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CREDIT CONSTRAINTS, HETEROGENEOUS FIRMS, AND INTERNATIONAL TRADE

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ABSTRACT

Three fundamental features of international trade flows are a predominance of zeros in the bilateral trade matrix, great variation in the number of products countries export, and substantial turnover in the product mix of exports over time. This paper provides evidence that credit constraints are an important determinant of all three patterns. I develop a model with credit-constrained heterogeneous firms, countries at different levels of financial development, and sectors of varying financial vulnerability, and find strong empirical support for the model's predictions. First, I show that financially developed countries are more likely to export bilaterally and ship greater volumes when they become exporters. This effect is more pronounced in sectors with a greater requirement for outside finance or fewer collateralizable assets. Firm selection into exporting accounts for a third of the effect of credit constraints on export volumes, whereas two thirds are due to the impact on firm-level exports. Second, in financially vulnerable sectors, financially developed countries export a wider variety of products and experience less product turnover in their exports over time. Finally, credit constraints lead to a pecking order of trade. While all countries export to large destinations, financially advanced countries have more trading partners and also export to smaller import markets, especially in financially vulnerable sectors.

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1 Introduction

Three stylized facts describe fundamental features of international trade patterns: First, while most countries export to at least one destination in each sector, they export to only a quarter of all potential trade partners in an average sector. Second, there is significant variation in export volumes and the range of products exported across country pairs and sectors. Finally, there is substantial turnover in the product composition of exports over time. More than a quarter of all bilaterally exported products are discontinued from one year to the next and replaced by new ones, resulting in the reallocation of 16% of bilateral trade by value.[1]

This paper provides evidence that credit constraints are an important determinant of global trade flows and contribute to all three stylized facts. I develop a model with credit-constrained heterogeneous firms, countries at different levels of financial development, and sectors of varying financial vulnerability. This model delivers rich empirical predictions for export patterns which find strong support in the data.

In the model, credit constraints affect firms in different countries and sectors differentially. In particular, for technological reasons, firms in some sectors need to finance a greater share of their export costs externally. In addition, sectors differ in their endowment of tangible assets that can serve as collateral. Thus, entrepreneurs find it easier to start exporting in some sectors because they need to raise less outside finance or because potential investors expect a higher return in case of default. Similarly, credit constraints vary across countries because contracts between firms and investors are more likely to be enforced at higher levels of financial development. If the financial contract is enforced, the firm makes a payment to the investor; otherwise the firm defaults and the creditor claims the collateral. Firms therefore find it easier to obtain external finance in countries with high levels of financial contractibility.

In the absence of credit constraints, all firms with productivity above a certain cut-off level become exporters as in Melitz (2003). Credit constraints, however, interact with firm heterogeneity and reinforce the selection of only the most productive firms into exporting: Because more productive firms raise higher revenues, they can offer creditors a greater return in case of repayment and are hence more likely to secure the outside capital necessary for exporting. The model thus predicts that the productivity cut-off for exporting varies systematically across countries and sectors. It is higher in financially vulnerable industries which require a lot of outside finance or have few collateralizable assets, and is lower in countries with high levels of financial contractibility. Importantly, the effect of financial development is more pronounced in financially vulnerable sectors.

Embedding credit constraints in this heterogeneous-firms model delivers rich empirical predictions. Countries are more likely to export to any given trade partner in a financially vulnerable sector if they are more financially developed. Credit constraints thus help explain the many in-

[1] These statistics are for sectors in the 3-digit ISIC industry classification and for products in the 4-digit SITC categorization. See also below.

stances of zero bilateral export flows, the asymmetric cases of country pairs with positive exports in only one direction, and the systematic variation in these patterns across countries and sectors. Given positive exports, the model also predicts that in financially vulnerable sectors more firms become exporters and export greater volumes when located in more financially developed countries. It follows that financially developed countries export a wider variety of products and relatively higher volumes in financially vulnerable sectors.

Conceptually, the model builds on Helpman, Melitz and Rubinstein (2008) (henceforth HMR), who consider a one-sector economy and show that the combination of fixed costs of exporting and firm heterogeneity can explain the selection of countries into exporting, as well as the volumes that countries export. This paper demonstrates that incorporating financial frictions in the HMR framework can rationalize the systematic variation in export patterns across sectors at different levels of financial vulnerability and countries at different levels of financial development.

To account for product turnover in exports over time, I extend the model and consider how shocks to trade costs affect exports in the presence of credit constraints. When firms observe either a high or a low fixed cost of exporting, two productivity cut-offs describe trade participation. While very productive firms always export, a band of firms with intermediate productivity levels only export when they face a low cost and exit otherwise. I show that firm survival is higher and, consequently, product churning is lower in financially developed countries, and especially so in financially vulnerable sectors.

The final implication of the model is that credit constraints lead to a pecking order of trade, in which market entry depends on the exporter's level of financial development and the importer's market size. Because firms' revenues increase with the size of the destination country, the productivity cut-off for exporting is lower for larger target markets. Thus, while most countries can export to large destinations, financially advanced countries have more trade partners and also export to smaller import markets, especially in financially vulnerable sectors.

I find strong support for the model's predictions in a panel of bilateral exports for 107 exporting countries and 27 3-digit ISIC sectors in 1985-1995.[2] In particular, I study how interactions of country level measures of financial development and sector level indicators of financial vulnerability predict export outcomes. I explicitly account for countries' output by sector, and isolate the effect of credit constraints on exporting above and beyond their impact on domestic production. The analysis also controls for traditional sources of comparative advantage (factor endowment differences), and identifies the effect of financial development separately from that of overall development as proxied by GDP per capita.

As my main measure of financial contractibility I use the amount of credit extended to the private sector as a share of GDP, and show consistent results with indices of contract repudiation, accounting standards, and the risk of expropriation. As in the model, sectoral financial vulnerability is measured by two variables. External finance dependence reflects the share of

[2] All of my results also hold in the cross-section for individual years.

investment not financed from internal cash flows. Asset tangibility, on the other hand, is the share of plant, property and equipment in total assets. Both measures are taken for the median US firm in a given sector between 1985-1995 based on Compustat data.

I find that credit constraints affect international trade patterns in the data in three important ways. First, credit constraints hinder selection into exporting and help explain the many cases of zero bilateral trade flows: Financially developed countries are more likely to export bilaterally and ship greater volumes when they become exporters. This effect is more pronounced in sectors with a greater need for outside finance or fewer collateralizable assets. I combine data on zero and positive bilateral exports in a structural two-stage estimation, and show that a third of the effect of financial development on trade volumes is attributable to firm selection into exporting, while two-thirds are due to the impact of credit constraints on firm-level exports. These results suggest that firms face credit constraints in the financing of both fixed and variable export costs.

Second, in line with the predictions of the model, I find that credit constraints limit product variety and increase product churning in bilateral exports. In the absence of systematic cross-country firm-level data, I take the number of 4-digit SITC products exported bilaterally within a sector as a measure of the extensive margin of trade. For exports to the U.S., I also study the number of 10-digit HS products by sector. I show that financially developed countries export a wider array of goods in financially vulnerable sectors. In addition, products originating in financially developed exporters are more likely to survive over time, and especially so in financially vulnerable sectors. These results indicate that credit constraints matter in the presence of stochastic costs (or other disturbances to export profitability) and are an important determinant of export dynamics.

Finally, I offer evidence for the pecking order of exporting predicted by the model. I show that the more financially advanced an exporter is, the more countries it sells to and the smaller the minimum GDP among its trade partners. These effects are again stronger in financially vulnerable sectors. At the same time, there is no systematic variation in the size of an exporter's largest import market across exporting countries and sectors. This result is consistent with the idea that larger expected revenues make it easier for exporters to cover fixed costs.

This paper contributes to a small but growing literature on financial institutions and trade. There has been robust empirical evidence that financially developed countries export relatively more in financially vulnerable sectors (Beck, 2002, 2003; Becker and Greenberg, 2005; Svaleryd and Vlachos, 2005; Hur et al., 2006). While all prior studies focus on export volumes, I explore the product composition of exports, product churning over time, and the prevalence of no trade (zeros) in the matrix of bilateral exports by sector. This allows me to study how credit constraints interact with firm heterogeneity and characteristics of trade partners to explain not only export volumes but many other trade patterns as well. In current work, Manova et al. (2008), Muuls (2008) and Greenaway et al. (2007) find consistent evidence of the effects of credit constraints

on exporting at the firm level.[3,4]

A number of theoretical models have also been presented, with the common feature that financial development becomes a source of comparative advantage in the presence of credit constraints (Kletzer and Bardhan, 1987; Beck, 2002; Matsuyama, 2004; Ju and Wei, 2005; Becker and Greenberg, 2005). The Ricardian representative-firm nature of these models, however, delivers the counterfactual prediction that either all or no producers in a given sector export. Chaney (2005) studies liquidity-constrained heterogeneous firms without modeling financial contracts or cross-sector differences explicitly. In contrast, I explicitly model sectoral variation in external finance dependence and asset tangibility in a framework with firm heterogeneity to distinguish between the extensive and intensive margins of trade.

My empirical results extend recent work on the intensive and extensive margins of trade. In a large sample of bilateral exports, Hummels and Klenow (2004) find that richer economies export a wider variety of products. On the other hand, Schott (2004) documents that most countries export the same products to the U.S..[5] In my analysis, I control for the impact of income per capita on the composition of countries' exports, and show an independent effect of financial development on the variety of products traded. In addition, my findings on the pecking order of trade can reconcile the results in these two studies.

The evidence I find in support of a pecking order of trade is also consistent with the results in Eaton et al. (2004a,b) that larger and more productive French firms export to a greater number of destinations and to smaller country markets. My model demonstrates how credit constraints and firm heterogeneity magnify these effects, and my empirical analysis generalizes their results to sector-level trade in the full matrix of bilateral exports.

My results on product turnover complement the evidence in Bernard et al. (2005), Bernard and Jensen (2004) and Allessandria and Choi (2007) on the importance of firm entry, death, and reentry into exporting, and the results on product survival in Besedes and Prusa (2006a,b, 2007). My findings may also help explain why product switching is an important margin of adjustment for US manufacturing firms, as Bernard et al. (2005) document. While I model firms as producers of unique products, a richer framework would deliver predictions for within-firm product churning in the presence of credit constraints.

My findings complement an earlier literature on the role of sunk costs and hysteresis in

[3] Manova (2005) shows that equity market liberalizations increase countries' exports relatively more in financially vulnerable sectors. This suggests that foreign capital provides an alternative source of external financing and can compensate for underdeveloped local financial markets. Some have also speculated that multinationals and large conglomerates may emerge endogenously in financially underdeveloped countries to provide firms with more internal financing.

[4] Financial development has been shown to affect aggregate growth and volatility (Rajan and Zingales, 1998; Braun, 2003; Aghion et al., 2006), as well as the patterns of multinational firm activity and foreign direct investment flows (Antras et al., 2006; Chor et al., 2006).

