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ABSTRACT

This paper examines the detrimental consequences of financial market imperfections for international trade. I develop a heterogeneous-firm model with countries at different levels of financial development and sectors of varying financial vulnerability. Applying this model to aggregate trade data, I study the mechanisms through which credit constraints operate. First, financial development increases countries' exports above and beyond its impact on overall production. Firm selection into exporting accounts for a third of the trade-specific effect, while two thirds are due to reductions in firm-level exports. Second, financially advanced economies export a wider range of products and their exports experience less product turnover. Finally, while all countries service large destinations, exporters with superior financial institutions have more trading partners and also enter smaller markets. All of these effects are magnified in financially vulnerable sectors. These results have important policy implications for less developed economies that rely on exports for economic growth but suffer from poor financial contractibility.

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1 Introduction

A growing body of work has argued that, in the presence of credit constraints, financially advanced economies have a comparative advantage in financially vulnerable industries. These studies have emphasized the variation in export values across countries and sectors, but ignored the effects of financial frictions on different trade margins and on overall production. On the other hand, a large literature has highlighted the importance of reallocations across firms and across products and trade partners within firms for aggregate trade and the adjustment to trade reforms. While firm heterogeneity has been successfully used to rationalize aggregate export outcomes, its consequences in the presence of imperfect financial markets have not been explored.

This paper provides an overall treatment of the effect of financial frictions on international trade in order to elucidate the mechanisms through which it operates. I develop a heterogeneous-firm model with countries at different levels of financial development and sectors of varying financial vulnerability. Using model-consistent estimation, I show empirically that credit constraints severely impede firm selection into exporting and restrict firms' sales abroad. Financial development thus allows countries to expand aggregate exports, broaden their export product scope, enter more foreign markets, and reduce product churning. These effects are magnified in financially vulnerable industries. Importantly, the impact of credit constraints on trade goes above and beyond that on overall production. These results have significant policy implications for less developed economies, many of which rely heavily on exports for economic growth but suffer from inefficient financial markets.

In the model, credit constraints affect manufacturers in different countries and sectors unevenly. First, for technological reasons, producers in certain industries require more external finance to fund their export activities. Sectors also differ in firms' endowments of tangible assets that can serve as collateral. Second, financial frictions vary across countries because contracts between entrepreneurs and investors are more likely to be enforced at higher levels of financial development. Exporters in financially vulnerable sectors are thus less credit constrained in economies with stronger financial contractibility.

Credit constraints also interact non-trivially with firm heterogeneity and reinforce the selection of only the most productive firms into exporting: Because more efficient suppliers earn higher revenues, they can offer financiers greater returns and are more likely to secure the external capital necessary to sell abroad. As a result, the productivity cut-off for exporting as well as firm-level exports vary systematically across exporting countries and sectors. These movements in turn influence a number of other trade features.

I find strong support for the model's predictions in a panel of bilateral exports for 107 countries and 27 ISIC 3-digit sectors in 1985-1995. I 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) predict different export outcomes. Exploiting the variation across both countries and

sectors allows me to establish a causal effect of credit constraints on trade. To guard against omitted variable bias, I 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).

I first show that financial frictions hinder international trade flows through three channels: the selection of firms into domestic production, the selection of active manufacturers into exporting, and firm-level exports. As a result, financially developed countries are more likely to enter any given market and export more conditional on trading. These effects are significantly stronger in sectors with greater requirements for outside finance or with fewer collateralizable assets. By explicitly controlling for domestic output, I establish that only 20%-25% of the total effect of credit constraints on export volumes reflects distortions to overall production. I then decompose the remaining 75%-80% into disruptions to the extensive and intensive margins of trade. In the absence of systematic cross-country data at the firm level, I do so by combining information on zero and positive bilateral exports in a two-stage structural estimation in the spirit of Helpman, Melitz and Rubinstein (2008). I conclude that a third of the trade-specific effect is attributable to firm selection into exporting, while two-thirds are due to reductions in firm-level exports.

I next document that credit constraints impede product variety and increase product churning in trade. I study the number of products exported by sector at the finest level of disaggregation available: 4-digit SITC goods in the full matrix of bilateral trade flows and 10-digit HS goods for exports specifically to the US. Financially advanced economies export a wider range of products and discontinue fewer export goods over time. These patterns are magnified in financially vulnerable sectors and corroborate the results above for the extensive margin of trade.

Finally, I establish that credit constraints force firms to add export destinations in decreasing order of market size until they exhaust their financial resources. This occurs because larger markets guarantee higher revenues, which make it easier for exporters to cover the associated fixed trade costs. Thus, while all countries service the largest markets in the world, financially advanced economies go further down the pecking order, enter smaller destinations as well, and as a result have more trade partners. Once again this advantage is particularly strong for sectors intensive in external capital or intangible assets.

My results imply that financial frictions have sizeable real effects on international flows, and are as important for understanding trade patterns as traditional Heckscher-Ohlin sources of comparative advantage. For example, the impact of a one-standard-deviation improvement in financial development is of the same economic magnitude as that of a similar rise in the human capital endowment, and substantially larger than that of a commensurate increase in the stock of physical capital. My estimates also suggest that the strengthening of financial institutions alone explains 22% of the observed growth in trade activity between 1985 and 1995, while factor accumulation accounts for only 12%.

This paper contributes to a quickly expanding literature on financial institutions and trade.

The main theoretical contribution is a parsimonious model of exporters' credit constraints that provides a transparent link to the data. First, it generates classic comparative-advantage predictions. Second, it incorporates firm heterogeneity and can thus analyze the impact of financial frictions on different trade margins. Prior models have featured either dimension but not both. For example, 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; Ju and Wei 2005; Becker and Greenberg 2007). The Ricardian, representative-firm nature of these frameworks, however, delivers the counterfactual prediction that either all or no producers in a given sector export. While Chaney (2005) examines heterogeneous firms, he does not explicitly model financial contracts or sector differences. He also does not address product churning nor the number and size of export destinations.

The paper also makes three empirical contributions to the literature. First, it isolates the effect of credit constraints on international trade above and beyond that on overall output. Prior studies have consistently found that financially advanced economies export relatively more in financially vulnerable sectors (Beck 2002, 2003; Becker and Greenberg 2007; Svaleryd and Vlachos 2005; Hur et al. 2006). They do not ask, however, whether this reflects the fact that financially developed countries produce more and grow faster in such industries (Rajan and Zingales 1998; Braun 2003; Fisman and Love 2007). I document that exports are affected disproportionately more than general economic activity, consistent with trade flows' higher sensitivity during the recent financial crisis (Chor and Manova 2010).

The second empirical contribution is in decomposing the trade-specific effects of credit market imperfections into distortions to the extensive and intensive margins of trade. While earlier work examines only positive aggregate flows, I show that financial frictions impede firm-level exports, as well as firm entry into foreign markets, export product scope and trade partner intensity.[1] This indicates that producers face binding constraints in the financing of both fixed and variable trade costs. My findings for product churning are also novel and suggest that financial frictions influence trade dynamics in the presence of shocks to export profitability. Together, these results imply that financial underdevelopment could play an important role in the adjustment to trade reforms, exchange rate movements and other cost or demand shocks.

Third, this paper is the first to show empirically that countries observe a pecking order of export destinations, and that credit constraints modify it importantly. While the heterogeneous-firm model without financial frictions (Melitz 2003) also predicts such a pecking order, it has never been tested in the full matrix of bilateral exports. Eaton et al. (2004, 2008) are the only studies to offer firm-level evidence that larger and more productive French firms export to more markets and to smaller economies. I generalize this result to sector-level trade in the full cross-section of country pairs, and illustrate how liquidity needs intensify the pecking order.

More broadly, the paper adds to recent work on the effects of financial frictions on aggregate

[1] Subsequent work by Greenaway et al. (2007), Muûls (2008), Amiti and Weinstein (2009), Manova et al. (2009) and Minetti and Zhu (2010) finds consistent evidence using firm data for UK, Belgium, Japan, China and Italy.

growth, volatility and multinational firm activity (Aghion et al. 2010; Antràs et al. 2009; Chor et al. 2006). Prior evidence suggests that foreign direct and portfolio investments provide an alternative source of external financing and can partly offset the disruptive effects of underdeveloped local financial markets on export flows (Manova 2008; Manova et al. 2009).

This paper also extends a line of research examining the impact of various contractual imperfections on international trade (Nunn 2007; Claessens and Laeven 2003; Levchenko 2007). Whereas these studies focus on aggregate exports, I also explore the implications of the institutional environment for a range of other trade outcomes. My empirical analysis ensures that the effects of financial development do not capture the role of other institutions.

