(-8.00)*** **
(Log) # Establish	0.098***	0.092***	0.090***	0.091***	0.091***
Importer's CPI	0.007***	0.008***	0.008***	0.009***	0.008***
Controls:	LGDPE, LGDPI, LDIST, Exp, Imp, Year, Sector FE, CPI x Sector FE				
	K, H, L, LGDPCE, Institutions and Interactions				
R-squared	0.63	0.64	0.64	0.65	0.64
# observations	579,485	428,444	436,931	396,112	436,931
# exporter-importer clusters	7,452	4,130	4,132	3,374	4,132
# exporters	95	40	40	32	40
Panel B. Dep variable: x_{ijst}, (log) # HS-10 products exported to the U.S. by sector					
Fin devt	-0.111	0.332			
	(-0.78)	(1.47)			
Fin devt x Ext fin dep	**0.802**	**0.518**	**0.346**	**0.020**	**0.326**
	(5.07)* **	**(2.74)*** **	**(5.13)*** **	**(3.68)*** **	**(3.05)*** **
Fin devt x Tang	**0.360**	**-0.148**	**-0.293**	**-0.034**	**-0.242**
	(1.08)	**(-0.36)**	**(-1.31)**	**(-2.15)** **	**(-0.79)**
(Log) # Establish	0.213***	0.185***	0.179***	0.189***	0.183***
Controls:	LGDPE, Exporter, Year and Sector FE, CPI x Sector FE				
	K, H, N, LGDPCE, Institutions and Interactions				
R-squared	0.86	0.89	0.89	0.90	0.89
# observations	9,605	5,836	5,916	4,899	5,916
# exporters	87	38	38	30	38

Table 5. Financial Constraints and Trade Partner Intensity

This table examines the effect of credit constraints on the number of countries' trading partners. The dependent variable is the number of country *j*'s export destinations in a 3-digit ISIC sector *s* and year *t*, 1985-1995. Panel A presents results for the full matrix of exporter-sector pairs, whereas Panel B restricts the sample to exporter-sector-year observations with at least 1 trade partner. The measure of financial development is indicated by the column heading. External finance dependence *Ext fin dep* and asset tangibility *Tang* are defined in the text. All regressions include a constant term, exporter, sector, and year fixed effects, and cluster errors by exporter. Columns 2-5 control for factor endowments, institutions, GDP per capita, and their relevant interactions as in Table 2. T-statistics in parenthesis. ***, **, and * indicate significance at the 1%, 5%, and 10% level.

Dependent variable: I_{js}, number of trade partners by sector

Financial development measure:	Private Credit		Repudiation of Contracts	Accounting Standards	Risk of Expropriation
Panel A. Whole sample					
Fin devt	-10.61	-4.71			
	(-2.29)**	(-0.71)			
Fin devt x Ext fin dep	**51.73**	**28.40**	**11.29**	**0.68**	**15.74**
	(15.27)* **	**(4.05)*** **	**(4.79)*** **	**(3.91)*** **	**(6.24)*** **
Fin devt x Tang	**8.20**	**-12.92**	**-10.56**	**-0.65**	**-10.68**
	(1.03)	**(-0.87)**	**(-2.73)*** **	**(-1.97)***	**(-1.96)***
LRGDPE	18.09	105.86	111.59	218.66	111.29
	(3.79)***	(2.53)**	(2.63)**	(5.41)**	(2.63)**
Controls:		Exporter, Year and Sector Fixed Effects			
		K, H, N, LGDPCE, Institutions and Interactions			
R-squared	0.8806	0.8646	0.8655	0.8729	0.8663
# observations	30,296	12,656	12,936	10,472	12,936
# exporters	107	42	42	34	42
Panel B. Sample with nonzero partners					
Fin devt	-2.23	-0.96			
	(-0.46)	(-0.14)			
Fin devt x Ext fin dep	**41.94**	**24.04**	**9.57**	**0.59**	**12.86**
	(13.44)* **	**(3.66)*** **	**(4.37)*** **	**(3.58)*** **	**(5.40)*** **
Fin devt x Tang	**-17.04**	**-22.68**	**-15.11**	**-0.87**	**-18.15**
	(-2.12) **	**(-1.55)**	**(-3.90)*** **	**(-2.72)*** **	**(-3.44)*** **
LRGDPE	19.99	111.00	117.36	227.55	117.75
	(3.88)***	(2.56)**	(2.67)**	(5.42)***	(2.68)**
Controls:		Exporter, Year and Sector Fixed Effects			
		K, H, N, LGDPCE, Institutions and Interactions			
R-squared	0.8986	0.8718	0.8730	0.8789	0.8734
# observations	26,900	12,170	12,440	10,088	12,440
# exporters	107	42	42	34	42

Table 6. Financial Constraints and Firm-Level Exports

This table examines the effect of credit constraints on average firm-level exports. The dependent variable is (log) exports from country *j* to country *i* in a 3-digit ISIC sector *s* and year *t*, 1985-1995. The measure of financial development is indicated by the column heading. External finance dependence *Ext fin dep* and asset tangibility *Tang* are defined in the text. Controlling for w_{ijs} or z_{ijs} corrects for firm selection into exporting, whereas controlling for eta_{ijs} corrects for Heckman selection. All regressions include a constant term, exporter, importer, sector, and year fixed effects; the exporter's (log) number of domestic establishments; the importer's CPI and its interactions with sector dummies; the (log) real GDP of both partners and the (log) distance between them; factor endowments, institutions, GDP per capita, and their interactions as in Table 2. Errors clustered by exporter-importer pair. T-statistics in parenthesis. ***, **, and * indicate significance at the 1%, 5%, and 10% level.