[5] Broda and Weinstein (2005) analyze the welfare benefits of the increased product variety in U.S. imports. Amiti and Freund (2007) find that most of China's export growth occurred on the intensive margin. Baldwin and Harrigan (2007) study missing trade and export unit values for product-level U.S. exports and imports.

exporting.[6] In a dynamic context credit constraints in the financing of sunk costs reinforce the effects of financial development on firm entry into exporting. In contrast, the impact of financial development on product turnover may become ambiguous: While financial development would still improve firm survival by facilitating the financing of temporary cost shocks, it would also ease the financing of sunk costs, thereby lowering the option value of exporting during bad times and encouraging temporary exit.

More broadly, this paper adds to a line of research examining the impact of institutional frictions on international trade flows (Nunn, 2005; Claessens and Laeven, 2003; Levchenko, 2007). Whereas these prior studies focus on export volumes, I explore the impact of financial institutions on a variety of export patterns. My empirical analysis ensures that the effects of financial development do not capture the role of other institutions.

I next take a first motivating glance at export patterns in the data before developing the model of credit-constrained heterogeneous firms in Section 3. I introduce the estimation approach in Section 4, discuss the data in Section 5, and present my empirical results in Section 6. The last section concludes.

2 A first glance at the data

There is tremendous systematic variation in export patterns across countries at different levels of financial development and across sectors at different levels of financial vulnerability. This section presents basic summary statistics and highlights some simple correlations in the data which serve as motivation for the theoretical model and more rigorous empirical analysis to follow. For clarity, I focus on trade flows in one year of data, 1995.

Table 1 describes the export behavior of 161 countries in 27 manufacturing sectors. Sectors are defined in the 3-digit ISIC industry classification. Most countries export to at least one destination in each industry, and only 15% of the exporter-sector cells show no trade. However, there is a lot of variation in the number of trade partners across exporting countries and sectors. On average, a country exports to 36 destinations 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 3-digit sector level: 75% of all exporter-importer-sector triplets are zeros. Moreover, there are many asymmetric cases in the data in which trade flows in only one direction between a pair of countries. This is true for individual sectors, as well as at the aggregate country level.

Focusing on positive bilateral trade flows, there is significant variation in export volumes and the range of products exported across countries and sectors. Detailed bilateral trade data is available at the 4-digit product group level in the SITC classification system, which I match to 3-

[6] See Baldwin (1989), Dixit (1989a,b), Roberts and Tybout (1997), and Allessandria and Choi (2005) on hysteresis in exporting and Hopenhayn (1992) on firm dynamics in the absence of credit constraints. Albuquerque and Hopenhayn (2004) and Costantini (2005) analyze firm dynamics with credit constraints.

digit ISIC sectors. Within a sector, an average exporter sells 5.34 product groups to a destination market, with a standard deviation of 6.61. Trade flows at a finer level of disaggregation are available for exports specifically to the U.S.. On average, countries sell 64 10-digit products to the U.S. within each industry, with a standard deviation of 148 products.

The product mix of countries' exports changes substantially over time. More than a quarter of all 4-digit product groups exported bilaterally are discontinued from one year to the next and replaced by new ones. At the 10-digit product level, countries replace more than half of all products they export to the U.S. each year. However, the survival rate of products varies significantly across sectors and exporting countries. While the prior literature has not emphasized product churning in export flows, understanding how and why product composition changes is important: 16% of the value of one-way bilateral trade in an average sector is reallocated across 4-digit product groups each year. This figure rises to 34% in the more finely disaggregated data for exports to the U.S..

The variation in the data across countries and sectors is not random. Financially developed countries 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) export to a greater number of destinations. Financially developed countries also export greater values and a wider variety of products. Figure 2 illustrates how the average value of bilateral exports from country j across sectors and importing countries varies with the level of financial development in j. Similarly, Figure 3 plots the average number of 4-digit SITC product groups j exports across trade partners and sectors. Both scatter plots are upward sloping. Finally, Figure 4 demonstrates that financially developed countries experience less product churning in their exports over time. The y-axis indicates the percentage share of trade value reallocated across 4-digit SITC product groups from one year to the next in the exports of country j to country i and sector s. This percentage has been averaged across importers, sectors, and years in the 1985-1995 period.

While these graphs suggest that export patterns vary systematically with the exporter's level of financial development, they do not explore the variation across sectors. Compare then the export outcomes for two countries: Italy (70th percentile by private credit) and Argentina (40th percentile by private credit). In Figure 5 I order sectors by their external finance dependence and plot the number of countries Italy and Argentina export to in each sector. Italy, the financially advanced country, exports to more countries than Argentina in all sectors, but its advantage is more pronounced in financially vulnerable sectors. The following three graphs show similar patterns. Italy exports more and a wider variety of products to an average trade partner than Argentina, but this advantage is greater for sectors intensive in external finance (Figures 6 and 7). Finally, product churning is lower in Italy's exports, and especially so in financially vulnerable sectors (Figure 8).

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 6 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 this systematic variation in zero bilateral exports, product variety and product churning across countries and sectors.

3 A model of credit constraints in trade

I incorporate credit constraints in a multi-sector application of the Melitz (2003) model of international trade with heterogeneous firms.[7]

3.1 Set up

Consider a world with J countries and S sectors. A continuum of heterogeneous firms produces differentiated goods in each country and sector, and the varieties produced by country j are distinct from those of country i.

Consumers exhibit love of variety and consume all available differentiated products in each sector. The utility function for country j is given by a Cobb-Douglas aggregate over sector-specific CES consumption indices C_{js}:

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

where $q_{js}(\omega)$ represents the consumption by country j of variety ω in sector s, and Ω_{js} is the set of varieties available to j in that sector. The constant elasticity of substitution across varieties is given by $\varepsilon = 1/(1-\alpha) > 1$ with $0 < \alpha < 1$. The parameters θ_s indicate the share of each sector in total expenditure and satisfy $\sum_s \theta_s = 1$, $0 < \theta_s < 1$. With this utility function, if total income (expenditure) on all goods in country j is Y_j, j's demand for variety ω in sector s is

$$q_{js}(\omega) = \frac{p_{js}(\omega)^{-\varepsilon} \theta_s Y_j}{P_{js}^{1-\varepsilon}}, \text{ where } P_{js} = \left[\int_{\omega \in \Omega_{js}} p_{js}(\omega)^{1-\varepsilon} \, d\omega \right]^{\frac{1}{1-\varepsilon}} \tag{1}$$

is the country's ideal price index in sector s, and $p_{js}(\omega)$ is the price of that variety in country j.

Firms incur a sunk cost to enter an industry before learning their productivity level. They then produce for the domestic market and potentially export. I analyze a static framework in which firms' decisions in each period are independently taken.[8]

3.2 Domestic producers

Production for the domestic market involves a constant marginal cost which is lower in more productive firms. In particular, the cost of producing one unit of output to a firm with pro-

[7] See Bernard et al. (2007) for a multi-sector extension of the Melitz (2003) model with firm heterogeneity and factor endowments as a source of comparative advantage. I abstract from factor intensity differences across sectors in the model, but take them into account in the empirical analysis.

[8] I present a partial-equilibrium analysis; in a general-equilibrium framework, sunk costs pin down a free entry condition and the predictions of the model do not change qualitatively.

ductivity level $1/a$ is $c_{js}a$, where c_{js} represents the cost of a cost-minimizing bundle of inputs specific to the country and sector of the firm. For convenience, I express the sunk cost of entry $c_{js}f_{ej}$ in units of the same bundle. While c_{js} captures differences in factor prices across countries and differences in factor intensities across sectors, a is firm specific and reflects productivity differences across firms. Productivity draws have a cumulative distribution function $G(a)$ with support $[a_L, a_H]$, $a_H > a_L > 0$. Since aggregate productivity differences across countries and sectors are subsumed in the c_{js} parameters, $G(a)$ is assumed to be the same across countries.

There is overwhelming evidence that credit constraints affect firms' investment and production decisions, and that this impact varies across sectors.[9] To focus on the impact of credit constraints on export patterns above and beyond their effect on production for the domestic market, I assume for simplicity 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. None of the implications of the model change qualitatively if these assumptions are relaxed. Let N_{js} be the measure of firms producing in country j and sector s, each supplying a differentiated product.

3.3 Credit constrained exporters

Firms can export their products to other countries. Exporting from country j to country i is associated with a fixed cost $c_{js}f_{ij}$ in each period, where $f_{ij} > 0$ for $i \neq j$ and $f_{jj} = 0$. Moreover, there is a variable iceberg trade cost so that $\tau_{ij} > 1$ units of a product need to be shipped for 1 unit to arrive. Note that f_{ij} and τ_{ij} are country-pair specific, and that the first subscript i indicates the destination market (importer), while the second subscript j signals the producing country (exporter).

Firms face credit constraints in the financing of trade costs. I begin by assuming that all firms in a given sector can finance their variable costs internally, but they need to raise outside capital for a fraction d_s, $0 < d_s < 1$, of the fixed export costs. Firms in country j producing in sector s therefore have to borrow $d_s c_{js} f_{ij}$ to export to country i. In Section 3.5 below I relax this assumption, and posit that firms face credit constraints in the financing of both fixed and variable costs of trade.

The underlying assumption is that firms cannot use profits from one period 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.[10] Alternatively, d_s is the fraction of fixed export costs that needs to be financed externally after all retained earnings from the previous period have been used up. This way of modeling financial constraints is akin to firms experiencing liquidity constraints because of up-front costs which they can cover after revenues

[9] For example, Rajan and Zingales (1998), Fisman and Love (2004a,b), and Braun (2003) show that sectors intensive in outside finance and sectors with few collateralizable assets grow faster in financially developed countries.

[10] In the presence of principal-agent problems, for example, stockholders may demand dividends at the end of each period instead of entrusting management with the utilization of retained earnings.

are realized but cannot finance internally in advance. For example, firms may need to learn about the profitability of potential export markets, make export-specific investments in capacity or product customization, or set up distribution networks. 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. This fraction corresponds to the measure of asset tangibility in my empirical analysis, and is also assumed to be inherent to the nature of the industry, as proposed by Braun (2003) and others.[11,12]

Finally, countries vary in their level of financial contractibility. In particular, 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. With probability $(1 - \lambda_j)$ the financial contract is not enforced, the firm defaults, and the creditor claims 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 part of the sunk investment.

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.

Profit-maximizing exporters from country j then choose their price and output levels in destination country i by solving

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

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

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

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

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

[11] 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.

[12] Firms may have an incentive to overinvest in tangible assets to increase their capacity for raising outside finance. This will be costly if firms face credit constraints in the financing of entry costs and since firms' asset structure will deviate from profit-maximizing levels.