Finally, my results expand the analysis of the extensive and intensive margins of trade (Hummels and Klenow 2004; Schott 2004; Broda and Weinstein 2006; Baldwin and Harrigan 2007) and the frequent product and firm turnover in exporting (Bernard et al. 2010; Bernard and Jensen 2004; Allessandria and Choi 2007; and Besedes and Prusa 2006, 2007).

The remainder of the paper is organized as follows. Section 2 describes why and how exporters use external finance, while Section 3 provides an overview of export patterns in the data. Section 4 develops the model, Section 5 introduces the estimation approach, Section 6 discusses the data, and Section 7 presents 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 mostly fixed, such as expenditures on R&D and product development, marketing research, advertising, and investment in fixed capital equipment. Some 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 60 days longer to complete than domestic orders. 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 quite important for firms' ability to finance their international activities. This is both because it is usually easier for firms to establish banking relationships at home than in a foreign country, as well as because the exporter's bank plays a crucial role in cross-border transactions regardless of the specific type of trade financing arrangement.[2]

These considerations motivate the way in which I model the effects of credit constraints on firm exports. In particular, I assume that exporters require external finance for a certain fraction of their fixed and variable costs of manufacturing and shipping, which they can raise by pledging collateral. I also focus on the role of financial development in the exporting country.[3]

3 A first glance at the data

There is systematic variation in export patterns across countries at different levels of financial development and across sectors at different levels of financial vulnerability. This section summarizes these patterns so as to motivate the theoretical model and empirical analysis to follow. For clarity, I focus on a single cross-section of data for 1995.

Table 1 describes the export activity of 161 countries in 27 manufacturing sectors in the ISIC 3-digit industry classification. Most countries export to at least one destination in each industry, and only 15% of the exporter-sector cells report no trade. However, the number of trade partners varies widely across exporting countries and sectors. On average, a country enters 36 markets in a given industry, with a standard deviation of 42 across countries and sectors. This variation explains why zeroes dominate the matrix of bilateral exports even at this highly aggregated sector level: 75% of all exporter-importer-sector triplets are zeros. Moreover, there are many asymmetric cases in which trade flows in only one direction between a pair of countries.

Export volumes and poduct variety also differ greatly across countries and sectors with positive cross-border sales. Bilateral trade data are available for each SITC 4-digit product group, which I match to ISIC 3-digit sectors. Within a sector, an average exporter sells 5.34 product groups to a destination market, with a standard deviation of 6.61. Flows are observed at a finer level of disaggregation for exports specifically to the US. On average, countries ship 64 HS 10-digit products to the US within each industry, with a standard deviation of 148.

The product mix of countries' exports changes frequently over time. More than a quarter of all 4-digit product groups sold bilaterally are discontinued each year and replaced by new ones.

[2] See *Trade Finance Guide* published by the International Trade Administration for more institutional details.

[3] While access to finance in the importing country might also matter, back-of-the-envelope calculations suggest that it 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 estimated coefficients on the latter are roughly 2-3 times bigger than those on the former. The two also appear to be complements instead of substitutes.

At the 10-digit level, each year countries replace more than half of their products bound for the US. However, products' survival rate varies significantly across sectors and exporting countries. Understanding the drivers of product churning is important because it affects 16% of global trade by value and up to 34% of US imports.

The variation across countries and sectors is not random. Financially developed economies systematically outperform exporters with less evolved financial institutions. As Figure 1 shows, countries with higher levels of credit extended to the private sector (as a share of GDP) record greater bilateral exports for the average sector and destination (correlation coefficient 0.66). Such countries also ship a wider range of products (corr coeff 0.71) to more destinations (corr coeff 0.74). Indeed, Figure 1 would look very similarly if it instead plotted exporters' number of foreign markets or number of bilaterally traded products against financial development. Finally, financially advanced countries experience less product churning over time. The simple correlation between the exporter's private credit and the percentage share of bilateral trade by value that is reallocated across SITC 4-digit products each year is □0.38.

While these patterns suggest that export outcomes vary systematically with 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 2, 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, export product variety, and product stability over time (figures available on request).

These graphs and summary statistics do not account for differences across countries and sectors unrelated to financial frictions. However, as the regression results in Section 7 show, the same patterns obtain in a large panel after controlling for factor endowments, overall development, and other institutions. I next present a model that rationalizes these patterns.

4 A model of credit constraints in trade

This section incorporates credit constraints and firm heterogeneity in a static, partial equilibrium model à la Melitz (2003). In order to provide a transparent link between theory and empirics, the model is kept as simple as possible. Its main predictions are, however, robust to alternative modeling choices as discussed below.

4.1 Set up

Consider a world with J countries and S sectors. A continuum of firms produce differentiated goods in each country and sector, and consumers exhibit love of variety. The utility function for

country i is a Cobb-Douglas aggregate over sector-specific CES consumption indices C_{is}:

$$U_i = \prod_s C_{is}^{\theta_s}, \quad C_{is} = \left[\int_{\omega \in \Omega_{is}} q_{is}(\omega)^{\alpha} \, d\omega \right]^{\frac{1}{\alpha}},$$

where $q_{is}(\omega)$ represents i's consumption of variety ω in sector s, $_{is}$ is the set of available varieties, and $\varepsilon = 1/(1 \square \alpha) > 1$ is the constant elasticity of substitution. The parameters θ_s indicate the share of each sector in total expenditure Y_i and satisfy $\sum_s \theta_s = 1$, $0 < \theta_s < 1$. If P_{is} is the ideal price index in sector s, i's demand for a variety with price $p_{is}(\omega)$ is

$$q_{is}(\omega) = \frac{p_{is}(\omega)^{\square \varepsilon} \theta_s Y_i}{P_{is}^{1 \square \varepsilon}}, \text{ where } P_{is} = \left[\int_{\omega \in \Omega_{is}} p_{is}(\omega)^{1 \square \varepsilon} \, d\omega \right]^{\frac{1}{1 \square \varepsilon}}. \quad (1)$$

4.2 Domestic producers

Firms incur a sunk cost $c_{js} f_{ej}$ to enter an industry before drawing a productivity level $1/a$ from a cumulative distribution function $G(a)$ with support $[a_L, a_H]$, $a_H > a_L > 0$. The cost of manufacturing 1 unit of output is $c_{js} a$, where c_{js} represents 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,[4] $G(a)$ does not depend on j and s.

There is overwhelming evidence that credit constraints distort firms' investment and production decisions, and that this impact varies across sectors.[5] To focus on the effect 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, which implies that all firms that enter the industry produce domestically. The consequences of financial frictions for trade would not change qualitatively if these assumptions are relaxed.[6] Importantly, the empirical analysis explicitly accounts for the fact that credit constraints might affect firms' selection into domestic production.

4.3 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.

[4] See Bernard et al. (2007) for a multi-sector, multi-factor extension of Melitz (2003).

[5] For example, Rajan and Zingales (1998), Fisman and Love (2007), and Braun (2003) show that sectors intensive in outside finance and sectors with few collateralizable assets grow faster in financially developed countries.

[6] When firms require external finance to produce for both the home and foreign market, two productivity cut-offs govern firms' behavior: a lower cut-off for domestic production and a higher one for exporting. Both cut-offs are systematically lower in financially developed countries, and even more so in financially vulnerable sectors. In other words, financially advanced economies export more (especially in some sectors) because (i) they have fewer domestic producers, (ii) fewer producers become exporters, and (iii) those who do so export less.

Firms face credit constraints in the financing of production and transportation expenditures related to international trade. I first assume that exporters can finance variable costs internally, but need to raise outside capital for a fraction d_s, $0 < d_s < 1$, of the fixed trade cost. Producers in country j and sector s therefore have to borrow $d_s c_{js} f_{ij}$ to service country i. In Section 4.5, I relax this assumption and posit that all costs are subject to liquidity constraints.

The underlying assumption is that firms cannot use profits from past periods to finance future operations. This assumption can be justified if, for example, firms cannot retain earnings but have to distribute all profits to shareholders at the end of each period.[7] Alternatively, d_s is the fraction of outlays that needs to be financed externally after all retained earnings have been used up. This is akin to firms experiencing liquidity shocks because of up-front costs which they can cover only after revenues are realized but not in advance. The relative importance of up-front costs varies across sectors for technological reasons specific to the nature of each industry, as argued by Rajan and Zingales (1998). The parameter d_s captures precisely this variation and corresponds to the measure of external finance dependence that I use in the empirical analysis.