Dependent variable: m_{ijst}, (log) bilateral exports by sector

Financial development measure:	Private Credit	Repudiation of Contracts	Accounting Standards	Risk of Expropriation
Panel A. Maximum Likelihood Estimation				
Fin devt	0.028 (0.34)			
Fin devt x Ext fin dep	**0.409** **(4.07)*****	**0.369** **(10.22)*****	**0.012** **(4.71)*****	**0.277** **(5.80)*****
Fin devt x Tang	**-0.803** **(-3.72)*****	**-1.182** **(-11.40)*****	**-0.052** **(-7.78)*****	**-1.123** **(-9.05)*****
delta (from w_{ijs})	0.806 (7.91)***	0.820 (8.25)***	0.758 (8.55)***	0.817 (8.24)***
eta_{ijs}	0.909 (9.63)***	0.877 (9.49)***	0.874 (10.86)***	0.875 (9.55)***
(Log) # Establish	0.305***	0.294***	0.297***	0.297***
Importer's CPI	0.004***	0.004***	0.005***	0.004***
Controls:	LGDPE, LGDPI, LDIST, Exp, Imp, Year, Sector FE, CPI x Sector FE K, H, N, LGDPCE, Institutions and Interactions			
# observations	398,726	406,677	367,634	406,677
# exporter-importer clusters	3,681	3,682	2,995	3,682

Table 6. Financial Constraints and Firm-Level Exports (cont.)

Dependent variable: m_{ijst}, (log) bilateral exports by sector

Financial development measure:	Private Credit	Repudiation of Contracts	Accounting Standards	Risk of Expropriation
Panel B. More flexible specification: OLS with polynomial in z_{ijs}				
Fin devt	0.030 (0.38)			
Fin devt x Ext fin dep	**0.357** **(3.75)*****	**0.360** **(10.36)*****	**0.012** **(4.87)*****	**0.250** **(5.40)*****
Fin devt x Tang	**-0.777** **(-3.63)*****	**-1.165** **(-11.48)*****	**-0.052** **(-7.81)*****	**-1.078** **(-8.79)*****
z_{ijs}	3.388 (15.77)***	3.346 (15.68)***	2.828 (12.93)***	3.308 (15.43)***
$(z_{ijs})^2$	-0.653 (-9.38)***	-0.635 (-9.12)***	-0.500 (-7.00)***	-0.625 (-8.90)***
$(z_{ijs})^3$	0.049 (6.35)***	0.047 (6.05)***	0.034 (4.32)***	0.046 (5.88)***
eta_{ijs}	1.479 (16.66)***	1.452 (16.68)***	1.380 (16.38)***	1.438 (16.43)***
(Log) # Establish	0.306***	0.296***	0.297***	0.298***
Importer's CPI	0.004***	0.004***	0.005***	0.004***
Controls:	LGDPE, LGDPI, LDIST, Exp, Imp, Year, Sector FE, CPI x Sector FE K, H, N, LGDPCE, Institutions and Interactions			
R-squared	0.62	0.62	0.63	0.62
# observations	398,726	406,677	367,634	406,677
# exporter-importer clusters	3,681	3,682	2,995	3,682
Panel C. Most flexible specification: OLS with 50 bins for predicted probability of exporting				
Fin devt	0.010 (0.12)			
Fin devt x Ext fin dep	**0.491** **(5.79)*****	**0.401** **(12.44)*****	**0.013** **(5.36)*****	**0.303** **(7.08)*****
Fin devt x Tang	**-0.881** **(-4.17)*****	**-1.235** **(-12.43)*****	**-0.054** **(-8.07)*****	**-1.144** **(-9.44)*****
(Log) # Establish	0.306***	0.296***	0.298***	0.299***
Importer's CPI	0.005***	0.004***	0.006***	0.004***
Controls:	LGDPE, LGDPI, LDIST, Exp, Imp, Year, Sector FE, CPI x Sector FE K, H, N, LGDPCE, Institutions and Interactions			
R-squared	0.62	0.62	0.63	0.62
# observations	398,726	406,677	367,634	406,677
# exporter-importer clusters	3,681	3,682	2,995	3,682

Table 7. Economic Significance: Comparative Statics

This table examines the economic significance of the effects of credit constraints on trade. Each cell reports on a different comparative static exercise based on coefficient estimates from regressions in Tables 2-6. The relevant trade outcome is indicated in the row heading. All values are in percentage points, except for the change in trade partner intensity which is in absolute levels. Column 1 (Column 3) shows how much bigger the effect of a one-standard-deviation increase in private credit (repudiation of contracts) is on the sector at the 75th percentile of the distribution by external finance dependence relative to the sector at the 25th percentile. Column 2 (Column 4) shows how much bigger the effect of a one-standard-deviation increase in private credit (repudiation of contracts) is on the sector at the 25th percentile of the distribution by asset tangibility relative to the sector at the 75th percentile. Column 5 (Column 6) shows how much bigger the effect of a one-standard-deviation increase in physical (human) capital endowment is on the sector at the 75th percentile of the distribution by physical (human) capital intensity relative to the sector at the 25th percentile.

	One st. dev. increase in:	Private Credit		Repudiation of Contracts		K Endow	H Endow
	Differential effect across sectors at different levels of:	Ext Fin Dep	Asset Tang	Ext Fin Dep	Asset Tang	K Intensity	H Intensity
Trade outcome:	1. Total Bilateral Exports	15%	14%	20%	30%	-9%	32%
	2. Probability of Bilateral Exports	14%	6%	19%	17%	3%	15%
	3. Bilateral Export Product Variety	5%	3%	10%	8%	3%	11%
	4. Trade Partner Intensity	3.2	1.6	5.7	4.8	-0.2	4.4
	5. (Avg.) Bilateral Firm Exports	6%	6%	15%	25%	-4%	30%

Table 8. Economic Significance: Predicted vs. Actual Trade Growth

This table examines the predictive power of financial development and factor accumulation for explaining changes in trade outcomes over time. The dependent variable in Columns 1-3 is the actual level of countries' worldwide exports by sector in 1995, while in Columns 4-6 it is the actual change in countries' worldwide exports by sector (in levels) between 1985 and 1995. The right hand side variables are the corresponding changes predicted by the change in the exporting country's level of private credit and factor endowments (natural resources, physical and human capital) between 1985 and 1995. These predicted changes are constructed using coefficient estimates from Tables 1 and 2. All regressions include a constant term and report robust standard errors. T-statistics in parenthesis. ***, **, and * indicate significance at the1%, 5%, and 10% level.