In the absence of credit constraints, exporting firms 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 extend finance to the firm if they expect to at least break even. Since $B_{ijs}(a)$ represents the financier's net return, restriction (3) expresses his participation constraint, normalizing his outside option to 0.[13]

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 investor to his participation constraint. Thus, in equilibrium $B_{ijs}(a) = 0$, and the maximization problem reduces to the firm's problem in the absence of financial frictions except for the credit constraint that $F(a)$ be no greater than the firm's net revenues. Hence, exporting firms optimally choose the same export quantities and prices, raise the same export revenues and earn the same profits from exporting as in Melitz (2003):

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

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

In the absence of credit constraints, this profit function defines a productivity cut-off $1/a^*_{ijs}$ above which all firms find it profitable to export, given by $r_{ijs}\left(a^*_{ijs}\right) = \varepsilon c_{js} f_{ij}$. Since revenues are increasing in productivity, low-productivity firms do not export because their foreign sales would be insufficient to cover the fixed cost of trade.

The familiar result that more productive firms have higher sales has further implications when firms face credit constraints. While all firms in a given sector have the same financing needs and collateralizable assets, more productive firms can offer investors greater returns in case of repayment. Hence, there are firms who could profitably export in the absence of credit constraints but are not productive enough to obtain sufficient outside finance. Such firms find that, even if they offer all net revenues to the investor in case of repayment, he cannot break even. In line with a large volume of literature in corporate finance, the model thus predicts that larger, more productive firms are less likely to be credit constrained.[14]

As a result, in the presence of credit constraints a new, higher productivity cut-off for exporting $1/a_{ijs}$ governs firms' decisions. This productivity cut-off is given by the condition $A_{ijs}(a_{ijs}, p_{ijs}(\cdot), q_{ijs}(\cdot), B_{ijs}(a_{ijs}) = 0) = F(a_{ijs})$, or equivalently,

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

Note that with perfect financial contractibility ($\lambda_j = 1$) the model reduces to the original Melitz

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

[14] See, for example, Beck et al. (2005a,b), and Forbes (2007).

(2003) formulation, $r_{ijs}\left(a^*_{ijs}\right) = \varepsilon c_{js} f_{ij}$. Hence, in this framework liquidity constraints only have an impact on the real economy to the extent that financial contracts are not perfectly enforced.

Since no firm with productivity level below $1/a^*_{ijs}$ can profitably export, the productivity cut-off for exporting cannot be lower than $1/a^*_{ijs}$ when firms face credit constraints. It is strictly higher ($1/a^*_{ijs} < 1/a_{ijs}$) whenever $d_s f_{ij} > t_s f_{ej}$. Intuitively, credit constraints bind and affect export participation whenever firms need to borrow more than what they can offer in the form of collateral. In view of my findings and results in the prior trade and finance literature, I assume that this condition holds in the rest of the analysis.

3.4 Entry into exporting

Figure 9 illustrates the wedge between the productivity cut-offs for exporting with and without credit constraints. The diagram shows export profits as a function of firm productivity for a firm exporting from country j to county i in sector s. While potential export profits are nonzero for all firms with productivity greater than $1/a^*_{ijs}$, only those with productivity above $1/a_{ijs}$ successfully obtain outside finance and export abroad.

Since revenues are increasing in productivity, all else equal the effects of financial contractibility and industry characteristics on the productivity cut-off in (4) can be signed:

$$\frac{\partial\left(1/a_{ijs}\right)}{\partial \lambda_j} \propto \frac{\varepsilon\left(t_s c_{js} f_{ej} - d_s c_{js} f_{ij}\right)}{\lambda_j^2} < 0, \tag{5a}$$

$$\frac{\partial\left(1/a_{ijs}\right)}{\partial d_s} \propto \frac{\varepsilon\left(1-\lambda_j\right)}{\lambda_j} c_{js} f_{ij} > 0, \qquad \frac{\partial^2\left(1/a_{ijs}\right)}{\partial d_s \partial \lambda_j} \propto -\frac{\varepsilon}{\lambda_j^2} c_{js} f_{ij} < 0, \tag{5b}$$

$$\frac{\partial\left(1/a_{ijs}\right)}{\partial t_s} \propto -\frac{\varepsilon\left(1-\lambda_j\right)}{\lambda_j} c_{js} f_{ej} < 0, \qquad \frac{\partial^2\left(1/a_{ijs}\right)}{\partial t_s \partial \lambda_j} \propto \frac{\varepsilon}{\lambda_j^2} c_{js} f_{ej} > 0. \tag{5c}$$

Proposition 1 *Under credit constraints, the productivity cut-off for exporting is lower in financially developed countries. Within each country, this cut-off is higher in sectors with a greater need for external finance and in sectors with few tangible assets. The effect of these sector characteristics is muted in financially more developed countries.*

Intuitively, how likely a firm is to be credit constrained depends on the industry it enters. For any productivity level investors are more willing to lend to firms in sectors that require less outside financing (d_s lower) or have more collateralizable assets (t_s higher). Moreover, these sectoral characteristics are more relevant the lower financial contractibility λ_j is. Thus, firms in financially vulnerable sectors find it relatively easier to start exporting in countries with a more developed financial system. Credit constraints therefore redistribute exports in two ways: towards sectors with more tangible assets and lower reliance on outside funds, and towards more productive firms within a sector.

HMR show that a combination of firm heterogeneity and fixed costs of exporting can rationalize the many cases of zero bilateral exports. They note that when the productivity cut-off

for exporting from country j to country i is too high, no firm will be productive enough to export, resulting in no trade from j to i. Moreover, symmetric trade costs ($f_{ij} = f_{ji}$, $\tau_{ij} = \tau_{ji}$) may have asymmetric trade outcomes, with i exporting to j even if j does not sell to i. A first implication of the model developed above is that credit constraints contribute to the selection of firms into exporting, and provide extra leverage in understanding the patterns of zero trade across countries and sectors. In particular, given the productivity distribution $G(a)$, country j will export to country i in sector s only if there are at least some firms with productivity above the $1/a_{ijs}$ cut-off. Proposition 1 therefore implies the following for the probability of exporting:

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.*

A second implication of the model, closely linked to the selection of firms and countries into exporting, concerns the variety of products traded. The model identifies firms with the differentiated products they produce. Therefore, the lower the productivity cut-off for exporting, the greater the number of firms which export and the richer the variety of products countries sell. Thus, the same comparative statics that determine $1/a_{ijs}$ apply to the product variety of countries' exports as well.

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

3.5 Credit constraints and firm-level exports

In the framework developed above, credit constraints restrict the number of firms that become exporters but do not affect firm-level exports. Financial frictions may reduce firm-level exports, however, if firms face credit constraints in the financing of both fixed and variable costs.

I now relax the assumption that firms finance variable costs internally and posit that firms in sector s need to raise outside capital for a fraction d_s of all export costs. This affects firm profits, investors' expected returns, and the condition that the investors' repayment when the contract is enforced be no greater than the firm's net revenues.

In this case two productivity cut-offs characterize firm export participation, as illustrated in Figure 10 which graphs export profits as a function of firm productivity. 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 $1/a_{ijs}^H$ do not earn sufficient export revenues to repay the investor if they export at first-best levels. Instead, they optimally reduce their export scale from the unconstrained maximum. This occurs because when firms need external capital to finance variable costs, exporting larger quantities requires more outside finance. This increases the repayment $F(a)$ necessary to meet the investor's participation constraint,

and reduces the set of firms able to raise sufficient outside capital to export. By adjusting their export quantities, firms with an intermediate productivity level ensure that they can earn some export profits, albeit lower than the first-best.

Appendix A formalizes this intution and shows that the comparative statics in the previous section hold for both the productivity cut-off for exporting $1/a_{ijs}^L$ and the cut-off for exporting at first-best levels $1/a_{ijs}^H$. In other words, more firms in financially vulnerable sectors will be able to export and to export at optimal levels if they are from financially developed countries.[15]

One can show that the export quantities and revenues for firms exporting at second-best levels vary systematically across countries and sectors. They are lower for firms in financially underdeveloped countries and for firms in sectors that are intensive in external finance or have few tangible assets. Export quantities and revenues are particularly low in financially vulnerable sectors for firms located in financially underdeveloped countries. The opposite effects hold true for export prices.

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, and especially so in financially vulnerable sectors.*

3.6 Bilateral export volumes

The model generates predictions for how exports will vary across exporting countries and sectors. The value of exports by all firms exporting at first-best levels is given by $\left(\frac{\tau_{ij}c_{js}}{\alpha P_{is}}\right)^{1-\varepsilon}\theta_s Y_i N_{js}\int_{a_L}^{a_{ijs}^H} a^{1-\varepsilon}dG(a)$. Similarly, the value of exports by firms exporting at second-best levels can be expressed as $\left(\frac{\tau_{ij}c_{js}}{\alpha P_{is}}\right)^{1-\varepsilon}\theta_s Y_i N_{js}\int_{a_{ijs}^H}^{a_{ijs}^L}\beta_{ijs}(a)a^{1-\varepsilon}dG(a)$, where $0<\beta_{ijs}(a)<1$ reflects these firms' reduced export scale. Thus, the total value of country i's imports from j in sector s is

$$M_{ijs}=\left(\frac{\tau_{ij}c_{js}}{\alpha P_{is}}\right)^{1-\varepsilon}\theta_s Y_i N_{js} V_{ijs} E_{ijs}, \tag{6}$$

$$\begin{aligned}\text{where } V_{ijs} &= \begin{cases}\int_{a_L}^{a_{ijs}^L} a^{1-\varepsilon}dG(a) & \text{for } a_{ijs}^L \geq a_L\\ 0 & \text{otherwise}\end{cases},\\ \text{and } E_{ijs} &= \left[\frac{\int_{a_L}^{a_{ijs}^H} a^{1-\varepsilon}dG(a)+\int_{a_{ijs}^H}^{a_{ijs}^L}\beta_{ijs}(a)a^{1-\varepsilon}dG(a)}{\int_{a_L}^{a_{ijs}^L} a^{1-\varepsilon}dG(a)}\right].\end{aligned}$$

[15] The differential impact of financial development on $1/a_{ijs}^L$ across sectors at different levels of external finance dependence is theoretically ambiguous. This occurs because more productive firms can offer greater revenues in case of repayment, but they also require more external capital for their variable costs since they operate at a larger scale. Appendix A presents the condition necessary for $\frac{\partial^2\left(1/a_{ijs}^L\right)}{\partial d_s \partial \lambda_j}<0$ to hold. Given results in the corporate finance literature that larger, more productive firms are less likely to be credit constrained, as well as my results in Section 6 below, I assume that this condition is satisfied.

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 and we observe $M_{ijs} = 0$. The variable V_{ijs} is thus a direct measure of the selection of firms into exporting, and is a monotonic function of 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 the comparative statics for a_{ijs}^L, the following proposition is true for exporting countries small enough to take the price index in the destination market P_{is} as given.