In obtaining outside finance, firms pledge tangible assets as collateral. I assume that a fraction t_s, $0 < t_s < 1$, of the sunk cost firms pay to enter an industry goes towards collateralizable assets such as plant, property and equipment.[8,9] This fraction corresponds to the measure of asset tangibility in my empirical analysis, and is also assumed to be an inherent feature of each industry, as proposed by Braun (2003) and others.

Finally, countries vary in their level of financial contractibility. An investor can expect to be repayed with probability λ_j, $0 < \lambda_j < 1$, which is exogenous to the model and determined by the strength of country j's financial institutions.[10] With probability $(1 \square \lambda_j)$ 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 payments at the end of the period.

[7] This might arise, for example, in the presence of principal-agent problems. In a dynamic model with endogenous default, if firms used retained earnings or financiers rewarded firms with better credit history, the effect of credit constraints on the selection of only the most productive firms into exporting would be reinforced since they have the highest profits and are thus most likely to retain earnings and to not default.

[8] The model's qualitative results would not change if the fixed costs of exporting were collateralizable instead. Because the latter are usually related to marketing and distribution networks, it is more realistic to assume that the sunk cost of entry into the industry represents in part tangible assets.

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

[10] The assumption that the default rate is exogenous is made for simplicity. Firms would presumably have less incentives to default in countries with superior financial contractibility where dafault is costlier. Firms would also be more likely to become insolvent and default in response to exogenous shocks if they are less productive, need more external finance, or have less collateral. The differential effects of credit constraints across countries, sectors and firms in the model would therefore continue to hold under endogenous default.

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

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

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

$$(2)\ A_{ijs}(a) \equiv p_{ijs}(a) q_{ijs}(a) \square q_{ijs}(a) \tau_{ij} c_{js} a \square (1 \square d_s) c_{js} f_{ij} \geq F(a), \text{ and}$$

$$(3)\ B_{ijs}(a) \equiv \square d_s c_{js} f_{ij} + \lambda_j F(a) + (1 \square \lambda_j) t_s c_{js} f_{ej} \geq 0.$$

The expression for profits above reflects the fact that the firm finances all its variable costs and a fraction $(1 \square d_s)$ of its fixed costs internally, pays the investor $F(a)$ when the financial contract is enforced (with probability λ_j) and replaces the collateral claimed by the creditor in case of default (with probability $(1 \square \lambda_j)$).

In the absence of credit constraints, exporters maximize profits subject to the demand condition given by the first constraint above. With external financing, two additional conditions bind firms' decisions. When the financial contract is enforced, entrepreneurs can offer at most their net revenues $A_{ijs}(a)$ to the creditor. In addition, investors only fund the firm if their net return $B_{ijs}(a)$ exceeds their outside option, which has been normalized to 0.[11]

With competitive credit markets, all investors break even and make zero expected profits. Firms therefore adjust their payment $F(a)$ so as to bring the financier to his participation constraint. Since $B_{ijs}(a) = 0$ in equilibrium, the maximization problem reduces to the firm's problem in the absence of financial frictions except for the liquidity constraint that $F(a)$ be no greater than the firm's net revenues. Hence, exporting firms optimally choose the same export quantities and prices, and earn the same export revenues and profits as in Melitz (2003):

$$p_{ijs}(a) = \frac{\tau_{ij} c_{js} a}{\alpha}, \qquad q_{ijs}(a) = \left(\frac{\tau_{ij} c_{js} a}{\alpha}\right)^{\square \varepsilon} \frac{\theta_s Y_i}{P_{is}^{1 \square \varepsilon}}, \quad (3)$$

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

4.4 Entry into exporting

Since revenues increase with efficiency and trade entails fixed costs, all firms with productivity above a certain cut-off level can profitably export. With perfect financial contractibility ($\lambda_j = 1$), the model would reduce to the original Melitz (2003) formulation, and this threshold $1/a^*_{ijs}$ would be pinned down by $r_{ijs}\left(a^*_{ijs}\right) = \varepsilon c_{js} f_{ij}$. Financial frictions, however, preclude some firms from becoming exporters and raise the productivity cut-off to $1/a_{ijs}$, given by the condition

$$r_{ijs}(a_{ijs}) = \left(\frac{\tau_{ij} c_{js} a_{ijs}}{\alpha P_{is}}\right)^{1 \square \varepsilon} \theta_s Y_i = \varepsilon \left\{ \left(1 \square d_s + \frac{d_s}{\lambda_j}\right) c_{js} f_{ij} \square \frac{1 \square \lambda_j}{\lambda_j} t_s c_{js} f_{ej} \right\}. \quad (4)$$

[11] This assumption is made for simplicity. If investors can earn a world-market net interest rate r, the right hand side of (3) would be $r d_s c_{js} f_{ij}$ and the model's predictions qualitatively unchanged.

Figure 3A plots export profits as an increasing function of productivity and illustrates the wedge between the productivity 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 $1/a_{ijs}$ successfully obtain outside finance and sell abroad. This effect arises because all firms in a given sector have the same financing needs and collateralizable assets, but more productive firms earn higher revenues and can offer investors greater returns in case of repayment. Some low-productivity firms could thus profitably export in the absence of financial frictions, but their sales are too low to incentivize a financier: Even if they offered all net revenues, he would not break even. In line with a large literature in corporate finance, the model thus predicts that larger, more productive firms are less likely to be credit constrained.[12]

Of note, $1/a^*_{ijs} < 1/a_{ijs}$ requires that $d_s f_{ij} > t_s f_{ej}$. Intuitively, credit constraints bind and affect export participation whenever firms need to borrow more than what they can pledge as collateral. In view of my findings, I assume that this condition holds in the rest of the analysis.

The extent to which financial frictions distort firm selection into exporting depends on the strength of countries' financial contractibility and the level of sectors' financial vulnerability. These comparative statics are summarized in the following proposition:

Proposition 1 *(Cut-off) Under credit constraints, the productivity cut-off for exporting is lower in financially developed countries* ($\frac{\partial(1/a_{ijs})}{\partial \lambda_j} < 0$). *Within each country, this cut-off is higher in sectors with a greater need for external finance and in sectors with fewer tangible assets* ($\frac{\partial(1/a_{ijs})}{\partial d_s} > 0$, $\frac{\partial(1/a_{ijs})}{\partial t_s} < 0$). *The effect of financial development is more pronounced in financially vulnerable sectors* ($\frac{\partial^2(1/a_{ijs})}{\partial d_s \partial \lambda_j} < 0$, $\frac{\partial^2(1/a_{ijs})}{\partial t_s \partial \lambda_j} > 0$).

Intuitively, how likely a firm is to be credit constrained depends on its industry. For any productivity level, investors are more willing to fund firms in sectors that require less outside capital (d_s lower) or have more collateralizable assets (t_s higher). These sector characteristics are more relevant the lower financial contractibility λ_j is. Thus, firms in financially vulnerable industries find it relatively easier to export from countries with a more developed financial system. Credit constraints therefore redistribute exports in two ways: towards financially less vulnerable sectors, and towards more productive firms within a sector.

While the level effect of financial development might become ambiguous under alternative modeling assumptions, its differential impact across sectors would remain robust. First, both effects would hold if firms also incurred fixed costs in domestic production and required external capital for their financing (see footnote 7). Second, in general equilibrium, the sunk costs of entry would pin down a free-entry condition which imposes zero expected profits. Improvements in financial contractibility could no longer reduce the productivity cut-off for exporting in all sectors, since the higher probability of foreign sales would generate positive expected profits and violate the free-entry condition. This effect would be magnified in large open economies, where a

[12] See, for example, Beck et al. (2005), Beck et al. (2008) and Forbes (2007).

fall in the exporting cut-off could raise the price index in the destination as less productive firms are able to sell there, thereby further increasing expected export profits. In general equilibrium, financial development would therefore reduce the cut-off for exporting in the financially most vulnerable sectors but raise it in the least vulnerable sectors. All other differential effects of financial development across industries derived below would similarly hold in general equilibrium.