Financial development measure: Private credit

	Dependent variable:	Actual Level of World Exports in 1995 (Beta Coefficients)			Actual Change in World Exports (Beta Coefficients)		
Predicted Value of Dep Var due to:	Financial Development	0.92***		1.02***	0.47***		0.40***
	Factor Accumulation		0.80***	-0.11		0.34***	0.19***
	R-squared	0.85	0.65	0.85	0.22	0.12	0.25
	# observations	4,508	4,508	4,508	4,508	4,508	4,508
	# exporters	161	161	161	161	161	161

Appendix Table 1. Countries' Financial Development

This table summarizes the variation in financial development in the data. Panel A reports the time-series mean and standard deviation for each country in the sample, as well as summary statistics for the cross-section of means and the entire panel, 1985-1995. Panel B presents summary statistics for repudiation of contracts, accounting standards, and the risk of expropriation, which vary only in the cross-section. [1,2,3,4,5] identify the country with the lowest, 1st quartile, median, 3rd quartile, and highest level of private credit.

Panel A. Private credit

Country	Avg	St Dev	Country	Avg	St Dev	Country	Avg	St Dev
Algeria	0.35	0.22	Germany	0.93	0.04	Nigeria	0.14	0.04
Argentina	0.14	0.03	Ghana	0.04	0.01	Norway	0.87	0.10
Australia	0.54	0.14	Greece	0.37	0.07	Pakistan	0.24	0.02
Austria	0.87	0.06	Guatemala	0.14	0.02	Panama	0.47	0.07
Bangladesh	0.15		Guinea-Bissau[1]	0.03	0.02	Papua New Guinea	0.23	0.05
Barbados	0.42	0.05	Guyana	0.23		Paraguay	0.16	0.05
Belize	0.37	0.03	Haiti	0.11	0.02	Peru	0.09	0.03
Benin	0.11	0.03	Honduras	0.29	0.04	Philippines[2]	0.23	0.08
Bolivia	0.24	0.14	Hong Kong	1.35	0.09	Poland	0.11	0.08
Brazil[3]	0.24	0.08	Hungary	0.33	0.11	Portugal[4]	0.58	0.09
Bulgaria	0.06	0.03	Iceland	0.40	0.06	Rwanda	0.09	0.02
Burkina Faso	0.13	0.03	India	0.26	0.04	Senegal	0.27	0.05
Burundi	0.09	0.03	Indonesia	0.33	0.13	Seychelles	0.10	0.02
Cameroon	0.20	0.07	Iran	0.29	0.03	Sierra Leone	0.03	0.00
Canada	0.73	0.06	Ireland	0.63	0.02	Singapore	0.95	0.06
Centr Afr Rep	0.07	0.02	Israel	0.53	0.05	South Africa	0.50	0.03
Chad	0.10	0.05	Italy	0.54	0.05	South Korea	0.80	0.13
Chile	0.51	0.07	Jamaica	0.26	0.04	Spain	0.77	0.05
China	0.78	0.04	Japan[5]	1.63	0.16	Sri Lanka	0.16	0.05
Colombia	0.24	0.07	Jordan	0.67	0.05	St Kitts and Nevis	0.54	0.11
Congo	0.12	0.04	Kenya	0.29	0.02	Sweden	1.15	0.17
Costa Rica	0.14	0.03	Madagascar	0.15	0.02	Switzerland	1.55	0.11
Cote d'Ivoire	0.33	0.06	Malawi	0.10	0.02	Syrian Arab Rep	0.08	0.01
Cyprus	0.87	0.23	Malaysia	0.85	0.17	Thailand	0.64	0.18
Denmark	0.43	0.08	Mali	0.12	0.02	Togo	0.24	0.03
Dominican Rep	0.24	0.03	Malta	0.72	0.15	Trinidad & Tobago	0.48	0.05
Ecuador	0.18	0.05	Mauritania	0.33	0.06	Tunisia	0.56	0.07
Egypt	0.29	0.03	Mauritius	0.32	0.07	Turkey	0.14	0.01
El Salvador	0.04	0.02	Mexico	0.19	0.09	Uganda	0.02	0.01
Equator Guinea	0.18	0.07	Morocco	0.25	0.13	United Kingdom	0.95	0.23
Ethiopia	0.16	0.03	Mozambique	0.10	0.01	United States	0.91	0.05
Fiji	0.33	0.06	Nepal	0.12	0.03	Uruguay	0.25	0.05
Finland	0.74	0.13	Netherlands	1.29	0.18	Venezuela	0.31	0.14
France	0.86	0.08	New Zealand	0.63	0.24	Zambia	0.06	0.02
Gabon	0.15	0.06	Nicaragua	0.18	0.13	Zimbabwe	0.20	0.06
Gambia	0.13	0.04	Niger	0.13	0.04			
Average in the cross-section:			0.39			Average in the panel:	0.40	
Standard deviation in the cross-section:			0.34			Standard deviation in the panel:	0.35	

Panel B. Other measures of financial development

Financial Devt Measure	# Obs	Average	St Dev	Min	Max
Repudiation of contracts	49	7.58	1.79	4.36	9.98
Accounting standards	41	60.93	13.40	24	83
Risk of expropriation	49	8.05	1.59	5.22	9.98

Appendix Table 2. Industry Characteristics

This table reports the measures of external finance dependence, asset tangibility, and factor intensity with respect to natural resources, physical and human capital for all 27 3-digit ISIC sectors used in the empirical analysis. The bottom two rows of the table give the mean and standard deviation of these measures across sectors.