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.*

Proposition 5 indicates that financially developed countries have a comparative advantage in sectors that require more outside finance and in sectors with few collateralizable assets.

4 Empirical specification

This model has a number of empirical predictions for the effect of financial development on the industry composition of countries' exports. In addition, because the model features firm heterogeneity, the differential effects of credit constraints on the extensive and intensive margins of exports can be examined. This section derives a parameterized estimation procedure for the model's predictions.

4.1 Firm selection into exporting

I begin by testing the model prediction that the productivity cut-off for exporting and thus the probability of positive bilateral trade varies systematically across countries and sectors.

I define a latent variable Z_{ijs} which is a monotonic transformation of the productivity cut-off for exporting $1/a_{ijs}^L$:

$$Z_{ijs} = \frac{\lambda_j (1-\alpha) \left(1 - d_s + \frac{d_s}{\lambda_j}\right)^{1-\varepsilon} \left(\frac{\alpha P_{is}}{\tau_{ij} c_{js}}\right)^{\varepsilon-1} \theta_s Y_i a_L^{1-\varepsilon}}{[d_s + \lambda_j(1-d_s)]\, c_{js} f_{ij} - (1-\lambda_j)\, t_s c_{js} f_{ej}} = \left(\frac{a_{ijs}^L}{a_L}\right)^{\varepsilon-1}. \tag{7}$$

Z_{ijs} captures the ratio of the productivity of the most productive firm, $1/a_L$, to the cut-off productivity for exporting. Remember that the cumulative distribution function for productivity $G(a)$ has support $[a_L, a_H]$, $a_H > a_L > 0$. Hence, 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. Z_{ijs} thus reflects the selection of both individual firms and countries into exporting.

I test Propositions 1 and 2 by log-linearizing (7) and estimating it with a Probit specification. Following HMR, I assume that both variable and fixed export costs are characterized by

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

I assume the terms in λ_j, d_s, and t_s in (7) can be expressed as a function of observed measures of country-level financial development $FinDevt_j$ and sectoral indicators of external finance dependence $ExtFin_s$ and asset tangibility $Tang_s$:

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

In the expression above, φ'_j, φ'_i, and φ_{ij} represent the exporter, importer and country-pair specific terms in f_{ij}. Note that 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.

With this specification the log-linearized estimation equation for $z_{ijs} \equiv \ln Z_{ijs}$ takes the following form:

$$\begin{aligned} z_{ijs} = {} & \gamma_1 FinDevt_j \cdot ExtFin_s - \gamma_2 FinDevt_j \cdot Tang_s \\ & + \gamma_0 + (\varepsilon - 1)\, p_{is} - \mu d_{ij} - \kappa\varphi_{ij} + \phi_j + \phi_i + \phi_s + \eta_{ij}, \end{aligned} \tag{8}$$

where $\eta_{ij} \equiv u_{ij} + \nu_{ij} \tilde{} N\left(0, \sigma_u^2 + \sigma_\nu^2\right)$, $\phi_j = -\varepsilon \ln c_j + \varphi'_j$, $\phi_i = \ln Y_i + \varphi'_i$, and $\phi_s = -\varepsilon \ln c_s + \varphi'_s$ are exporter, importer and sector fixed effects respectively, and $p_{is} \equiv \ln P_{is}$ is the sectoral price index in the importing country.

Although z_{ijs} is unobserved, (8) can be estimated with a Probit specification because $z_{ijs} > 0$ whenever j exports to i in sector s and $z_{ijs} = 0$ otherwise. If T_{ijs} is an indicator variable equal to 1 when j exports to i in sector s in the data, then the conditional probability of exporting ρ_{ijs} is given by the following Probit equation:

$$\begin{aligned} \rho_{ijs} = \Pr\left(T_{ijs} = 1 \mid \text{observed variables}\right) = \Phi(\gamma_0^* + (\varepsilon - 1)^* p_{is} - \mu^* d_{ij} - \kappa^* \varphi_{ij} \\ + \gamma_1^* FinDevt_j \cdot ExtFin_s - \gamma_2^* FinDevt_j \cdot Tang_s + \phi_j^* + \phi_i^* + \phi_s^*). \end{aligned} \tag{9}$$

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

4.2 Product variety

I next test Proposition 3, which predicts how the range of exported products varies across countries and industries. Given a measure N_{js} of firms producing in country j and sector s, the

mass of firms exporting to i from this country and sector is $X_{ijs} = N_{js}G\left(a_{ijs}^{L}\right)$. I assume that $\ln G\left(a_{ijs}^{L}\right)$ can be decomposed and $x_{ijs} \equiv \ln X_{ijs}$ expressed as follows:

$$\begin{aligned} x_{ijs} = {} & \xi_1 FinDevt_j \cdot ExtFin_s - \xi_2 FinDevt_j \cdot Tang_s \\ & + \xi_0 + \xi_3 n_{js} + \xi_4 p_{is} - \xi_5 d_{ij} - \xi_6 \varphi_{ij} + \xi_j + \xi_i + \xi_s + \eta_{ij}, \end{aligned} \tag{10}$$

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 $1/a_{ijs}^{L}$. However, while the latent variable z_{ijs} can be used to analyze zero versus positive trade flows, (10) examines the variety of products (the extensive margin) within positive exports at the sector level. Note also that the mass of domestically active firms only enters the equation for product variety.

4.3 Trade volumes

To test Proposition 5, I derive an estimation equation for the value of bilateral exports M_{ijs} in (6). I follow HMR in assuming that firm productivity $1/a$ has a truncated Pareto distribution with support $[a_L, a_H]$, $a_H > a_L > 0$. In particular, $G(a) = \left(a^k - a_L^k\right) / \left(a_H^k - a_L^k\right)$, where $k > \varepsilon - 1$. V_{ijs}, the term in the expression for M_{ijs} which captures firm selection into exporting, can then be rewritten as

$$V_{ijs} = \frac{k a_L^{k-\varepsilon+1}}{(k-\varepsilon+1)\left(a_H^k - a_L^k\right)} W_{ijs}, \text{ where } W_{ijs} = \max\left\{\left(\frac{a_{ijs}^{L}}{a_L}\right)^{k-\varepsilon+1} - 1, 0\right\}. \tag{11}$$

Log-linearizing (6) and invoking the assumptions $c_{js} \equiv c_j c_s$ and $\tau_{ij}^{\varepsilon-1} \equiv D_{ij}^{\mu} e^{-u_{ij}}$, the estimating equation for the value of bilateral exports in a given sector becomes

$$m_{ijs} = \varsigma_0 + (\varepsilon - 1) p_{is} - \varsigma_1 d_{ij} + \varsigma_j + \varsigma_i + \varsigma_s + n_{js} + w_{ijs} + e_{ijs} + u_{ij}, \tag{12}$$

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

Note that financial frictions can affect bilateral exports m_{ijs} through three channels. First, credit constraints contribute to the selection of firms into exporting and thus influence trade volumes through w_{ijs}. Second, credit constraints may affect firm-level exports; this effect is captured by e_{ijs}. Finally, in a fuller model which incorporates credit constraints in domestic production as well as in exporting, the mass of active firms in the exporting country n_{js} would also be a function of the interaction of financial development with sectors' financial vulnerability. The comparative statics for the productivity cut-off for domestic production would mimic those for the exporting threshold. In other words, there would be both more active firms and more exporting firms in financially developed countries, and this effect would be more pronounced in financially vulnerable sectors.

The prior literature has performed reduced-form analyses in which the estimation of export flows does not control for the measure of domestic producers n_{js}. It is therefore not clear whether the effects found in earlier work reflect credit constraints in the financing of export costs or simply the impact of financial frictions on domestic production. In addition, previous studies have examined only positive trade values and not considered how credit constraints affect the selection of firms into exporting.

I estimate (12) with a two-stage procedure in the spirit of HMR, which uses the information in both zero and positive bilateral exports. I first obtain the predicted probability of exports from j to i in sector s from the Probit specification in (9) and use it to construct an estimate of w_{ijs}. I then include this imputed measure of firm selection into exporting in (12), control for n_{js}, and estimate the equation with either OLS or Maximum Likelihood. The measure of fixed export costs φ_{ij} enters only the first stage and provides the exclusion restriction necessary for the estimation of the second stage. This is possible because φ_{ij} affects directly only the selection of firms into exporting but not trade values.

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 or exporting. Once n_{js} and w_{ijs} are included in the estimation, any additional impact of credit constraints on m_{ijs} represents an effect on firm-level exports channeled through e_{ijs}, which I do not observe or control for directly.

If $\widehat{\rho}_{ijs}$ is the predicted probability of exports from j to i in sector s, then an estimate for the latent variable $z^*_{ijs} \equiv z_{ijs}/\sigma_\eta$ is $\widehat{z}^*_{ijs} = \Phi^{-1}\left(\widehat{\rho}_{ijs}\right)$. I construct a consistent estimate for W_{ijs} from

$$W_{ijs} = \max\left\{\left(Z^*_{ijs}\right)^{\delta} - 1, 0\right\}, \text{ where } \delta = \sigma_\eta\left(k - \varepsilon + 1\right)/\left(\varepsilon - 1\right). \tag{13}$$

The error term u_{ij} in (12) is correlated with w_{ijs} because the error term in the equation for z_{ijs} (8) is $\eta_{ij} \equiv u_{ij} + \nu_{ij}$. In addition, there may be sample selection bias arising from the positive correlation between trade barriers d_{ij} and u_{ij}: country pairs with high observable trade costs d_{ij} which trade with each other likely have low unobserved costs, i.e. high u_{ij}. The consistent estimation of (12) thus requires controlling for firm selection into exporting conditional on positive exports, $E\left[w_{ijs}|., T_{ijs} = 1\right]$, and 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. Thus, including $\widehat{\overline{\eta}}^*_{ij}$ and $\widehat{\overline{w}}^*_{ijs}$ in the second stage of the estimation produces consistent estimates and accounts for the selection of firms in exporting.

The exact estimation of $\widehat{\overline{\eta}}^*_{ij}$ and $\widehat{\overline{w}}^*_{ijs}$ depends on the assumption of joint normality of the unobserved trade costs u_{ij} and ν_{ij}, as well as on the assumption of a Pareto distribution for firm-level productivity. In robustness checks I drop the second assumption and include a polynomial in the estimated latent variable $\widehat{z}^*_{ijs}$ in the second stage instead of $\widehat{\overline{w}}^*_{ijs}$. I also relax both

assumptions and control directly for the predicted probabilities of exporting $\widehat{\rho}_{ijs}$. As in HMR, I find that these robustness checks leave my results unchanged.

4.4 Additional predictions: product turnover in exports

The analysis so far has examined how credit constraints affect export outcomes in a static world. In this subsection, I extend the model and consider how stochastic trade costs interact with credit constraints and determine the evolution of the product composition of exports over time. I show that the equilibrium firm exit and entry rates vary systematically with countries' financial development and sectors' financial vulnerability.