Trade occurs only if there are at least some firms with productivity above the $1/a_{ijs}$ cut-off. Proposition 1 thus implies that credit constraints generate systematic variation in the probability of positive bilateral exports across countries and sectors:

Proposition 2 *(Nonzero) Country j is more likely to export to country i if j is more financially developed. This effect is more pronounced in financially vulnerable sectors.*

Since firms manufacture differentiated goods, the lower the productivity cut-off for exporting, the greater the measure of exporters and the bigger the range of products the country sells abroad. Thus, the comparative statics for $1/a_{ijs}$ also apply to the product variety of countries' exports:

Proposition 3 *(Product variety) The more financially developed country j is, the more products it exports to country i. This effect is more pronounced in financially vulnerable sectors.*

4.5 Firm-level exports

In addition to restricting the number of firms that become exporters, credit constraints can also distort firm-level exports if firms require external funds for both fixed and variable costs. I now relax the assumption that firms finance variable costs internally and posit that exporters in sector s need to raise outside capital for a fraction d_s of all costs associated with foreign sales. This affects firm profits and investors' expected returns in (2), as well as the condition that the investor's repayment when the contract is enforced do not exceed the firm's net revenues.

As Online Appendix A proves, now two productivity cut-offs characterize firms' trade activity. This is illustrated by the graph of export profits in Figure 3B. While all firms with productivity above a certain threshold $1/a_{ijs}^L$ become exporters, only firms 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 export revenues to repay the investor if they exported at first-best levels. Instead, they choose to export lower quantities than the unconstrained optimum in order to reduce their requirement for external capital ncessary for financing variable costs. This allows them to meet the investor's participation constraint with a lower repayment $F(a)$. In this way, firms of intermediate productivity ensure that they can earn some export profits, albeit lower than the first-best.

Online Appendix A shows that Proposition 1 holds for both $1/a_{ijs}^L$ and $1/a_{ijs}^H$. In other words, more firms in financially vulnerable sectors can export and export at optimal scale if they are from financially developed countries. In addition, the distortion to the revenues of firms exporting at second-best levels also varies systematically across countries and sectors:

Proposition 4 *(Firm-level exports) When firms face credit constraints in the financing of both fixed and variable costs, high-productivity exporters export at first-best levels but low-productivity exporters export less. The export revenues of firms producing at second-best levels are higher for firms in financially developed countries, especially in financially vulnerable sectors.*[13]

4.6 Aggregate exports

Aggregating, the total value of exports by all firms selling at first-best levels is given by $\left(\frac{\tau_{ij}c_{js}}{\alpha P_{is}}\right)^{1\square\varepsilon}$ $\theta_s Y_i N_{js} \int_{a_L}^{a_{ijs}^H} a^{1\square\varepsilon} dG(a)$, where N_{js} is the (exogenous) measure of firms active in country j and sector s. The exports of firms operating at second-best levels can similarly be expressed as $\left(\frac{\tau_{ij}c_{js}}{\alpha P_{is}}\right)^{1\square\varepsilon} \theta_s Y_i N_{js} \int_{a_{ijs}^H}^{a_{ijs}^L} \beta_{ijs}(a) a^{1\square\varepsilon} dG(a)$, where $0 < \beta_{ijs}(a) < 1$ reflects these firms' reduced export scale. Thus, aggregate exports from country j to i in sector s are

$$M_{ijs} = \left(\frac{\tau_{ij}c_{js}}{\alpha P_{is}}\right)^{1\square\varepsilon} \theta_s Y_i N_{js} V_{ijs} E_{ijs}, \tag{5}$$

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

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

Note that V_{ijs} is nonzero if and only if the productivity cut-off for exporting falls within the support of the productivity distribution function. When $1/a_{ijs}^L$ is too high, no firm is productive enough to export, no trade takes place, and $M_{ijs} = 0$. V_{ijs} is thus a direct measure of the selection of firms into exporting, and is a monotonic function of $1/a_{ijs}^L$ and the proportion of firms exporting $G\left(a_{ijs}^L\right)$. On the other hand, E_{ijs} reflects the share of firms exporting at first-best levels and captures any effect of credit constraints on average firm-level exports.

Given Propositions 1 and 4, it immediately follows that financially developed countries have a comparative advantage in sectors intensive in outside finance and intangible assets:

Proposition 5 *(Trade volumes) The more financially developed country j is, the higher the value of its exports to country i. This effect is more pronounced in financially vulnerable sectors.*

5 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 implications.

[13] 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. Online Appendix A presents the condition necessary for $\frac{\partial^2\left(1/a_{ijs}^L\right)}{\partial d_s \partial \lambda_j} < 0$. 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.

5.1 Firm selection into exporting

Consider first the predictions for the productivity cut-off for exporting and the probability of positive bilateral trade. 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, $1/a_{ijs}^L$:

$$Z_{ijs} = \frac{\lambda_j (1 \square \alpha) \left(1 \square d_s + \frac{d_s}{\lambda_j}\right)^{1 \square \varepsilon} \left(\frac{\alpha P_{is}}{\tau_{ij} c_{js}}\right)^{\varepsilon \square 1} \theta_s Y_i a_L^{1 \square \varepsilon}}{[d_s + \lambda_j (1 \square d_s)] c_{js} f_{ij} \square (1 \square \lambda_j) t_s c_{js} f_{ej}} = \left(\frac{a_{ijs}^L}{a_L}\right)^{\varepsilon \square 1}. \quad (6)$$

Note that whenever $a_{ijs}^L > a_L$ 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 positive trade.

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, $\tau_{ij}^{\varepsilon \square 1} \equiv D_{ij}^{\mu} e^{\square u_{ij}}$, where D_{ij} is the distance between i and j, $u_{ij} \tilde{} N\left(0, \sigma_u^2\right)$, and $f_{ij} \equiv \exp\left(\varphi_j + \varphi_i + \kappa_1 \varphi_{ij} \square \kappa_2 \nu_{ij}\right)$, 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, $c_{js} \equiv c_j c_s$.

I assume the terms in λ_j, d_s, and t_s in (6) 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 $Tang_s$:

$$\frac{\lambda_j \left(1 \square d_s + \frac{d_s}{\lambda_j}\right)^{1 \square \varepsilon}}{[d_s + \lambda_j (1 \square d_s)] f_{ij} \square (1 \square \lambda_j) t_s f_{ej}} \equiv \exp(\varphi_j' + \varphi_i' \square \kappa \varphi_{ij} + \nu_{ij} + \varphi_s' + \\ + {}_1 FinDevt_j \cdot ExtFin_s \square {}_2 FinDevt_j \cdot Tang_s).$$

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.

I test Propositions 1 and 2 by log-linearizing equation (6) for $z_{ijs} \equiv \ln Z_{ijs}$ and estimating

$$z_{ijs} = {}_1 FinDevt_j \cdot ExtFin_s \square {}_2 FinDevt_j \cdot Tang_s \quad (7) \\ + {}_0 + (\varepsilon \square 1) p_{is} \square \mu d_{ij} \square \kappa \varphi_{ij} + \phi_j + \phi_i + \phi_s + \eta_{ij},$$

where $\eta_{ij} \equiv u_{ij} + \nu_{ij} \tilde{} N\left(0, \sigma_u^2 + \sigma_\nu^2\right)$, $\phi_j = \square \varepsilon \ln c_j + \varphi_j'$, $\phi_i = \ln Y_i + \varphi_i'$, and $\phi_s = \square \varepsilon \ln c_s + \varphi_s'$ are exporter, importer and sector fixed effects, respectively, and $p_{is} \equiv \ln P_{is}$.

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, (7) 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:

$$\rho_{ijs} = \Pr\left(T_{ijs} = 1 \mid \text{observed variables}\right) = \Phi(\ {}^{*}_{0} + (\varepsilon \square 1)^{*} p_{is} \square \mu^{*} d_{ij} \square \kappa^{*} \varphi_{ij} \qquad (8)$$
$$+\ {}^{*}_{1} FinDevt_j \cdot ExtFin_s \square\ {}^{*}_{2} FinDevt_j \cdot Tang_s + \phi^{*}_{j} + \phi^{*}_{i} + \phi^{*}_{s}).$$

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.

5.2 Product variety

I next test Proposition 3 for the range of exported products across countries and industries. The measure of firms exporting from j to i in sector s is $X_{ijs} = N_{js} G\left(a^L_{ijs}\right)$. I assume that $\ln G\left(a^L_{ijs}\right)$ can be decomposed and $x_{ijs} \equiv \ln X_{ijs}$ expressed as follows:

$$x_{ijs} = \xi_1 FinDevt_j \cdot ExtFin_s \square \xi_2 FinDevt_j \cdot Tang_s \qquad (9)$$
$$+ \xi_0 + \xi_3 n_{js} + \xi_4 p_{is} \square \xi_5 d_{ij} \square \xi_6 \varphi_{ij} + \xi_j + \xi_i + \xi_s + \eta_{ij},$$

where $n_{js} = \ln N_{js}$, 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 $1/a^L_{ijs}$. However, while (8) analyzes zero versus positive trade flows with Probit, (9) 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.