ISIC code	Industry	External Finance Dependence	Asset Tangibility	Physical Capital Intensity	Human Capital Intensity	Natural Resource Intensity
311	Food products	0.1368	0.3777	0.0616	0.8117	0
313	Beverages	0.0772	0.2794	0.0620	1.1345	0
314	Tobacco	-0.4512	0.2208	0.0181	1.3539	0
321	Textiles	0.4005	0.3730	0.0726	0.6881	0
322	Wearing apparel, except footwear	0.0286	0.1317	0.0189	0.5017	0
323	Leather products	-0.1400	0.0906	0.0324	0.6869	0
331	Wood products, except furniture	0.2840	0.3796	0.0653	0.7409	1
332	Furniture, except metal	0.2357	0.2630	0.0390	0.6984	0
341	Paper and products	0.1756	0.5579	0.1315	1.1392	1
342	Printing and publishing	0.2038	0.3007	0.0515	0.9339	0
352	Other chemicals	0.2187	0.1973	0.0597	1.2089	0
353	Petroleum refineries	0.0420	0.6708	0.1955	1.6558	1
354	Misc. petroleum and coal products	0.3341	0.3038	0.0741	1.1531	1
355	Rubber products	0.2265	0.3790	0.0656	0.9854	0
356	Plastic products	1.1401	0.3448	0.0883	0.8274	0
361	Pottery, china, earthenware	-0.1459	0.0745	0.0546	0.8041	0
362	Glass and products	0.5285	0.3313	0.0899	1.0121	0
369	Other non-metallic products	0.0620	0.4200	0.0684	0.9522	1
371	Iron and steel	0.0871	0.4581	0.1017	1.2510	1
372	Non-ferrous metals	0.0055	0.3832	0.1012	1.0982	1
381	Fabricated metal products	0.2371	0.2812	0.0531	0.9144	0
382	Machinery, except electrical	0.4453	0.1825	0.0582	1.1187	0
383	Machinery, electric	0.7675	0.2133	0.0765	1.0636	0
384	Transport equipment	0.3069	0.2548	0.0714	1.3221	0
385	Prof and scient equipment	0.9610	0.1511	0.0525	1.2341	0
390	Other manufactured products	0.4702	0.1882	0.0393	0.7553	0
3511	Industrial chemicals	0.2050	0.4116	0.1237	1.4080	0
	Industry Average	0.2534	0.3044	0.0714	1.0168	0.2593
	Industry Standard Deviation	0.3301	0.1372	0.0369	0.2666	0.4466

Appendix Table 3. Export Patterns in the Data

This table summarizes the variation in export activity across 161 countries and 27 sectors in 1995. A sector is defined at the 3-digit level in the ISIC industry classification. The table reports summary statistics for countries' number of trade partners, bilateral exports and bilateral export product scope by sector. All summary statistics are for the sample with positive trade values, except for the first row in the table. Products are defined in the 4-digit SITC industry classification (all destinations) or in the 10-digit HS classification (exports to the U.S.).

Export Outcome	# Obs	Average	St Dev across Exporters, Importers and Sectors	St Dev of Exporter Averages	Min	Max
# Trade partners (by exporter-sector)						
full sample	4,347	32.35	41.15	38.05	0	163
partners>0	3,913	35.94	41.85	37.72	1	163
Bilateral exports (in logs)	137,490	6.31	2.83	1.15	0	17.72
Product variety						
SITC-4, full sample	137,490	5.34	6.61	1.97	1	62
HS-10, exports to U.S.	3,933	64.41	147.54	77.39	1	1,482

Appendix Table 4. Firm selection into exporting vs. firm-level exports

This table summarizes the breakdown of the effect of credit constraints on bilateral exports into fewer firms becoming exporters and lower firm-level exports. Each cell reports the ratio of the coefficient on the interaction of financial development with external finance dependence (asset tangibility) from a second-stage regression of (log) exports in Table 6 to the coefficient on the same interaction term in an unreported regression of (log) exports with the same controls but no correction for firm selection into exporting, in percentage terms. The bottom two rows of the table report the arithmetic average across all specifications.

Reported statistic: The contribution of the effect of credit constraints on firm-level exports to the trade-specific effect of credit constraints on bilateral exports

Financial development measure:	Private Credit	Repudiation of Contracts	Accounting Standards	Risk of Expropriation
Panel A. Maximum Likelihood Estimation				
Fin devt x Ext fin dep	36%	63%	46%	48%
Fin devt x Tang	60%	78%	72%	75%
Panel B. OLS with polynomial in z_{ijs}				
Fin devt x Ext fin dep	32%	61%	47%	44%
Fin devt x Tang	58%	77%	72%	72%
Panel C. OLS with 50 bins for predicted probability of exporting				
Fin devt x Ext fin dep	44%	68%	51%	53%
Fin devt x Tang	66%	81%	74%	76%
Average across all specifications				
Fin devt x Ext fin dep	49%			
Fin devt x Tang	72%			

A Appendix. Proofs of theoretical propositions

A.1 Proof of Proposition 1

The productivity cut-off for exporting $1/a_{ijs}$ is given by the condition

$$r_{ijs}\left(a_{ijs}\right)=\left(\frac{\tau_{ij}c_{js}a_{ijs}}{\alpha P_{is}}\right)^{1-\varepsilon}\theta_s Y_i=\varepsilon\left\{\left(1-d_s+\frac{d_s}{\lambda_j}\right)c_{js}f_{ij}-\frac{1-\lambda_j}{\lambda_j}t_s c_{js}f_{ej}\right\}.$$