For simplicity, I focus on the case of credit constraints in the financing of stochastic fixed costs only, which are i.i.d. across firms and over time. I 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 $(1-q)$. Hence, in making their export decisions firms solve the same maximization problem as in (2), with the fixed cost taking the value observed that period.

In this framework, two productivity cut-offs define firms' export behavior. These cut-offs are given by equation (4), with the fixed cost being $\underline{f_{ij}}$ and $\overline{f_{ij}}$ respectively. Firms with productivity above the higher cut-off $1/\overline{a_{ijs}}$ always export regardless of the fixed cost they observe. Firms with productivity below the lower cut-off $1/\underline{a_{ijs}}$ never export, 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 from exporting of these "marginal exporters" drives firm dynamics in trade.

Recall that X_{ijs} indicates the measure of firms in country j exporting to i in sector s, while N_{js} is the mass of firms in j active in sector s. The equilibrium mass of exporters is therefore $X_{ijs} = N_{js}\left\{G\left(\overline{a_{ijs}}\right) + q\left[G\left(\underline{a_{ijs}}\right) - G\left(\overline{a_{ijs}}\right)\right]\right\}$, since in any period a fraction q of all marginal exporters observe a low trade cost and export. In the next period, a fraction $(1-q)$ of these firms observe a high export cost and exit. Hence the observed exit rate δ can be expressed as

$$\delta = \frac{(1-q)\,q\left[G\left(\underline{a_{ijs}}\right) - G\left(\overline{a_{ijs}}\right)\right]}{G\left(\overline{a_{ijs}}\right) + q\left[G\left(\underline{a_{ijs}}\right) - G\left(\overline{a_{ijs}}\right)\right]}. \tag{14}$$

In equilibrium the mass of exporters is constant over time and the exit rate exactly equals the entry rate.

From Proposition 1, the two productivity cut-offs for exporting are lower in financially developed countries, and especially so in financially vulnerable sectors. One can show that the two cut-offs are closer to each other in financially developed countries. This effect is stronger in sectors intensive in external finance, but does not vary with sectors' asset tangibility. For a productivity distribution function with no unit point masses these comparative statics extend to $G\left(\underline{a_{ijs}}\right) - G\left(\overline{a_{ijs}}\right)$. Given the equivalence of firm and product variety in the model, this implies the following proposition:

Proposition 6 *(Product churning) Financial development increases the survival rate of exporting firms from one period to the next. This effect is more pronounced in financially vulnerable sectors.*[16]

I test Proposition 6 with the following reduced form estimation equation for (14):

$$\begin{aligned}\delta_{ijs} = \chi_1 FinDevt_j \cdot ExtFin_s - \chi_2 FinDevt_j \cdot Tang_s \\ + \chi_0 + \chi_3 p_{is} - \chi_4 d_{ij} - \chi_5 \varphi_{ij} + \chi_j + \chi_i + \chi_s + \epsilon_{ijs},\end{aligned} \tag{15}$$

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 have an impact on firm's exit from exporting since they affect $\overline{a_{ijs}}$ and $\underline{a_{ijs}}$.

4.5 Additional predictions: trade partners

The framework developed in Section 3 examines how credit constraints affect the decision of a firm in country j to export to a particular country i. In reality, firms can export to more than one country, and they select their destinations so as to maximize total profits.

In the absence of credit constraints, firms export to all countries for which expected profits are positive. With credit constraints, however, the decision to export to country i is not independent from the decision to export to country k. This occurs because firms have limited collateral with which to raise external capital and finance the costs of trading with multiple destinations. For this reason, the optimal number and type of trade partners vary systematically with the exporter's level of financial development and the sector's financial vulnerability.

An important factor in a firm's export decision is the destination country's market size. All else equal, firms generate more sales and earn greater profits from exporting to larger countries. At the same time, because higher revenues make it easier to cover the fixed costs of trade, the productivity cut-off for exporting is lower for larger destinations, as can be seen from equation (4). To maximize total profits, firms therefore optimally export to the largest n countries in the world for which they can raise sufficient outside finance. In other words, if a firm increases the number of its trade partners from n to $(n+1)$ countries, it would continue exporting to the n largest economies in the world and add the next largest market as its $(n+1)$st destination. I refer to the pattern in which firms first export to the largest economies and add export destinations in decreasing order of market size as *the pecking order of trade*. Appendix B extends the model presented in Section 3 and formalizes the intuition for this result.

Appendix B also shows that more productive firms export to a greater number of destinations because their higher revenues allow them to go further down the pecking order of trade partners.

[16] This result would hold if firms face credit constraints in the financing of both fixed and variable costs. In addition, a similar prediction would obtain for the behavior of firms in the vicinity of the productivity cut-off for exporting at first-best levels. While most productive firms would always export at first-best, a band of firms would switch between exporting at first- or second-best levels depending on the fixed cost observed in that period. Their switching would not, however, affect the overall mass of exporting firms.

Thus, while all firms export to the largest economies in the world, more productive firms also export to smaller markets. This result is consistent with the recent empirical evidence in Eaton, Kortum and Kramarz (2004a,b) (EKK) on the exporting behavior of French firms.[17]

With credit constraints, the number and market size of export destinations vary systematically across countries and sectors. Since the productivity cut-off for exporting to any individual market depends on the exporter's level of financial development, the importer's market size, and the sector's financial vulnerability, the model has the following two implications:

Proposition 7 *(Trade partners) The more financially developed country j is, the greater the number of 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 Proposition 7 with the following reduced-form estimation equation:

$$\#Partners_{js} = \mu_0 + \mu_1 FinDevt_j \cdot ExtFin_s - \mu_2 FinDevt_j \cdot Tang_s + \mu_j + \mu_s + \epsilon_{js}, \qquad (16)$$

where $\#Partners_{js}$ is the number of countries j exports to in sector s, and μ_j and μ_s are exporter and sector fixed effects.

I test the pecking order of trade hypothesis by analyzing the smallest and the largest economy to which country j exports in a given sector. I estimate the following two equations:

$$\max_{i, i \in TP_{js}} Y_i = \overline{\iota_0} - \overline{\iota_1} FinDevt_j \cdot ExtFin_s + \overline{\iota_2} FinDevt_j \cdot Tang_s + \overline{\iota_j} + \overline{\iota_s} + \epsilon_{js}, \qquad (17)$$

$$\min_{i, i \in TP_{js}} Y_i = \underline{\iota_0} - \underline{\iota_1} FinDevt_j \cdot ExtFin_s + \underline{\iota_2} FinDevt_j \cdot Tang_s + \underline{\iota_j} + \underline{\iota_s} + \epsilon_{js}, \qquad (18)$$

where TP_{js} ($TradePartners$) represents the set of countries j exports to in sector s, and $\overline{\iota_j}$, $\overline{\iota_s}$, $\underline{\iota_j}$, and $\underline{\iota_s}$ capture exporter and sector fixed effects. Note that the model predicts no effect of countries' financial development and sectors' financial vulnerability in equation (17) for the largest economy to which j sells to, $\overline{\iota_1} = \overline{\iota_2} = 0$. In contrast, if financially developed countries export to smaller destination markets, and especially so in financially vulnerable sectors, then $-\underline{\iota_1} < 0$ and $\underline{\iota_2} > 0$ in (18). Finally, to test the direct link between the number of trade partners and the size of the smallest export destination, I control for the number of trade partners in (18) and expect that financial variables no longer enter significantly.

5 Data on trade and credit constraints

In my empirical analysis, I examine unidirectional bilateral exports for 107 countries and 27 sectors over the 1985-1995 period.[18] I evaluate the impact of credit constraints on trade by

[17] EKK also present a model that rationalizes the relationship between firm productivity and the number of trade partners. They do not study credit constraints or variations across exporting countries and sectors.

[18] All results obtain in the cross-section for single years as well.

regressing export outcome variables on the interaction of country-level measures of financial development with sector-level measures of financial vulnerability.

Trade data

A sector in the data is defined as a 3-digit category in the ISIC industry classification system. I obtain bilateral exports 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.

When I study the product composition of countries' exports I conduct the analysis at two different levels of industry disaggregation. In the absence of detailed cross-country firm-level export data, I take the number of 4-digit SITC product groups that countries export within a 3-digit ISIC sector as a proxy for product variety. In robustness tests I also use data on the number of 10-digit HS products countries export to the U.S. in the 1989-1995 period, available from the *U.S. Imports, Exports and Tariff Data*.

Financial development 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 and is therefore 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., 2004) as well as in most papers on finance and trade.

In the panel of 107 countries that I am limited to by data, private credit varies significantly across countries and over time. Panel A in Appendix Table 1 lists the countries I use and gives the mean and standard deviation of each country's private credit over the 1985-1995 period. The bottom two rows summarize the cross-sectional variation of the period 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%.

In robustness checks, I use measures of the repudiation of contracts, accounting standards, and the risk of expropriation from La Porta et al. (1998). While these indices are not a direct measure of the probability that financial contracts will be enforced, they do reflect the contractual environment in a given country, which applies to financial contracting as well. These indices are available for a subset of countries, and do not vary over time. Panel B summarizes the cross-sectional variation in these three measures.

Financial vulnerability data

Industry-level measures of external capital dependence and asset tangibility follow closely their definitions in the model. Both variables come from Braun (2003), and are based on data for all publicly traded U.S.-based companies from Compustat's annual industrial files. The indicator of a sector's reliance on outside financing is the share of capital expenditures not financed with cash flow from operations for the median firm in each industry.[19] Asset tangibility is similarly defined as the share of net property, plant and equipment in total book-value assets for the median firm in a sector. Both measures are constructed as averages for the 1986-1995 period, and appear very stable over time when compared to indices for 1976-1985 or 1966-1975.

Constructing the industry measures from U.S. data is motivated by two considerations. The United States are characterized by one of the most advanced and sophisticated financial systems, which makes it reasonable that the measures reflect firms' true demand for external capital and tangible assets. Using the U.S. as the reference country is convenient because of limited data for many other countries, but it also eliminates the potential for the measures to endogenously respond to a country's level of financial development. In fact, if some of the very external capital intensive industries in the U.S. 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 tangibility and external capital dependence levels 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 a sector and is therefore a good proxy for ranking industries in all countries. They point out that the measures vary substantially more across sectors than among companies within an industry.

The external capital dependence and asset tangibility measures for the 27 sectors in my sample are listed in Appendix Table 2. Most U.S. 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 the petroleum refineries; paper and products; iron and steel; and industrial chemicals sectors. Identifying both interaction terms in the estimating equations is possible because the two industry variables are only weakly correlated at -0.0408.

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

[19] Rajan and Zingales (1998) first proposed and used this measure.