5.3 Trade volumes

To test Proposition 5, I derive an estimating equation for the value of bilateral exports M_{ijs} in (5). I follow HMR in assuming that firm productivity has a truncated Pareto distribution with support $[a_L, a_H]$: $G(a) = \left(\square a^k \square a_L^k\right) / \left(\square a_H^k \square a_L^k\right)$, where $a_H > a_L > 0$ and $k > \varepsilon \square 1$. V_{ijs}, the term in the expression for M_{ijs} which captures firm selection into exporting, can then be rewritten as $V_{ijs} = \frac{k a_L^{k \square \varepsilon + 1}}{(k \square \varepsilon + 1)\left(a_H^k \square a_L^k\right)} W_{ijs}$, where $W_{ijs} = \max\left\{\left(a^L_{ijs}/a_L\right)^{k \square \varepsilon + 1} \square 1, 0\right\}$. Log-linearizing (5) and invoking the assumptions $c_{js} \equiv c_j c_s$ and $\tau_{ij}^{\varepsilon \square 1} \equiv D_{ij}^{\mu} e^{\square u_{ij}}$,

$$m_{ijs} = \varsigma_0 + (\varepsilon \square 1)\, p_{is} \square \varsigma_1 d_{ij} + \varsigma_j + \varsigma_i + \varsigma_s + n_{js} + w_{ijs} + e_{ijs} + u_{ij}, \qquad (10)$$

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

Financial frictions can reduce bilateral exports m_{ijs} through three channels: the selection of firms into production (n_{js}), the selection of producers into exporting (w_{ijs}), and firm exports (e_{ijs}). While the model has focused on the latter two channels, in a fuller model with credit constraints in domestic production as well as in exporting, n_{js} would also depend on countries'

financial development and sectors' financial vulnerability. The comparative statics for the productivity cut-off for domestic production would then mimic those for the exporting threshold.

The prior literature has counfounded 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}.

I estimate (10) with a two-stage structural procedure in the spirit of HMR, which uses the information in both zero and positive bilateral exports. In the first stage, I obtain the predicted probability of exporting from j to i in sector s, $\widehat{\rho}_{ijs}$, from the Probit specification in (8), 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 then 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 estimate (10) controlling for n_{js} and the imputed measure of w_{ijs}. Since fixed export costs φ_{ij} directly affect only the extensive margin of trade, they enter only the first stage and provide the exclusion restriction necessary for the identification of the second stage.

In the second stage, I also include measures of countries' financial institutions and sectors' financial vulnerability, and observe whether they affect bilateral exports above and beyond the selection of firms into domestic production and into exporting. Once n_{js} and w_{ijs} are controlled for, any residual impact of credit constraints on m_{ijs} represents an effect on the unobserved firm-level exports.

The error term u_{ij} in (10) is correlated with w_{ijs} because the error term in the equation for z_{ijs} (7) is $\eta_{ij} \equiv u_{ij} + \nu_{ij}$. Any 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 exports, $E\left[w_{ijs}|., T_{ijs} = 1\right]$, 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 $\widehat{\overline{w}}^*_{ijs} \equiv \ln\left\{\exp\left(\delta\widehat{\overline{z}}^*_{ijs}\right) - 1\right\}$ 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 of the estimation thus produces consistent estimates and accounts for the selection of firms in 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.

5.4 Firm dynamics

The analysis so far has examined the effects of financial frictions in a static world. I now consider how stochastic trade costs interact with credit constraints and determine the product composition of countries' exports over time. For simplicity, I assume that firms require outside finance only for their fixed export costs, which are i.i.d. across firms and over time.[14] I further assume that in each period firms observe a low cost $\underline{f_{ij}}$ with probability q and a high cost $\overline{f_{ij}}$ with probability $(1 \square q)$. Hence, in making their export decisions, each period firms solve the maximization problem in (2) for the fixed cost they draw that period.

Two productivity cut-offs now define firms' export behavior. These cut-offs are given by equation (4), with the fixed cost set to $\underline{f_{ij}}$ and $\overline{f_{ij}}$, respectively. Firms with productivity above the higher cut-off $1/\overline{a_{ijs}}$ are always able to export. Firms with productivity below the lower cut-off $1/\underline{a_{ijs}}$ never sell abroad, either because they could not profitably do so or because they are credit constrained. Firms in the intermediate range of productivity $(1/\underline{a_{ijs}} \leq 1/a < 1/\overline{a_{ijs}})$ export if and only if they observe a low trade cost. The endogenous entry and exit of these marginal exporters drives firm dynamics in trade.

The mass of exporters is $X_{ijs} = N_{js}\left\{G\left(\overline{a_{ijs}}\right) + q\left[G\left(\underline{a_{ijs}}\right) \square G\left(\overline{a_{ijs}}\right)\right]\right\}$, since in any period a fraction q of all marginal exporters observe a low trade cost and export. In the next period, a fraction $(1 \square q)$ of these firms draw a high export cost and exit. In equilibrium, X_{ijs} is constant over time, the exit rate δ exactly equals the entry rate, and is given by

$$\delta = \frac{(1 \square q)\, q\left[G\left(\underline{a_{ijs}}\right) \square G\left(\overline{a_{ijs}}\right)\right]}{G\left(\overline{a_{ijs}}\right) + q\left[G\left(\underline{a_{ijs}}\right) \square G\left(\overline{a_{ijs}}\right)\right]}. \tag{11}$$

From Proposition 1, the two productivity cut-offs for exporting are lower in financially developed countries, especially in financially vulnerable sectors. Given the equivalence of firm and product variety, and a productivity distribution with no unit point masses, it follows that:

Proposition 6 *(Product churning) Financial development increases firm and product survival in countries' exports over time. This effect is more pronounced in financially vulnerable sectors.*

I test Proposition 6 with the following reduced form estimating equation for (11):

$$\begin{aligned}\delta_{ijs} = {} & \chi_1 FinDevt_j \cdot ExtFin_s \square \chi_2 FinDevt_j \cdot Tang_s \\ & + \chi_0 + \chi_3 p_{is} \square \chi_4 d_{ij} \square \chi_5 \varphi_{ij} + \chi_j + \chi_i + \chi_s + \epsilon_{ijs},\end{aligned} \tag{12}$$

where χ_j, χ_i, and χ_s represent exporter, importer, and sector fixed effects. I allow the price index in the destination market, as well as both variable and fixed trade costs, to impact firms' exit from exporting since they affect $\overline{a_{ijs}}$ and $\underline{a_{ijs}}$.[15]

[14] Proposition 6 holds if firms need external finance for both fixed and variable costs. While very productive firms would always export at first-best levels, a band of firms would switch between exporting at first- and second-best levels depending on their fixed cost draw. Their switching would not affect the overall mass of exporting firms.

[15] In a dynamic model with sunk costs, the effects of financial development on turnover can be ambiguous: While

5.5 Multiple export destinations

While the focus so far has been on firms' exports to a particular country i, in reality producers can sell to multiple destinations. In the absence of financial frictions, firms enter all markets that offer positive expected profits. With credit constraints, however, the decision to service country i is not independent from the decision to service country k, because firms have limited collateral with which to secure external finance for all of their foreign activities.

To maximize total profits, firms therefore export to the n most profitable markets in the world for which they can raise sufficient funds. All else equal, bigger economies offer firms higher export profits and a lower productivity cut-off for exporting (see equation (4)). Firms thus optimally add export destinations in decreasing order of market size until they exhaust the total amount of outside capital they can obtain: If a firm increases the number of its trade partners from n to $(n+1)$ countries, it continues exporting to the n largest economies in the world and targets the next biggest market as its $(n+1)$st destination. More productive exporters supply more destinations because their higher revenues allow them to go further down this pecking order of trade partners.[16] Online Appendix B formally establishes these results.