Let $RHS=\left(1-d_s+\frac{d_s}{\lambda_j}\right)c_{js}f_{ij}-\frac{1-\lambda_j}{\lambda_j}t_s c_{js}f_{ej}$. Taking first derivatives, $\frac{\partial RHS}{\partial d_s}=\left(\frac{1}{\lambda_j}-1\right)c_{js}f_{ij}$ >0 and $\frac{\partial RHS}{\partial t_s}=-\left(\frac{1}{\lambda_j}-1\right)c_{js}f_{ej}<0$ since $\lambda_j \epsilon\left(0,1\right)$. Also taking first derivatives, $\frac{\partial RHS}{\partial \lambda_j}=$ $\frac{1}{\lambda_j^2}\left(t_s c_{js}f_{ej}-d_s c_{js}f_{ij}\right)<0$ if the loan exceeds the collateral as assumed, $t_s c_{js}f_{ej}<d_s c_{js}f_{ij}$. Taking second derivatives, $\frac{\partial^2 RHS}{\partial \lambda_j \partial d_s}=-\frac{1}{\lambda_j^2}c_{js}f_{ij}<0$ and $\frac{\partial^2 RHS}{\partial \lambda_j \partial t_s}=\frac{1}{\lambda_j^2}c_{js}f_{ej}>0$. Since revenues $r_{ijs}\left(a_{ijs}\right)$ are strictly increasing in productivity $1/a_{ijs}$, this proves Proposition 1.

A.2 Proof of Proposition 4

If firms sell to multiple destinations, they require outside capital for a fraction d_s of the fixed costs associated with entering each market. Companies then choose the optimal number of importers I, the price and quantity in each market to maximize worldwide export profits by solving

$$\max_{p,q,I,F}\pi_{js}\left(a\right)=\sum_{i=1}^{I}p_{ijs}\left(a\right)q_{ijs}\left(a\right)-\sum_{i=1}^{I}q_{ijs}\left(a\right)\tau_{ij}c_{js}a-\left(1-d_s\right)c_{js}\sum_{i=1}^{I}f_{ij}-\lambda_j F\left(a\right)-\left(1-\lambda_j\right)t_s c_{js}f_{ej} \tag{1}$$

subject to (1.1) $q_{ijs}\left(a\right)=\frac{p_{ijs}(a)^{-\varepsilon}\theta_s Y_i}{P_{is}^{1-\varepsilon}}$,

$$\text{(1.2) } A_{js}\left(a\right)\equiv\sum_{i=1}^{I}p_{ijs}\left(a\right)q_{ijs}\left(a\right)-\sum_{i=1}^{I}q_{ijs}\left(a\right)\tau_{ij}c_{js}a-\left(1-d_s\right)c_{js}\sum_{i=1}^{I}f_{ij}\geq F\left(a\right), \text{ and}$$

$$\text{(1.3) } B_{js}\left(a\right)\equiv-d_s c_{js}\sum_{i=1}^{I}f_{ij}+\lambda_j F\left(a\right)+\left(1-\lambda_j\right)t_s c_{js}f_{ej}\geq 0.$$

With competitive credit markets, investors break even in expectation and producers adjust the payment $F\left(a\right)$ so that $B_{js}\left(a\right)=0$. Firms have to use their limited collateral to fund their activities in multiple destinations. However, export revenues in one market are not directly affected by sales in a different market. This implies that all exporters add trade partners in the same decreasing order of profitability (determined by Y_i, P_{is}, τ_{ij}, and f_{ij}) until they exhaust their financial resources. If the liquidity constraint (1.2) does not bind, sellers therefore set their first-best price, quantity, revenues and profit levels in each market they choose to service.

For any given I, there is a productivity cut-off $1/a_{js,I}$ below which (1.2) binds. Plugging $B_{js}\left(a\right)=0$ and the optimal price and quantity in $A_{js}\left(a_{js,I}\right)=F\left(a_{js,I}\right)$, this cut-off is given by

$$\sum_{i=1}^{I}r_{ijs}\left(a_{js,I}\right)=\sum_{i=1}^{I}\left(\frac{\tau_{ij}c_{js}a_{js,I}}{\alpha P_{is}}\right)^{1-\varepsilon}\theta_s Y_i=\varepsilon\left\{\left(1-d_s+\frac{d_s}{\lambda_j}\right)c_{js}\sum_{i=1}^{I}f_{ij}-\frac{1-\lambda_j}{\lambda_j}t_s c_{js}f_{ej}\right\}.$$

The left-hand side of this expression is increasing in $1/a_{js,I}$, while the right-hand side inherits all properties of RHS above. This implies that $\frac{\partial\left(1/a_{js,I}\right)}{\partial \lambda_j}<0$, $\frac{\partial\left(1/a_{js,I}\right)}{\partial d_s}>0$, $\frac{\partial\left(1/a_{js,I}\right)}{\partial t_s}<0$, $\frac{\partial^2\left(1/a_{js,I}\right)}{\partial \lambda_j \partial d_s}<0$ and $\frac{\partial^2\left(1/a_{js,I}\right)}{\partial \lambda_j \partial t_s}>0$. Since all firms add foreign markets in the same order of profitability, country j exports to I destinations only if at least one firm in j is more productive than $1/a_{js,I}$ and exports to these I destinations. This proves Proposition 4.

A.3 Proof of Proposition 5

When firms need outside capital for a fraction d_s of both fixed and variable costs, their maximization problem becomes

$$\max_{p,q,F} \pi_{ijs}(a) = p_{ijs}(a) q_{ijs}(a) - (1-d_s) q_{ijs}(a) \tau_{ij} c_{js} a - (1-d_s) c_{js} f_{ij} - \lambda_j F(a) - (1-\lambda_j) t_s c_{js} f_{ej} \tag{2}$$

subject to (1.1) $q_{ijs}(a) = \frac{p_{ijs}(a)^{-\varepsilon} \theta_s Y_i}{P_{is}^{1-\varepsilon}}$,

(1.2) $A_{ijs}(a) \equiv p_{ijs}(a) q_{ijs}(a) - (1-d_s) q_{ijs}(a) \tau_{ij} c_{js} a - (1-d_s) c_{js} f_{ij} \geq F(a)$, and

(1.3) $B_{ijs}(a) \equiv -d_s q_{ijs}(a) \tau_{ij} c_{js} a - d_s c_{js} f_{ij} + \lambda_j F(a) + (1-\lambda_j) t_s c_{js} f_{ej} \geq 0$.