6 Credit constraints and export patterns in the data

6.1 The effect of credit constraints on bilateral export volumes

Earlier papers on the role of credit constraints in trade have documented that financially developed countries export relatively higher volumes in financially vulnerable sectors. Table 2 establishes this basic pattern in a panel of 107 countries and 27 industries between 1985-1995. In Column 1 I regress (the log of) unidirectional bilateral exports on the exporter's level of private credit and its interactions with the industry measures of external finance dependence and asset tangibility. I find that financially developed countries export relatively more in sectors that require more outside finance and in sectors with few collateralizable assets. This result obtains in a traditional gravity-model specification controlling for the market size (GDP) of the exporting and importing country, as well as the distance between the two trade partners.

The results in Column 1 can be seen as a reduced-form estimation of equation (12) for country export volumes.[20] The estimation 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 reflects unobserved variation in country-pair trade costs in (12).

Some of the effects estimated in Column 1 may, however, capture the impact of credit constraints on the measure of active producers in the exporting country, n_{js} in (12). To isolate the effect of financial frictions on exports above and beyond that on domestic production, in Column 2 I control for the (log) number of establishments in the exporting country by year and sector.

I find that 75%-80% of the total effect of financial frictions on export volumes is independent of their effect on domestic production. In unreported results, I have confirmed that a greater number of establishments are active in financially developed countries, especially in financially vulnerable sectors. This finding is consistent with the prior literature on finance and growth.

The model also posits that the estimation of bilateral export volumes control for the sector price index in the importing country. In the absence of a direct measure for p_{is}, I pursue three different estimation approaches, and find my results unchanged. In Column 3 I include a measure of the importer's CPI and its interactions with a full set of sector dummies. In Column 4 I control instead for the importer's (log) total consumption by sector, computed as the sum of domestic production and net imports at the sector level. In the last column I include importer-sector fixed effects. Since the choice of p_{is} proxy only minimally affects my results, I perform the rest of the analysis with only one of these measures, importer's CPI interacted with sector fixed effects.

The effect of credit constraints on bilateral exports is highly statistically and economically significant. For example, if the Philippines, the country at the first quartile of the distribution of private credit, were to improve its financial system to the level of the third quartile (Italy), the

[20] Because of the panel nature of the data, the importer's GDP is no longer subsumed by the importer's fixed effect and enters explicitly in the estimation. The distance measure proxies for the trade cost variables in the model. HMR show how to rewrite (12) to include the exporter's GDP.

Philippines could increase its (average bilateral) textile exports (highly dependent on external finance, 3rd quartile) by 19 percentage points more than its mineral products exports (intensive in internal funding, 1st quartile). Similarly, (average bilateral) 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. I account for traditional sources of comparative advantage by controlling for the interaction of countries' 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 include in the regression interactions of the exporter's overall rule of law and level of corruption with the industry measures of financial vulnerability.[22,23] 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 developed countries export relatively more in sectors with a greater need for outside finance and sectors with few tangible 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 highly significant results. These findings present strong support for Proposition 5.

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 may arise because an increase in relative foreign demand for sectors intensive in external funds may 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.[24]

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. Then, holding financial dependence constant, the sectoral composition of export demand would not affect private credit. The result that financially underdeveloped countries export less in sectors with fewer tangible assets is thus strong evidence of a credit constraints channel.[25] Finally, using time-invariant

[21] Comparative statics based on Column 3 of Table 2.

[22] This is motivated by results in the prior literature on the differential impact of rule of law and law enforcement on exports across sectors. See for example Nunn (2007), Levchenko (2007) and Claessens and Laeven (2003).

[23] Chor (2006) and Manova (2005) also find that the impact of financial institutions survives even after controlling for a range of other institutional characteristics.

[24] Braun and Raddatz (2004) and Do and Levchenko (2007) find that trade openness may stimulate financial development, reinforcing the concern that causality may run from trade to financial development.

[25] To establish causality, prior researchers have instrumented for private credit with legal origin. I have confirmed that all of my results hold with this IV approach. However, legal origin has been shown to impact institution

measures of contractibility (repudiation of contracts, 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 credit to the private sector may.

6.2 Zero and positive export values

I next follow the two-stage estimation procedure outlined in Sections 4.1 and 4.3, and decompose the effect of credit constraints on the volume of bilateral exports into the component due to firm selection into exporting and that due to average firm-level exports.

Proposition 2 suggests that financially developed countries are more likely to export bilaterally and that their advantage is more pronounced in financially vulnerable sectors. I test this prediction of the model by estimating (9) for the conditional probability of exporting ρ_{ijs} with a Probit specification. As the outcome measure I use an indicator variable, which is equal to 1 if country j exports to country i in sector s and year t. This Probit specification also tests how credit constraints affect firm selection into exporting in the absence of comprehensive cross-country firm-level data on export participation.

I estimate (9) with exporter, importer, sector and year fixed effects, and control for the sector price index in the importing country and both partners' GDP level. Both fixed and variable trade costs are predicted to affect firms' exporting decision in (9). I account for such country-pair specific trade costs with a full set of commonly used proxies: the (log) bilateral distance, indicator variables for whether the countries share a common border, common language, common colonizer or past colonial relationship, as well as a binary measure of whether at least one country is an island or landlocked.

Table 4 presents strong empirical evidence in support of Proposition 2. Financially developed countries are more likely to export to any given potential trade partner, and this effect is especially pronounced in sectors that require more outside finance or have few collateralizable assets. This result is independent of other sources of comparative advantage, such as factor endowments, the overall level of development, or other institutions. It is also robust to the choice of financial contractibility measure.

I next estimate the effect of credit constraints on average firm-level exports predicted by Proposition 4. This requires including a measure of firm selection into exporting in the specification for sector-level bilateral exports. In addition, the estimation should correct for a Heckman-type selection of countries into exporting based on low unobserved trade costs. To this end, I obtain the predicted value of the probability of exporting $\widehat{\rho}_{ijs}$ from each Probit specification in Table 4 and an estimate of the latent variable $\widehat{z}^*_{ijs} = \Phi^{-1}\left(\widehat{\rho}_{ijs}\right)$. I also impute the value of the disturbance term $\widehat{\overline{\eta}}^*_{ij}$ conditional on positive bilateral exports, $\widehat{\overline{\eta}}^*_{ij} = \phi\left(\widehat{z}^*_{ijs}\right)/\Phi\left(\widehat{z}^*_{ijs}\right)$.[26]

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.

[26] A relatively small number of exporter-importer-sector triplets in the data have a probability of trade $\widehat{\rho}_{ijs}$ indistinguishable from 1 or 0, and I cannot infer any differences in the latent variable $\widehat{z}^*_{ijs}$ for these triplets.

Since the model predicts that the measure of firm selection into exporting 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 (12) with a Maximum Likelihood Estimator.

Estimating (12) in this way requires an exclusion restriction. In the model, this is provided by fixed trade costs which affect export volumes only through the selection of firms into exporting. In the data, this exclusion restriction is satisfied by the variable indicating whether at least one trade partner is an island. While this variable is often significant (and negative) in a reduced form regression of export volumes, it becomes insignificant when measures of firm selection into exporting from the first stage are included in the second stage (results not reported). Moreover, this variable always strongly predicts whether or not countries trade in the first stage. Thus, being an island country appears to present a hurdle to trade associated with a fixed cost; once this hurdle is overcome island isolation does not seem to impair variable trade costs. One possible explanation for this result is that shipping by sea entails a substantially higher fixed cost compared to trucking and railroad transportation, while unit transportation costs are similar over land and waterbound.

Panel A of Table 5 presents the results from the second stage MLE estimation. In all specifications, exporting firms in financially developed countries sell significantly larger export volumes on average, and this effect is especially pronounced in highly external capital dependent sectors and in industries with low asset tangibility. This result suggests that financial development allows more firms to export at first-best levels and/or increases export revenues for firms operating at second-best. These effects are particularly strong in financially vulnerable sectors, and lend support to Proposition 4.

I gauge the relative importance of credit constraints for firm selection into exporting and firm-level exports 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 about a third of the total effect of financial development on bilateral export volumes results from fewer firms becoming exporters, whereas two thirds are due to depressed firm-level exports. The exact decomposition varies across specifications, and gives more weight to firm selection into exporting when the coefficients on the interaction of financial development with external finance dependence are used (see Appendix Table 3).[27]

These results are not sensitive to the assumptions made in the imputation of $\widehat{\overline{\eta}}^*_{ij}$ and $\widehat{\overline{w}}^*_{ijs}$. In Panel B of Table 5, I drop the assumption of a Pareto distribution for firm-level productivity, and include a cubic polynomial in the estimated latent variable $\widehat{z}^*_{ijs}$ in the second stage instead of $\widehat{\overline{w}}^*_{ijs}$. Since all regressors now enter linearly, I estimate the second stage with OLS. This

I follow HMR in assigning a value of $\widehat{\rho}_{ijs} = 0.9999999$ to all triplets with $\widehat{\rho}_{ijs}$ geater than this cut-off, and $\widehat{\rho}_{ijs} = 0.0000001$ to all triplets with $\widehat{\rho}_{ijs}$ lower than this cut-off. This affects less than 1% of the sample.

[27] In unreported robustness checks, I have used measures of the average fixed costs of setting up a firm in the exporting and importing countries as the exclusion restriction, as in HMR. My results obtained at comparable levels of statistical significance, and ascribed roughly 5%-10% more of the effect of credit constraints on bilateral export volumes to firm selection into exporting.

modification leaves all results both qualitatively and quantitatively unchanged.

Finally, I 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 $\widehat{\widehat{\eta}}^*_{ij}$ and the latent variable $\widehat{z}^*_{ijs}$ can no longer be exactly imputed from the predicted probability of exporting $\widehat{\rho}_{ijs}$. I follow HMR in controlling instead directly for the predicted probabilities by categorizing all $\widehat{\rho}_{ijs}$'s in 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 findings presented in this section suggest that firms face credit constraints in the financing of both fixed and variable export costs. For this reason, financial frictions affect export patterns both by restricting firms from becoming exporters and by preventing firms from exporting at first-best levels. I next examine the consequences of credit constraints for the product composition of countries' exports.

6.3 Product variety and product churning

Proposition 3 predicts that financially developed countries should export a wider variety of products to any trade partner, and that this advantage should be more pronounced in financially vulnerable sectors. I test this prediction by estimating equation (10) for the (log) number of 4-digit SITC product groups an exporter sells to a given country within a 3-digit ISIC sector. Since a 4-digit product category itself encompasses a range of products and we do not observe how many of them a country exports, using this measure likely underestimates the impact of credit constraints on product variety. At the same time, there is sufficient variation in the data even at the 4-digit level (see Table 1).