Note that a country exports to a given destination only if at least one firm sells there. Since the productivity cut-off for exporting depends on the exporter's level of financial development, the importer's market size, and the sector's financial vulnerability, the following holds:

Proposition 7 *(Trade partners) The more financially developed country j is, the more countries it exports to. This effect is more pronounced in financially vulnerable sectors.*

Proposition 8 *(Pecking order of trade) All countries export to the largest economies in the world. The more financially developed country j is, the more likely it is to also export to smaller destination markets. This effect is more pronounced in financially vulnerable sectors.*

I test Propositions 7 and 8 with the following reduced-form estimating equations:

$$\#Partners_{js} = \mu_0 + \mu_1 FinDevt_j \cdot ExtFin_s \square \mu_2 FinDevt_j \cdot Tang_s + \mu_j + \mu_s + \epsilon_{js}, \quad (13)$$

$$\max_{i, i \in TP_{js}} Y_i = \overline{\iota_0} \square \overline{\iota_1} FinDevt_j \cdot ExtFin_s + \overline{\iota_2} FinDevt_j \cdot Tang_s + \overline{\iota_j} + \overline{\iota_s} + \epsilon_{js}, \quad (14)$$

$$\min_{i, i \in TP_{js}} Y_i = \underline{\iota_0} \square \underline{\iota_1} FinDevt_j \cdot ExtFin_s + \underline{\iota_2} FinDevt_j \cdot Tang_s + \underline{\iota_j} + \underline{\iota_s} + \epsilon_{js}, \quad (15)$$

Here $\#Partners_{js}$ is the number of countries j exports to in sector s, TP_{js} the set of these trade partners, and $\max_{i, i \in TP_{js}} Y_i$ ($\min_{i, i \in TP_{js}} Y_i$) the size of the largest (smallest) among them. μ_j, μ_s, $\overline{\iota_j}$, $\overline{\iota_s}$, $\underline{\iota_j}$, and $\underline{\iota_s}$ capture exporter and sector fixed effects. The model predicts $\overline{\iota_1} = \overline{\iota_2} = 0$ and $\square \underline{\iota_1} < 0$ and $\underline{\iota_2} > 0$.

it would still improve firm survival by facilitating the financing of temporary cost shocks, it would also ease the funding of sunk costs, thereby lowering the option value of exporting during bad times and encouraging exit. My empirical results pick up a net effect and imply that the former effect dominates. See Dixit (1989a,b), Roberts and Tybout (1997), Albuquerque and Hopenhayn (2004), Costantini (2005), and Alessandira and Choi (2007).

[16] This result is consistent with the evidence in Eaton et al. (2004, 2008) for French firms.

6 Data

The empirical analysis uses data on bilateral exports for 107 countries and 27 sectors over the 1985-1995 period.[17] A sector is defined as a 3-digit category in the ISIC industry classification system. 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 detailed cross-country trade data at the firm level, I measure the product variety of countries' exports with the number of 4-digit SITC groups exported 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*.

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 requires a measure of the level 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 (Rajan and Zingales 1998; Braun 2003; Aghion et al. 2010), 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 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 of 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).

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

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

assets.[18] 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, which makes it reasonable that the measures reflect firms' optimal choice over external financing and asset 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. 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.

Appendix A describes all other variables used in the empirical analysis.

[18] A firm's book value includes a number of other assets that are arguably less tangible and can either not be liquidated or 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.

7 Credit constraints and export patterns in the data

7.1 Bilateral export flows

I begin by showing that financially developed countries indeed have a comparative advantage in financially vulnerable sectors. In Column 1 of Table 2, 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. 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).[19] 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 evidence that this impact is large and not driven by cross-border sales scaling proportionately with domestic activity. I have confirmed that more establishments are indeed 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. Of note, all results in the paper 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.[20]

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 and find my results unchanged. 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 estimates only 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

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

[20] All results in the paper are also robust to controlling for the exporter's output growth by year and sector in addition to any other controls in the reported tables.

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).[21]

Table 3 confirms the robustness of these results. Columns 1 and 2 establish 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 5.[23]

Table 3 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 9, 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 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

[21] Comparative statics based on Column 4 in Table 2.

[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 lower or higher real exchange rates. See Russ and Valderrama (2009) on the link between financial development and real exchange rates in general equilibrium.

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 results 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 evolve over this period as a result of financial development, holding all other variables fixed at their 1985 levels. In Table 10, 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).

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.[26]

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

[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 paterns typically changed little between 1985 and 1995 relative to export levels in 1985.

[26] Braun and Raddatz (2008) and Do and Levchenko (2007) find that trade openness can stimulate financial development, reinforcing the concern that causality might run from trade to financial development.

assets is thus strong evidence of a credit constraints channel.[27] Finally, using time-invariant measures of contractibility (contract repudiation, accounting standards and the risk of expropriation) further helps with establishing causality as these variables do not respond to variation in export demand the way private credit might.

7.2 Zero and positive exports

I next implement the two-stage estimation procedure outlined in Sections 5.1 and 5.3, and decompose the effect of credit constraints on bilateral exports (beyond that on output) into the component due to firm selection into exporting and that due to average firm-level exports.

This approach requires the use of an empirical proxy for the fixed costs of international trade, which affect firms' export status but not the scale of their sales. In the absence of direct trade cost measures, I exploit data on the regulation costs of firm entry from Djankov et al. (2002).[28] This choice is motivated by the presumption that countries which set high regulatory barriers to firms' 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 (relative to GDP per capita) to an entrepreneur of legally starting a business. 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 for each 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 level of firm exports.[29]

Proposition 2 states that financially developed countries are more likely to export bilaterally and that this advantage is more pronounced in financially vulnerable sectors. I test this prediction by estimating equation (8) 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 the sector price index in the importing country and both partners' GDP. Since both variable and fixed trade costs affect firms' 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 firm selection into exporting.

Table 4 presents strong empirical evidence in support of Proposition 2. Financially developed countries are more likely to enter a given market, and this effect is stronger in sectors that require

[27] 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.

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

[29] 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).

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.

I next estimate the effect of credit constraints on average firm exports predicted by Proposition 4. 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. To this end, I obtain the predicted probability of exporting $\widehat{\rho}_{ijs}$ from each Probit regression in Table 4 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, $\widehat{\overline{\eta}}^*_{ij} = \phi\left(\widehat{z}^*_{ijs}\right)/\Phi\left(\widehat{z}^*_{ijs}\right)$.[30] 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 5 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 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 4.

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 total 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 3). 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 5, I first drop the assumption of a Pareto distribution for firm productivity. Instead of $\widehat{\overline{w}}^*_{ijs}$, I now include a cubic polynomial in the estimated latent variable $\widehat{z}^*_{ijs}$ in the second stage. Since all regressors 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 $\widehat{z}^*_{ijs}$ can no longer 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.

The effects of credit constraints on firm selection into exporting and (average) firm exports

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

are not only statistically highly significant, but also of considerable economic magnitude. The comparative statics in the second and third rows of Table 9 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 and 15% larger firm exports in a sector reliant on outside finance (75th percentile) relative to a sector with little need for external capital (25th percentile). The corresponding differential effects across sectors at different levels of asset tangibility are 17% and 25%, respectively. 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 and firm-level exports by 15% and 30% more in a human-capital intensive sector (75th percentile) relative to a human-capital scarce industry (25th percentile). By contrast, the impact of a comparable change in physical capital stocks is only a fifth to an eighth as large.

7.3 Product variety and product churning

I next examine the consequences of financial frictions for the product composition of countries' exports. In particular, I estimate equation (9) with the (log) number of 4-digit SITC product groups exported bilaterally within a 3-digit ISIC sector as the outcome variable. Since a 4-digit product category itself encompasses an unobserved range of products, using this measure likely underestimates the true impact of credit constraints on product scope.

Consistently with Proposition 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 6). 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 9: A one-standard-deviation rise in the index of contract repudiation, for example, would increase 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 improvement in human capital would have comparable reallocation effects across sectors at different levels of human capital intensity, while the impact of a similar growth in physical capital would be about two-thirds smaller.

These results are robust to measuring product variety at a finer level of disaggregation. In Panel B of Table 6, 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.[31]

The results for exporters' product scope are closely related to the earlier finding that credit constraints distort countries' probability of exporting. Both patterns are consistent with the idea that financial frictions interact with firm heterogeneity and intensify the selection of firms into exporting. 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 for product variety controlling for firm selection into exporting with the predicted probability of exporting, the impact of credit constraints is substantially diminished (available on request).

The model also predicts that in the presence of stochastic trade costs, credit constraints will affect the stability of exporters' product mix over time. To examine product turnover, I focus on the sample of exporter-importer-sector triplets with positive trade flows in two consecutive periods. This ensures that any observed product churning is not driven by large adjustments in export conditions but characterizes an environment approximating steady-state equilibrium. I measure the product survival rate with the ratio of the number of products traded both this year and last year to the number of products sold last year. Similarly, I compute the product entry rate as the number of newly introduced products this period as a share of the number of products shipped last period.[32]

As Table 7 suggests, the exports of financially developed countries exhibit less product churning, and this effect is more pronounced in financially vulnerable sectors. In line with Proposition 6, the survival rate of products exported by financially advanced economies is higher in sectors with a greater need for external finance and in sectors with few collateralizable assets. The opposite is true of the product entry rate. These results are robust to controlling for other sources of comparative advantage, market size effects, bilateral distance, the importer's sectoral price index, and a full set of country, sector and year fixed effects. The patterns are also robust to the choice of financial contractibility measure or level of industry disaggregation.