With competitive credit markets, investors break even in expectation and producers adjust the payment $F(a)$ so that $B_{ijs}(a) = 0$. If the liquidity constraint (1.2) does not bind, firms thus export at their first-best price, quantity, revenues and profit levels as in Melitz (2003). This will be the case for firms with productivity above $1/a_{ijs}^H$, defined by $A_{ijs}\left(a_{ijs}^H\right) = F\left(a_{ijs}^H\right)$, or

$$\left[1 - (1-d_s)\alpha - \frac{d_s \alpha}{\lambda_j}\right] \left(\frac{\tau_{ij} c_{js} a_{ijs}^H}{\alpha P_{is}}\right)^{1-\varepsilon} \theta_s Y_i = \left(1 - d_s + \frac{d_s}{\lambda_j}\right) c_{js} f_{ij} - \frac{1-\lambda_j}{\lambda_j} t_s c_{js} f_{ej}. \tag{3}$$

The right-hand side of this expression is exactly RHS above and exhibits the same properties. The left-hand side LHS is increasing in productivity $1/a_{ijs}^H$. Since it does not depend on t_s or the interaction term $t_s \lambda_j$, $\frac{\partial\left(1/a_{ijs}^H\right)}{\partial t_s} < 0$ and $\frac{\partial^2\left(1/a_{ijs}^H\right)}{\partial \lambda_j \partial t_s} > 0$ because $\frac{\partial RHS}{\partial t_s} < 0$ and $\frac{\partial^2 RHS}{\partial \lambda_j \partial t_s} > 0$. Taking first and second derivatives, $\frac{\partial LHS}{\partial d_s} = \left[\alpha - \frac{\alpha}{\lambda_j}\right] \left(\frac{\tau_{ij} c_{js} a_{ijs}^H}{\alpha P_{is}}\right)^{1-\varepsilon} \theta_s Y_i < 0$, $\frac{\partial LHS}{\partial \lambda_j} = \frac{d_s \alpha}{\lambda_j^2} \left(\frac{\tau_{ij} c_{js} a_{ijs}^H}{\alpha P_{is}}\right)^{1-\varepsilon} \theta_s Y_i > 0$ and $\frac{\partial^2 LHS}{\partial \lambda_j \partial d_s} = \frac{\alpha}{\lambda_j^2} \left(\frac{\tau_{ij} c_{js} a_{ijs}^H}{\alpha P_{is}}\right)^{1-\varepsilon} \theta_s Y_i > 0$ because $\lambda_j \epsilon (0,1)$. Since the signs of these three derivatives are opposite to those of $\frac{\partial RHS}{\partial d_s} > 0$, $\frac{\partial RHS}{\partial \lambda_j} < 0$ and $\frac{\partial^2 RHS}{\partial \lambda_j \partial d_s} < 0$, it follows that $\frac{\partial\left(1/a_{ijs}^H\right)}{\partial d_s} > 0$, $\frac{\partial\left(1/a_{ijs}^H\right)}{\partial \lambda_j} < 0$ and $\frac{\partial^2\left(1/a_{ijs}^H\right)}{\partial \lambda_j \partial d_s} < 0$. The comparative statics for $1/a_{ijs}^H$ are thus identical to those for $1/a_{ijs}$ above.

When firms finance only fixed costs externally as in Section 3.3, maximizing profits is equivalent to maximizing net revenues $A_{ijs}(a)$. First-best prices then also maximize firms' possible payment to the investor $F(a)$ and hence the probability of exporting. In contrast, when firms require external capital for both fixed and variable costs, firms with productivity below $1/a_{ijs}^H$ have an incentive to reduce their export scale from the unconstrained optimum. This occurs because exporting larger quantities requires more outside finance, which increases the repayment $F(a)$ necessary to meet the investor's participation constraint. Given (1.1), constrained firms thus sell lower quantities at higher prices. Because deviating from the first-best lowers profits, they scale down (and increase the price) as little as possible to ensure that investors can break even. Plugging (1.1) and $B_{ijs}(a) = 0$ into (1.2) and setting $A_{ijs}(a) = F(a)$, firms' prices solve

$$\frac{p_{ijs}(a)^{1-\varepsilon} \theta_s Y_i}{P_{is}^{1-\varepsilon}} - \left(1 - d_s + \frac{d_s}{\lambda_j}\right) \tau_{ij} c_{js} a \frac{p_{ijs}(a)^{-\varepsilon} \theta_s Y_i}{P_{is}^{1-\varepsilon}} = \left(1 - d_s + \frac{d_s}{\lambda_j}\right) c_{js} f_{ij} - \frac{1-\lambda_j}{\lambda_j} t_s c_{js} f_{ej}. \tag{4}$$

Constrained firms choose a price between the first best $\frac{\tau_{ij} c_{js} a}{\alpha}$ and the price that maximizes the left-hand side of (4) LHS. In this range, LHS is increasing in $p_{ijs}(a)$. To see this, take the first derivative $\frac{\partial LHS}{\partial p_{ijs}} = \frac{p_{ijs}(a)^{-\varepsilon-1} \theta_s Y_i}{P_{is}^{1-\varepsilon}} \cdot \left[(1-\varepsilon) p_{ijs}(a) + \varepsilon \left(1 - d_s + \frac{d_s}{\lambda_j}\right) \tau_{ij} c_{js} a\right]$. Since $p_{ijs}(a) \geq \frac{\tau_{ij} c_{js} a}{\alpha}$, $\frac{\partial LHS}{\partial p_{ijs}} \geq \frac{p_{ijs}(a)^{-\varepsilon-1} \theta_s Y_i}{P_{is}^{1-\varepsilon}} \cdot \varepsilon \tau_{ij} c_{js} a \left(-d_s + \frac{d_s}{\lambda_j}\right) > 0$ because $\lambda_j \epsilon (0,1)$.