As Panel A of Table 6 shows, financially advanced countries export a wider range of products in industries intensive in outside finance and sectors with few collateralizable assets. These effects have large economic significance: A one-standard-deviation increase in the index of contract repudiation, for example, would increase an average country's bilateral product variety by 10 percentage points more in a highly external capital dependent industry (3rd quartile) relative to a less dependent industry (1st quartile). Similarly, product variety would rise by 8 percentage points more in a low-tangibility sector (1st quartile) relative to a sector with harder assets (3rd quartile).

These results are not driven by other sources of comparative advantage such as factor endowments, overall development or other institutions. In addition, the findings obtain after controlling for the number of active establishments in the exporting country and sector, the importer's price index, the market size and distance between the two trade partners, and a full set of exporter, importer, sector and year fixed effects.

These results are also robust to measuring product variety at a finer level of industry disaggregation. In Panel B, I restrict the analysis to exports specifically to the U.S., for which it is possible to count the number of 10-digit HS products traded within a 3-digit ISIC sector. In this

sample there is even more variation in product variety across countries and sectors (Table 1). I continue to observe that financially developed countries export a greater variety of products in financially vulnerable sectors, although the interaction of financial development with asset tangibility is often imprecisely estimated.[28] One reason why these results may differ from those in the full sample is that the United States is one of the largest economies in the world. I return to this interpretation when I discuss the pecking order of trade in Section 6.4 below.

The effect of credit constraints on product variety in exports is closely related to the earlier finding that financially developed countries are more likely to export in financially vulnerable sectors. Both results indicate that credit constraints intensify the selection of firms into exporting, and are consistent with the idea that financial frictions interact importantly with firm heterogeneity. Although I do not observe the number of exporting firms from each country and industry, the number of products countries export appears to capture well the extensive margin of trade: In unreported results, I have repeated the analysis of product variety controlling for firm selection into exporting by using the predicted probability of exporting. The impact of credit constraints on product variety is substantially diminished in economic magnitude and statistical significance in these specifications.

The model also predicts that in the presence of stochastic trade costs, credit constraints will affect the stability of countries' export product composition over time. In the data, there is substantial churning of products and significant variation across countries and sectors. In 1994, more than a quarter of all 4-digit product groups traded bilaterally in a given sector were discontinued in 1995 and replaced by new ones. This resulted in the reallocation of 16% of bilateral trade by value. At the 10-digit product level, countries replaced more than a half of all products they exported to the U.S. in a given sector, or 34% of bilateral trade by value.

To study the role of financial development in product turnover, I focus on the sample of exporter-importer-sector triplets with positive trade flows in two consecutive periods. This ensures that the observed changes in the product composition of exports are not driven by large adjustments in export conditions but obtain instead in an environment approximating steady-state equilibrium. I construct a measure of the rate of product survival by taking the ratio of the number of products exported both this year and last year to the total number of products exported last year. Similarly, I measure the rate of product entry as the ratio of newly introduced products this period to the number of products exported last period.[29]

As the results in Table 7 suggest, financially developed countries experience fewer changes to the product composition of their exports, and this effect is more pronounced in financially vulnerable sectors. In line with Proposition 6, the survival rate of products exported by finan-

[28] 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 U.S. instead of the natural logarithm of that number.

[29] I obtain the same results for product survival if I do not restrict the sample to triplets with positive trade in consecutive periods; this restriction is irrelevant in the case of product entry. I also obtain the same results for product entry if I define the entry rate as the share of newly introduced products this period in the total number of products traded this period.

cially advanced countries is higher in sectors with a greater need for external finance or 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, the distance between partners, the sectoral price index in the importing country, and a full set of country, sector and year fixed effects. The results are also robust to the choice of financial contractibility measure or level of industry disaggegreation, although the interaction of financial development with asset tangibility is imprecisely estimated in some of the specifications for U.S. imports at the 10-digit level.

6.4 Trade partners and the pecking order of trade

In addition to the structure of bilateral exports, the model also makes predictions for the number and type of countries' trade partners. Table 8 presents evidence on the systematic variation of trade partner intensity across exporting countries and sectors. Panel A exhibits the results for the full matrix of exporter-sector pairs, whereas Panel B restricts the sample to exporter-sector-year observations with at least one trading partner. In line with Proposition 7, I find that financially developed exporters sell to a significantly larger number of destinations in sectors with high dependence on external capital or sectors with few tangible assets. This result obtains after controlling for exporter, sector and year fixed effects, as well as 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.[30]

Proposition 8 states that while all countries can export to very large importing markets, financially advanced economies should also export to smaller countries, particularly in financially vulnerable sectors. To test this hypothesis, I obtain measures of the smallest and largest market to which countries export. For each exporter-sector pair I record the maximum and the 10th percentile values of the distribution of (log) GDP among all export destinations.[31,32]

As Panel A of Table 9 demonstrates, the market size of countries' largest trade partner does not vary systematically across exporters and sectors. In contrast, in Panel B the smallest market to which financially developed countries export is significantly smaller in financially vulnerable sectors.[33] Moreover, as the model predicts, this effect is largely driven by financially developed countries exporting to a greater number of destinations: When I control for the number of trade partners in Panel C, the minimum destination market size varies substantially less across countries and sectors. The estimated coefficients on the interaction of financial development with

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

[31] I take the 10th percentile of the distribution of export markets' GDPs instead of the minimum to protect the results from idiosyncracies in export patterns. The results are robust to alternative measures of the smallest destination market size.

[32] For the measures of smallest and largest destination market to be meaningful, there should be a range of market sizes among countries' partners. I restrict the analysis to country-sector-year observations with more than 5 trade partners. My results are robust to alternative subsampling.

[33] I have also confirmed that, controlling for the size of the largest or 90th percentile trading partner, financially developed countries export to systematically smaller countries in financially vulnerable sectors.

external capital dependence and asset tangibility are of much lower magnitudes and much less often statistically significant.

The model's predictions for the pecking order of trade are *ceteris paribus*, and hold for given fixed costs of exporting. In unreported results, I have repeated the analysis in Table 9 after adjusting the destination country market size for differences in bilateral trade costs. I obtained the residual of the importer's GDP from a regression with bilateral distance as the only regressor, and found my results on the pecking order of trade unchanged.[34]

These results are consistent with the idea that larger expected revenues make it easier for exporters to cover fixed costs. I further test this notion by examining whether financial development helps countries export a greater variety of products or more of each product depending on the importer's market size. I expect that the smaller the destination market, the greater the relative importance of financial development for overcoming fixed trade costs, alleviating firm's entry into exporting, and hence increasing export product variety.

I split all importing countries in the sample into four quartiles depending on their GDP level.[35] I then divide the sample of bilateral exports in four subsamples based on the importer's market size, and estimate the total impact of financial development on bilateral export volumes in each subsample with a reduced form OLS specification as in Table 3. Similarly, I reestimate the effect of credit constraints on product variety from Table 6 in each subsample. Since both export volumes and product variety are in log terms, the difference between the coefficient estimates in the two regressions represents the effect of financial development on average exports per product. Thus, the ratio of the coefficients from the product variety specification relative to the coefficients from the total export volume regression provides an indicator of the relative importance of credit constraints for the extensive margin of trade.

I obtain these ratios for the interactions of financial development with both external finance dependence and asset tangibility in each subsample. Table 10 summarizes the results for all four measures of financial contractibility. The robust pattern that emerges is that financial development is relatively more important for product variety when the destination market is smaller. This result may explain the less pronounced effects of credit constraints on U.S. import product variety in Panel B of Table 6. In addition, the evidence in Table 10 reinforces my earlier findings on the pecking order of exporting and on the interaction of the destination market size with firm heterogeneity in the presence of credit constraints.

[34] The model predicts that the importer's GDP be used as a measure of market size, assuming that all countries equally allocate expenditure across sectors. In unreported regressions, I have also used the destination country's consumption by sector as a proxy for market size. This produces qualitatively the same results, although some effects are imprecisely estimated.

[35] I determine these quartiles separately for each year to allow countries to change their ranking.

7 Conclusion

This paper analyzes export outcomes in the presence of credit constraints, cross-country differences in financial development and cross-industry variation in external finance dependence and asset tangibility. I develop a model with heterogeneous firms, in which larger, more productive firms have an advantage in obtaining external finance. This framework delivers a range of predictions which find strong empirical support in a large panel of bilateral exports for 27 industries in the 1985-1995 period.

My findings indicate that firms face credit constraints in the financing of both fixed and variable costs of exporting, and highlight the role of financial frictions in the presence of stochastic export costs. I find robust, systematic variations in export participation, volumes, product variety, product turnover, and trade partners across countries at different levels of financial development and across sectors at different levels of financial vulnerability. My results thus provide strong evidence that credit constraints are an important determinant of international trade patterns.

Appendix A. External financing of both fixed and variable costs

This Appendix proves the results summarized in Section 3.5.

When firms in sector s need to raise outside capital for a fraction d_s of all export costs, firms' maximization problem becomes

$$\max_{p,q,F(a)} \pi_{ijs}(a) = p_{ijs}(a) q_{ijs}(a) - (1-d_s) q_{ijs}(a) \tau_{ij} c_{js} a - (1-d_s) c_{js} f_{ij} - \lambda_j F(a) - (1-\lambda_j) t_s c_{js} f_{ej} \tag{19}$$

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

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

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

With competitive credit markets, all investors break even and in equilibrium $B_{ijs}(a) = 0$. The maximization problem reduces to the firm's problem in the absence of financial frictions except for the credit constraint that $F(a)$ be no greater than the firm's net revenues. Whenever this restriction does not bind, firms optimally export at the price and quantity levels that obtain in the absence of credit constraints. These first-best export levels satisfy condition (2) for all firms with productivity above $1/a_{ijs}^H$, defined by $A_{ijs}\left(a_{ijs}^H, p_{ijs}\left(a_{ijs}^H\right)\right) = F\left(a_{ijs}^H\right)$, or

$$\left[1 - (1-d_s)\alpha - \frac{d_s \alpha}{\lambda_j}\right] \left(\frac{\tau_{ij} c_{js} a_{ijs}^H}{\alpha P_{is}}\right)^{1-\varepsilon} \theta_s Y_i = \left(1 - d_s + \frac{d_s}{\lambda_j}\right) c_{js} f_{ij} - \frac{1-\lambda_j}{\lambda_j} t_s c_{js} f_{ej}. \tag{20}$$

One can show that the comparative statics in Section 3.4 hold true for $1/a_{ijs}^H$.

When firms finance only fixed costs externally, maximizing profits is equivalent to maximizing variable revenues $A_{ijs}(a)$. First-best prices then also maximize firms' possible payment to the investor $F(a)$ and hence the probability of exporting. In contrast, when firms require external capital for both fixed and variable costs, firms with productivity below $1/a_{ijs}^H$ have an incentive to reduce their export scale from the unconstrained first-best level. This occurs because exporting larger quantities requires more outside finance, which increases the repayment $F(a)$ necessary to meet the investor's participation constraint, and reduces the probability that the firm is able to raise sufficient outside capital to export.