In economic terms, the effects of credit market imperfections on export product churning are limited (Table 9). A one-standard-deviation improvement in financial development would boost product survival by only 1% more in a financially vulnerable sector (3rd quartile) compared to a financially less vulnerable sector (1st quartile). These effects are nevertheless similar to those of a one-standard-deviation change in physical or human capital endowments.

7.4 Trade partners and the pecking order of trade

Finally, I test the model's predictions for the number and type of countries' trade partners. Table 8 analyzes the systematic variation in trade partner intensity across exporting countries and sectors in the full sample and among observations with at least one destination (Panel A).

[31] All interaction terms in Panel B of Table 6 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.

[32] The same results obtain if I do not restrict the sample to triplets with positive trade in consecutive periods or if I define the entry rate as the share of newly introduced products in the total number of products this period.

In line with Proposition 7, I find that financially developed exporters enter significantly more markets in financially vulnerable industries. This result obtains after controlling for exporter, sector and year fixed effects, as well as for differences in factor endowments, other institutions, overall development and market size across exporting countries. The estimates are also robust to alternative measures of financial contractibility.[33]

Given the large effects of financial frictions on the probability of exporting, it is not surprising that their impact on trade partner intensity is also sizeable (Table 9). If a country improves its contract enforcement by one standard deviation, it could add 5-6 more destinations in a financially vulnerable sector (3rd quartile) relative to a less dependent industry (1st quartile). These estimates 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.

Proposition 8 states that while all exporters can enter large markets, financially advanced economies can also service smaller destinations, particularly in financially vulnerable sectors. Indeed, the market size of countries' largest trade partner does not vary systematically across exporters and sectors (Panel B). In contrast, the smallest market to which financially developed countries sell is significantly smaller in financially vulnerable sectors (Panel C).[34] Moreover, as the model predicts, this effect is largely driven by financially advanced economies exporting to more destinations: When I control for the number of trade partners, the minimum importer market size varies substantially less across countries and sectors (available on request).[35]

These results are consistent with the idea that bigger markets and the associated larger sales revenues there make it easier for exporters to cover fixed trade costs. This implies that, while financial development allows countries to export more products and more of each product to every market, its effect on product variety should be relatively more important for smaller export destinations. In unreported regressions, I have confirmed that this is indeed the case. This is congruent with the weaker effects of credit constraints on the range of products countries export to the large US market in Panel B of Table 6.

8 Conclusion

This paper examines the detrimental consequences of financial market imperfections for international trade. It 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

[33] All regressions in this section cluster errors by exporter.

[34] To ensure a range of market sizes among countries' export destinations, I restrict the sample to observations with more than 5 trade partners. I also take the GDP of the destination at the 10th percentile instead of the minimum to guard against idiosyncracies in export patterns. The results are robust to alternative subsampling and measures of the smallest market size.

[35] The pecking order of destinations based on market size alone holds for given trade costs. I have confirmed that the results in Table 8 obtain after adjusting destinations' size by their bilateral distance (available on request).

vulnerability. Applying this model to a large panel of bilateral exports for 27 industries in 1985-1995, I show that financial frictions impede firm selection into exporting as well as firm-level exports. As a result, weak financial institutions lead to fewer destination markets, lower aggregate trade volumes, reduced export product variety, and more frequent export product turnover. These distortions are magnified in financially vulnerable sectors.

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. In fact, 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 recent global financial crisis.

My analysis further indicates that the trade-specific effects of credit constraints act both on the extensive and intensive margins of trade. This implies that firms face credit constraints in the financing of both fixed and variable costs of exporting. The evidence also suggests that financial frictions influence trade dynamics in the presence of shocks to export profitability. These conclusions raise the possibility that financial underdevelopment could play an important role in the adjustment to trade reforms, exchange rate movements, and other cost or demand shocks. The policy implications of such impacts make them a fruitful area for future research.

9 Appendix A. 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 $K_t = I_t + \delta K_{t\square 1}$, where I_t is investment and δ is the depreciation rate. The initial capital stock K_o is computed as $I_0/(g+\delta)$, 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 $h = e\varphi(s)$, where s is the average years of schooling in the population over 25 years old, and $\varphi(s)$ 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.*

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Table 1. 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 by sector, as well as their export volumes, product scope and product churning in bilateral exports by sector. All summary statistics are for the sample with positive trade values, except for the first row in the table. Product churning by count is defined as the average of the number of products exported in 1994 which were discontinued in 1995 and the number of newly introduced products, as a share of the average number of products traded in 1994. Product churning by volume is the average of two ratios: the share of the volume of trade in products discontinued after 1994 to total bilateral exports in 1994, and the share of the volume of trade in newly introduced products to total bilateral exports in 1995. 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
Product churning						
SITC-4, by count	113,188	0.28	0.39	0.16	0	14
SITC-4, by value	113,188	0.16	0.28	0.12	0	1
HS-10, by count	3,550	0.57	0.46	0.29	0	10
HS-10, by value	3,550	0.34	0.36	0.25	0	1

Table 2. Financial Development and Export Volumes

This table examines the effect of credit constraints on export volumes. 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} proxy				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 3. Financial Development and Export Volumes: Robustness

This table examines the robustness of the effect of credit constraints on export volumes. 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 4. Financial Development 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 3. Errors clustered by exporter-importer pair. T-statistics in parenthesis. ***, **, and * indicate significance at the 1%, 5%, and 10% level.

Dependent variable: 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 5. Financial Development and Firm-Level Exports

This table examines the effect of credit constraints on 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 3. 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**	**0.369**	**0.012**	**0.277**
	(4.07)* **	**(10.22)*** **	**(4.71)*** **	**(5.80)*** **
Fin devt x Tang	**-0.803**	**-1.182**	**-0.052**	**-1.123**
	(-3.72)* **	**(-11.40)*** **	**(-7.78)*** **	**(-9.05)*** **
delta (from w_{ijs})	0.806	0.820	0.758	0.817
	(7.91)***	(8.25)***	(8.55)***	(8.24)***
eta_{ijs}	0.909	0.877	0.874	0.875
	(9.63)***	(9.49)***	(10.86)***	(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 5. Financial Development 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				
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 6. Financial Development 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 3. 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: (log) # SITC-4 products exported bilaterally by sector, full sample					
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: (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 7. Financial Development and Export Product Churning

This table examines the effect of credit constraints on product churning in exports. The dependent variable is the survival or entry rate of products exported by country *j* to country *i* in a 3-digit ISIC sector *s* and year *t*. The sample is limited to exporter-importer-sector triplets with positive trade in both *t* and *t-1*. Panel A covers the 1985-1995 period, while Panel B covers exports to the U.S. in 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 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 the bilateral distance, importer GDP and 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 3. 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. Level of disaggregation: 4-digit SITC products within 3-digit ISIC sectors, full sample					
Pr(Survival) = # Surviving Products / # Products Last Period , by sector					
Fin devt	-0.005	-0.029***			
Fin devt x Ext fin dep	0.072***	0.036***	0.024***	0.002***	0.031***
Fin devt x Tang	-0.086***	0.016	-0.023***	-0.002***	-0.033***
R-squared	0.14	0.15	0.15	0.16	0.15
Pr(Entry) = # New Products / # Products Last Period , by sector					
Fin devt	-0.017	0.003			
Fin devt x Ext fin dep	-0.129***	-0.046***	-0.033***	-0.003***	-0.053***
Fin devt x Tang	0.148***	0.029	0.040***	0.002**	0.068***
R-squared	0.09	0.09	0.09	0.10	0.09
Controls:		LGDPE, Exporter, Year and Sector FE, CPI x Sector FE K, H, L, LGDPCE, Institutions and Interactions			
# observations	686,650	522,910	531,403	488,554	531,403
# exporter-importer clusters	7,315	4,148	4,148	3,490	4,148
# exporters	107	42	42	34	42
Panel B. Level of disaggregation: 10-digit HS products within 3-digit ISIC sectors, exports to the U.S.					
Pr(Survival) = # Surviving Products / # Products Last Period , by sector					
Fin devt	0.003	0.011			
Fin devt x Ext fin dep	0.160***	0.114***	0.070***	0.004***	0.086***
Fin devt x Tang	-0.138**	-0.067	-0.065*	-0.006***	-0.082
R-squared	0.40	0.43	0.43	0.43	0.43
Pr(Entry) = # New Products / # Products Last Period , by sector					
Fin devt	-0.084	-0.104			
Fin devt x Ext fin dep	-0.236***	-0.126**	-0.103***	-0.004**	-0.115***
Fin devt x Tang	0.088	0.121	0.129**	0.008*	0.114
R-squared	0.19	0.21	0.21	0.23	0.21
Controls:		LGDPE, Exporter, Year and Sector FE, CPI x Sector FE K, H, L, LGDPCE, Institutions and Interactions			
# observations	11,735	6,429	6,511	5,407	6,511
# exporters	105	41	41	33	41