The right-hand side of (4) is the same RHS as above. Since LHS does not depend on t_s or $t_s\lambda_j$, $\frac{\partial p_{ijs}}{\partial t_s} < 0$ and $\frac{\partial^2 p_{ijs}}{\partial t_s \partial \lambda_j} > 0$ because $\frac{\partial RHS}{\partial t_s} < 0$ and $\frac{\partial^2 RHS}{\partial \lambda_j \partial t_s} > 0$. Taking first and second derivatives, $\frac{\partial LHS}{\partial d_s} = \left(1 - \frac{1}{\lambda_j}\right) \tau_{ij} c_{js} a \frac{p_{ijs}(a)^{-\varepsilon} \theta_s Y_i}{P_{is}^{1-\varepsilon}} < 0$, $\frac{\partial LHS}{\partial \lambda_j} = \frac{d_s}{\lambda_j^2} \tau_{ij} c_{js} a \frac{p_{ijs}(a)^{-\varepsilon} \theta_s Y_i}{P_{is}^{1-\varepsilon}} > 0$ and $\frac{\partial^2 LHS}{\partial \lambda_j \partial d_s} = \frac{1}{\lambda_j^2} \tau_{ij} c_{js} a \frac{p_{ijs}(a)^{-\varepsilon} \theta_s Y_i}{P_{is}^{1-\varepsilon}} > 0$ because $\lambda_j \epsilon (0,1)$. Since the signs of these three derivatives are opposite to those of $\frac{\partial RHS}{\partial d_s} > 0$, $\frac{\partial RHS}{\partial \lambda_j} < 0$ and $\frac{\partial^2 RHS}{\partial \lambda_j \partial d_s} < 0$, it follows that $\frac{\partial p_{ijs}}{\partial d_s} > 0$, $\frac{\partial p_{ijs}}{\partial \lambda_j} < 0$ and $\frac{\partial^2 p_{ijs}}{\partial \lambda_j \partial d_s} < 0$. Since export quantities and revenues are decreasing in the price, the comparative statics for them are reversed: $\frac{\partial r_{ijs}}{\partial \lambda_j} > 0$, $\frac{\partial r_{ijs}}{\partial d_s} < 0$, $\frac{\partial r_{ijs}}{\partial t_s} > 0$, $\frac{\partial^2 r_{ijs}}{\partial \lambda_j \partial d_s} > 0$ and $\frac{\partial^2 r_{ijs}}{\partial \lambda_j \partial t_s} < 0$. This proves Proposition 5.

Some potentially profitable exporters will not be able to sell abroad. The left-hand side of (4) is maximized at $p_{ijs}^L(a) = \left(1 - d_s + \frac{d_s}{\lambda_j}\right) \frac{\tau_{ij} c_{js} a}{\alpha}$ and firms have no incentive to raise their price above this level. Therefore, firms with productivity below $1/a_{ijs}^L$ cannot export because, even if they set this price and give all revenues to the investor in case of repayment, the investor would not break even. Plugging $p_{ijs}^L(a)$ into (4), this cut-off is defined by

$$\left(1 - d_s + \frac{d_s}{\lambda_j}\right)^{1-\varepsilon} \left(\frac{\tau_{ij} c_{js} a_{ijs}^L}{\alpha P_{is}}\right)^{1-\varepsilon} \theta_s Y_i = \varepsilon \left\{ \left(1 - d_s + \frac{d_s}{\lambda_j}\right) c_{js} f_{ij} - \frac{1 - \lambda_j}{\lambda_j} t_s c_{js} f_{ej} \right\}. \quad (5)$$

The right-hand side of (5) inherits the properties of RHS above. The left-hand side of (5) LHS is increasing in productivity $1/a_{ijs}^L$. Since it does not depend on t_s or $t_s\lambda_j$, $\frac{\partial\left(1/a_{ijs}^L\right)}{\partial t_s} < 0$ and $\frac{\partial^2\left(1/a_{ijs}^L\right)}{\partial \lambda_j \partial t_s} > 0$ because $\frac{\partial RHS}{\partial t_s} < 0$ and $\frac{\partial^2 RHS}{\partial \lambda_j \partial t_s} > 0$. Taking first derivatives, $\frac{\partial LHS}{\partial d_s} = (\varepsilon - 1)\left(1 - d_s + \frac{d_s}{\lambda_j}\right)^{-\varepsilon} \left(1 - \frac{1}{\lambda_j}\right) \left(\frac{\tau_{ij} c_{js} a_{ijs}^L}{\alpha P_{is}}\right)^{1-\varepsilon} \theta_s Y_i < 0$ and $\frac{\partial LHS}{\partial \lambda_j} = (\varepsilon - 1)\left(1 - d_s + \frac{d_s}{\lambda_j}\right)^{-\varepsilon} \frac{d_s}{\lambda_j^2} \left(\frac{\tau_{ij} c_{js} a_{ijs}^L}{\alpha P_{is}}\right)^{1-\varepsilon} \theta_s Y_i > 0$ because $\lambda_j \epsilon (0,1)$. Since the signs of these derivatives are opposite to those of $\frac{\partial RHS}{\partial d_s} > 0$ and $\frac{\partial RHS}{\partial \lambda_j} < 0$, it follows that $\frac{\partial\left(1/a_{ijs}^L\right)}{\partial d_s} > 0$ and $\frac{\partial\left(1/a_{ijs}^L\right)}{\partial \lambda_j} < 0$. While $\frac{\partial^2 RHS}{\partial \lambda_j \partial d_s} < 0$ can be signed, however, the sign of $\frac{\partial^2 LHS}{\partial \lambda_j \partial d_s} = (\varepsilon - 1)\left(\frac{\tau_{ij} c_{js} a_{ijs}^L}{\alpha P_{is}}\right)^{1-\varepsilon} \theta_s Y_i \cdot \left(1 - d_s + \frac{d_s}{\lambda_j}\right)^{-\varepsilon-1} \frac{1}{\lambda_j^2} \left[1 + d_s(\varepsilon - 1)\left(1 - \frac{1}{\lambda_j}\right)\right] \gtrless 0$ is ambiguous because $\lambda_j \epsilon (0,1)$. Intuitively, more productive firms have higher revenues to offer in case of repayment, but they also require more external capital for their variable costs since they operate at a larger scale. The former effect dominates and $\frac{\partial^2 LHS}{\partial \lambda_j \partial d_s} > 0$ whenever $1 + d_s(\varepsilon - 1)\left(1 - \frac{1}{\lambda_j}\right) > 0$. In that case we can unambiguously conclude that $\frac{\partial^2\left(1/a_{ijs}^L\right)}{\partial \lambda_j \partial d_s} < 0$. This is a sufficient but not a necessary condition: $\frac{\partial^2\left(1/a_{ijs}^L\right)}{\partial \lambda_j \partial d_s} < 0$ will hold even if $\frac{\partial^2 LHS}{\partial \lambda_j \partial d_s} < 0$ as long as RHS falls faster with $d_s\lambda_j$ than LHS.[1] Given results in the corporate finance literature that larger, more productive firms are less likely to be credit constrained, as well as my own empirical findings, I assume that $\frac{\partial^2\left(1/a_{ijs}^L\right)}{\partial \lambda_j \partial d_s} < 0$ is satisfied. This confirms that Proposition 1 holds when firms borrow for both fixed and variable costs.