Table 8. Financial Development and Trade Partners

This table examines the effect of credit constraints on the number and size of countries' trade partners. In Panel A, the dependent variable is the number of country *j* 's export destinations in a 3-digit ISIC sector *s* and year *t* , 1985-1995. In Panel B, it is the (log) GDP of *j* ' biggest export partner in sector *s* and year *t* , 1985-1995. In Panel C, it is the (log) GDP of the country at the 10th percentile of the size distribution across *j* 's export partners in 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 include the exporters' (log) real GDP, 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 3. 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: # export destinations, by sector					
Whole sample					
Fin devt	-10.61**	-4.71			
Fin devt x Ext fin dep	**51.73*** **	**28.40*** **	**11.29*** **	**0.68*** **	**15.74*** **
Fin devt x Tang	**8.20**	**-12.92**	**-10.56*** **	**-0.65***	**-10.68***
R-squared	0.88	0.86	0.87	0.87	0.87
# observations	30,296	12,656	12,936	10,472	12,936
# exporters	107	42	42	34	42
Sample with at least one partner					
Fin devt	-2.23	-0.96			
Fin devt x Ext fin dep	**41.94*** **	**24.04*** **	**9.57*** **	**0.59*** **	**12.86*** **
Fin devt x Tang	**-17.04** **	**-22.68**	**-15.11*** **	**-0.87*** **	**-18.15*** **
R-squared	0.90	0.87	0.87	0.88	0.87
# observations	26,900	12,170	12,440	10,088	12,440
# exporters	107	42	42	34	42
Panel B. Dep variable: maximum (log) GDP across export partners, by sector					
Fin devt	-0.007	0.103			
Fin devt x Ext fin dep	**-0.059**	**0.078**	**-0.027**	**-0.002***	**-0.046**
Fin devt x Tang	**0.446*** **	**-0.251**	**0.060**	**0.005**	**0.246***
R-squared	0.27	0.34	0.34	0.46	0.34
# observations	20,991	11,819	12,089	9,961	12,089
# exporters	107	42	42	34	42
Panel C. Dep variable: 10th percentile of export partners' (log) GDP, by sector					
Fin devt	-0.313	-0.102			
Fin devt x Ext fin dep	**-0.335*** **	**-0.465*** **	**-0.172** **	**-0.015*** **	**-0.184***
Fin devt x Tang	**0.740*** **	**1.141** **	**0.477*** **	**0.028** **	**0.672*** **
R-squared	0.54	0.49	0.49	0.53	0.49
# observations	20,991	11,819	12,089	9,961	12,089
# exporters	107	42	42	34	42
Controls:		LGDPE, Exporter, Year and Sector Fixed Effects			
		K, H, N, LGDPCE, Institutions and Interactions			

Table 9. 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 2-8. 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. Bilateral Exports	15%	14%	20%	30%	-9%	32%
	2. Probability of Bilateral Exports	14%	6%	19%	17%	3%	15%
	3. (Avg.) Bilateral Firm Exports	6%	6%	15%	25%	-4%	30%
	4. Bilateral Export Product Variety	5%	3%	10%	8%	3%	11%
	5. Bilateral Export Product Survival	1%	1%	1%	1%	0%	2%
	6. Bilateral Export Product Entry	-2%	-1%	-2%	-1%	-1%	-2%
	7. Trade Partner Intensity	3.2	1.6	5.7	4.8	-0.2	4.4

Table 10. Economic Significance: Predicted vs. Actual Trade Growth

This table examines the predictive power of improvements in financial development and changes in factor endowments 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 2 and 3. 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:	Change in Fin Development	0.92***		1.02***	0.47***		0.40***
	Change in Factor Endowments		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. Private Credit in the Sample

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 in the data

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	N	Average	Standard Deviation	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 report the cross-sector mean and standard deviation of these measures.

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. 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 5 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 total 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. More flexible specification: 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. Most flexible specification: OLS with 50 bins for predicted probability				
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%			

Figure 1. 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=0.4303.

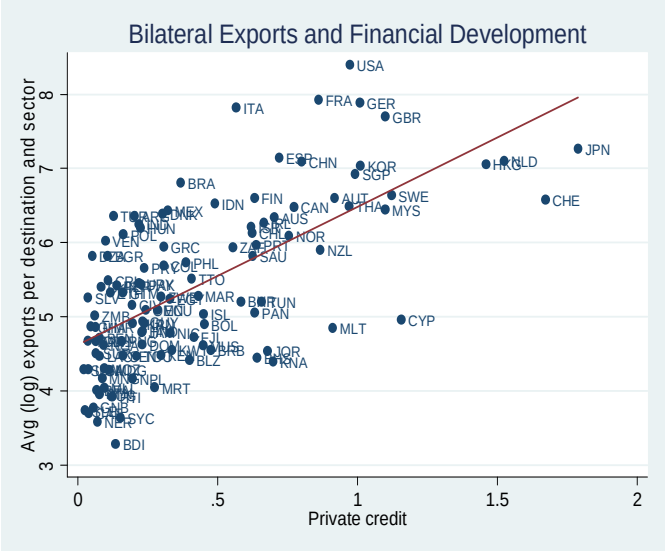

Figure 2. Bilateral Exports and Sectors' Financial Vulnerability

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).

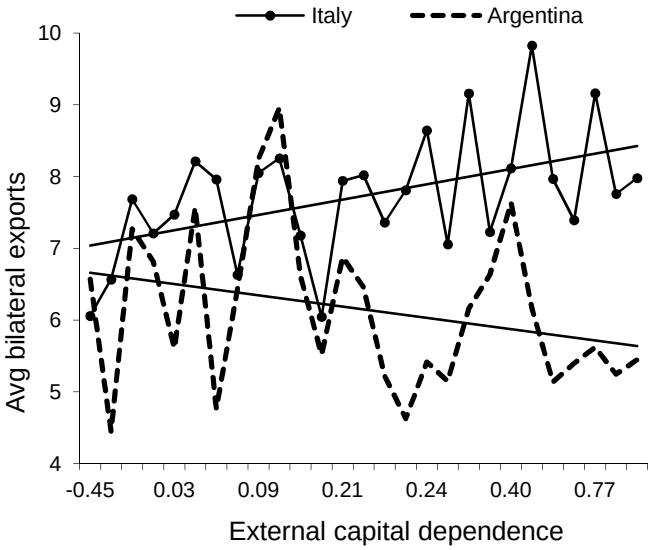

Figure 3. The Productivity Cut-off for Exporting

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 3A) and of both fixed and variable costs (Figure 3B). Figure 3B also shows the lower profits earned by firms with productivity below the cut-off for exporting at first-best levels.

Figure 3A

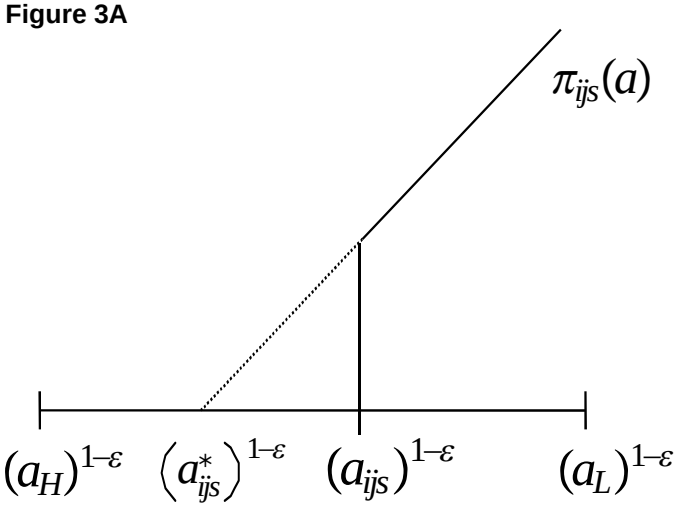

Figure 3B