[1] The necessary condition is $\frac{\varepsilon - 1}{\lambda_j^2}\left(1 - d_s + \frac{d_s}{\lambda_j}\right)^{-\varepsilon-1} \left[1 + d_s(\varepsilon - 1)\left(1 - \frac{1}{\lambda_j}\right)\right] \left(\frac{\tau_{ij} c_{js}}{\alpha P_{is}}\right)^{1-\varepsilon} \theta_s Y_i > -\frac{\varepsilon}{\lambda_j^2} c_{js} f_{ij}$.

A.4 Proof of Proposition 6

Aggregating across firms, total exports from country j to country i in sector s are $M_{ijs} = \left(\frac{\tau_{ij}c_{js}}{\alpha P_{is}}\right)^{1-\varepsilon}\theta_s Y_i N_{js}\left[\int_{a_L}^{a_{ijs}^H} a^{1-\varepsilon}dG\left(a\right) + \int_{a_{ijs}^H}^{a_{ijs}^L}\beta_{ijs}(a)a^{1-\varepsilon}dG\left(a\right)\right]$, where N_{js} is the exogenous measure of active producers. The first term in the brackets corresponds to companies trading at first-best levels. The second term captures the reduced revenues of constrained exporters, which for simplicity have been expressed as a fraction $\beta_{ijs}(a)\epsilon\left(0,1\right)$ of first-best revenues. Taking first derivatives, $\frac{\partial M_{ijs}}{\partial a_{ijs}^H} = \left(\frac{\tau_{ij}c_{js}}{\alpha P_{is}}\right)^{1-\varepsilon}\theta_s Y_i N_{js}\left(a_{ijs}^H\right)^{1-\varepsilon}\left[1-\beta_{ijs}(a_{ijs}^H)\right] = 0$ since $\beta_{ijs}(a_{ijs}^H) = 1$, $\frac{\partial M_{ijs}}{\partial a_{ijs}^L} = \left(\frac{\tau_{ij}c_{js}}{\alpha P_{is}}\right)^{1-\varepsilon}\theta_s Y_i N_{js}\beta_{ijs}(a_{ijs}^L)\left(a_{ijs}^L\right)^{1-\varepsilon} > 0$, and $\frac{\partial M_{ijs}}{\partial \beta_{ijs}(a)} = \left(\frac{\tau_{ij}c_{js}}{\alpha P_{is}}\right)^{1-\varepsilon}\theta_s Y_i N_{js}a^{1-\varepsilon} > 0$. Given the comparative statics for $1/a_{ijs}^H$, $1/a_{ijs}^L$ and $\beta_{ijs}(a)$ above, this implies that $\frac{\partial M_{ijs}}{\partial \lambda_j} > 0$, $\frac{\partial M_{ijs}}{\partial d_s} < 0$, $\frac{\partial M_{ijs}}{\partial t_s} > 0$, $\frac{\partial^2 M_{ijs}}{\partial \lambda_j \partial d_s} > 0$ and $\frac{\partial^2 M_{ijs}}{\partial \lambda_j \partial t_s} < 0$. This proves Proposition 6.

B Appendix. Data sources

GDP and GDP per capita: from the *Penn World Tables 6.1.*

Corruption and rule of law: from La Porta et al. (1998).

Physical and human capital endowments per capita: from Caselli (2005). The stock of physical capital is obtained according to the perpetual inventory method as $K_t = I_t + \delta K_{t-1}$, where I_t is investment and δ is the depreciation rate. The initial capital stock K_o is computed as $I_0/\left(g+\delta\right)$, where I_0 is the earliest value of investment available, and g is the average geometric growth rate of investment before 1970. Human capital per worker is calculated from the average years of schooling in a country with Mincerian non-linear returns to education. It is measured as $h = e\varphi\left(s\right)$, where s is the average years of schooling in the population over 25 years old, and $\varphi\left(s\right)$ is piecewise linear with slope 0.13 for $s \leq 4$, 0.10 for $4 < s \leq 8$, and 0.07 for $8 < s$.

Natural resources per worker: from the World Bank's *Expanding the Measure of Wealth.*

Sectors' factor intensity: from Braun (2003).

Output and number of establishments by sector: from *UNIDO.*

Consumer price index: from the IMF's *International Financial Statistics.*