Since firms prefer to earn some export profits to none, firms with productivity below $1/a_{ijs}^H$ optimally export smaller quantities at higher prices. Because deviating from the first-best lowers profits, these firms increase their price to the minimum level which ensures that they can satisfy investors' repayment constraint by solving $A_{ijs}(a) = F(a)$. Rewriting, firms' prices solve

$$\frac{p_{ijs}(a)^{1-\varepsilon} \theta_s Y_i}{P_{is}^{1-\varepsilon}} - \left(1 - d_s + \frac{d_s}{\lambda_j}\right) \tau_{ij} c_{js} a \frac{p_{ijs}(a)^{-\varepsilon} \theta_s Y_i}{P_{is}^{1-\varepsilon}} = \left(1 - d_s + \frac{d_s}{\lambda_j}\right) c_{js} f_{ij} - \frac{1-\lambda_j}{\lambda_j} t_s c_{js} f_{ej}. \tag{21}$$

Firms choose a price between the first best, $p_{ijs}(a) = \frac{\tau_{ij} c_{js} a}{\alpha}$, and the price that maximizes the left-hand side of (21). In this range the left-hand side of (21) is increasing in $p_{ijs}(a)$. Since export quantities and revenues are decreasing in the price, the comparative statics for them are opposite to those for the price. One can show that firm-level export quantities and revenues are lower for firms in financially underdeveloped countries and for firms in financially vulnerable sectors that are intensive in external finance or have few tangible assets. Furthermore, export quantities and revenues are particularly low in financially vulnerable sectors for firms located in financially underdeveloped countries.

Some potentially profitable exporters will not be able to export. Because the left-hand side of (21) is maximized at $p_{ijs}^L(a) = \left(1 - d_s + \frac{d_s}{\lambda_j}\right) \frac{\tau_{ij} c_{js} a}{\alpha}$, firms have no incentive to raise their

price above $p_{ijs}^{L}(a)$. Therefore, firms with productivity below a lower cut-off $1/a_{ijs}^{L}$ cannot export because, even if they adjust their export scale and give all revenues to the investor in case of repayment, the investor would not break even. This productivity cut-off is defined by $A_{ijs}\left(a_{ijs}^{L}, p_{ijs}^{L}\left(a_{ijs}^{L}\right)\right) = F\left(a_{ijs}^{L}\right)$, or equivalently,

$$\left(1-d_s+\frac{d_s}{\lambda_j}\right)^{1-\varepsilon}\left(\frac{\tau_{ij}c_{js}a_{ijs}^{L}}{\alpha P_{is}}\right)^{1-\varepsilon}\theta_s Y_i = \varepsilon\left\{\left(1-d_s+\frac{d_s}{\lambda_j}\right)c_{js}f_{ij}-\frac{1-\lambda_j}{\lambda_j}t_s c_{js}f_{ej}\right\}. \quad (22)$$

The productivity cut-off for exporting $1/a_{ijs}^{L}$ is systematically higher in financially underdeveloped countries and in financially vulnerable sectors. Moreover, financial development reduces $1/a_{ijs}^{L}$ relatively more in sectors with few collateralizable assets. However, the differential 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 have greater net revenues to offer in case of repayment, but they also require more external capital for their variable costs since they operate at a larger scale. The former effect dominates whenever $1+(\varepsilon-1)\,d_s\left(1-\frac{1}{\lambda_j}\right)>0$.[36] Given results in the corporate finance literature that larger, more productive firms are less likely to be credit constrained, as well as my results in Section 6, I assume that this condition is satisfied.

Appendix B. Trade partners and credit constraints

This Appendix proves the results summarized by Propositions 7 and 8 in Section 4.5.

I begin by assuming that firms finance exports to each destination with a separate financing contract. I further assume that if firms export to n countries they can pledge a fraction $1/n$ of their collateral in each contract they sign. To focus on whether or not there are any positive exports between two countries, I study the effects of credit constraints in the financing of fixed costs only.

If a firm in country j and sector s sells to n countries, including country i, its export prices and quantities in i solve the same profit maximization problem as in (2) adjusted to reflect the reduced collateral available, $t_s c_{js} f_{ej}/n$. The firm's revenues and profits from sales in i are therefore the same as in the absence of credit constraints. The firm can raise sufficient outside finance to export to i only if its productivity is higher than $1/a_{ijs,n}$ given by

$$r_{ijs}(a_{ijs,n}) = \left(\frac{\tau_{ij}c_{js}a_{ijs,n}}{\alpha P_{is}}\right)^{1-\varepsilon}\theta_s Y_i = \varepsilon\left\{\left(1-d_s+\frac{d_s}{\lambda_j}\right)c_{js}f_{ij}-\frac{1-\lambda_j}{\lambda_j}\frac{t_s c_{js}f_{ej}}{n}\right\}. \quad (23)$$

For any potential export market i, the productivity cut-off for exporting is increasing in the number of trade partners, $\partial\left(1/a_{ijs,n}\right)/\partial n>0$. For any exporting country j, sector s, and number of export partners n, let $\Gamma_{js,n}\equiv\{1/a_{ijs,n}\}$, $i=1,2,...,J$, $i\neq j$ be the set of productivity cut-offs associated with exporting to all potential destination markets. Let this set be ordered in increasing order such that $1/a_{1js,n}\leq 1/a_{2js,n}\leq ...\leq 1/a_{Jjs,n}$.

All else equal, firms raise more sales and make greater profits from exporting to larger countries. Because higher revenues make it easier to cover the fixed costs of trade, the productivity cut-off for exporting is lower for sales to a larger market, $\partial\left(1/a_{ijs,n}\right)/\partial Y_i<0$. Moreover, the relative ordering of countries in the $\Gamma_{js,n}$, $\Gamma_{js,n+1}$, ... sets is always the same. Hence, if a firm increases the number of its trade partners from n to $(n+1)$ countries, it would continue exporting to the n largest economies in the world and add the next largest market as its $(n+1)$st destination. I refer to the pattern in which firms add export destinations in decreasing order of market size as *the pecking order of trade*.

[36] This is a sufficient but not necessary condition. The necessary condition is $\frac{\varepsilon-1}{\lambda_j^2}\left(1-d_s+\frac{d_s}{\lambda_j}\right)^{-\varepsilon-1}\left[1+(\varepsilon-1)\,d_s\left(1-\frac{1}{\lambda_j}\right)\right]\left(\frac{\tau_{ij}c_{js}}{\alpha P_{is}}\right)^{1-\varepsilon}\theta_s Y_i>-\frac{\varepsilon}{\lambda_j^2}c_{js}f_{ij}$.

Since profits earned in different export markets are independent of one another, firms export to as many countries as possible. In the absence of credit constraints firms export to all countries for which revenues exceed costs. In the presence of credit constraints, firms consider all $\Gamma_{js,n}$ sets and find the greatest number of trade partners possible $n_{js}^{*}(a)$, for which $1/a \geq 1/a_{n_{js}^{*}(a)js,n_{js}^{*}(a)}$ but $1/a < 1/a_{\left(n_{js}^{*}(a)+1\right)js,\left(n_{js}^{*}(a)+1\right)}$. Because the productivity cut-off for exporting decreses in Y_i but profits increase in Y_i, to maximize total profits the firm optimally exports to the first n countries in the $\Gamma_{js,n}$ set, which are also the largest n countries in the world.

More productive firms export to a greater number of destinations since for them it is more likely that $1/a \geq 1/a_{njs,n}$. While all firms export to the largest economies in the world, more productive firms also export to smaller markets.

All comparative statics for the productivity cut-off for exporting to one country apply to each of the $1/a_{ijs,n}$ productivity cut-offs. Hence all $1/a_{ijs,n}$ cut-offs are lower for export countries at higher levels of financial development and for sectors with less need for external finance or more collateralizable assets. In addition, the cut-offs in financially vulnerable sectors are lower in more financially developed export countries. For this reason all countries can export to the largest destinations in the world, but financially developed countries also export to smaller target markets. These effects are more pronounced in financially vulnerable sectors.

If firms sign a separate financial contract for each export market but can optimally allocate their collateral across contracts, they would follow the same pecking order of exporting to maximize profits. Firms would optimally pledge the minimum collateral necessary that ensures sufficient outside finance for exporting to the n-th largest country. Since larger markets are associated with smaller productivity cut-offs and higher profits, firms would tend to shift larger fractions of their available collateral to financial contracts for smaller export markets. These economic forces would weaken but not overturn the effects in Propositions 7 and 8, and act against me finding empirical support for these predictions in the data.

Relaxing the assumption that firms sign individual contracts for each export market would have similar implications. Imagine that firms could pool export revenues from all export markets and sign one big contract for the financing of exporting to all destinations. The average revenues investors expect to receive in case of repayment would increase relative to the average fixed cost of exporting. This would allow firms to use revenues from larger markets to obtain the necessary outside finance to export to smaller markets. However, firms would still optimally follow the pecking order of trade to maximize profits.

Appendix C. Data sources

Annual total and per capita GDP come from the *Penn World Tables 6.1*. The indices of corruption and rule of law are from La Porta et al. (1998). All country-pair specific trade barrier measures (bilateral distance, number of landlocked and island countries in the pair, indicators for common border, common language, common colonizer and past colonial relationship) come from Glick and Rose (2002).

I use the measures of (log) stock of physical capital per capita and human capital per worker as constructed by Caselli (2005). The stock of physical capital is obtained according to the perpetual inventory method as $K_t = I_t + \delta K_{t-1}$, where I_t is investment and δ is the depreciation rate. The initial capital stock K_o is computed as $I_0/\left(g+\delta\right)$, where I_0 is the earliest value of investment available, and g is the average geometric growth rate of investment before 1970. Human capital per worker is calculated from the average years of schooling in a country with Mincerian non-linear returns to education. It is measured as $h = e\varphi\left(s\right)$, where s is the average years of schooling in the population over 25 years old, and $\varphi\left(s\right)$ is piecewise linear with slope 0.13 for $s \leq 4$, 0.10 for $4 < s \leq 8$, and 0.07 for $8 < s$. I construct a measure of (log) natural resources per worker using data on natural resource endowments from the World Bank's *Expanding the Measure of Wealth*. I use the intensity of each sector with respect to these three factors of production from Braun (2003).

I obtain data on the output and the number of domestically active establishments in each country, year and sector from the *UNIDO* database. I construct a measure of (log) consumption in each country, year and sector as the sum of production and net exports. The data on the consumer price index by country and year comes from the *International Financial Statistics* database compiled by the International Monetary Fund.

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Figure 1. Export Partners and Financial Development

This graph shows the relationship between the exporter's financial development and export market intensity. Financial development is measured by the amount of credit extended by banks and other financial institutions to the private sector, as a share of GDP (private credit). The y-axis gives the number of trade partners for each exporting country averaged over 27 sectors. All data is for 1995. Coeff=75.98***, R-squared=0.5405.

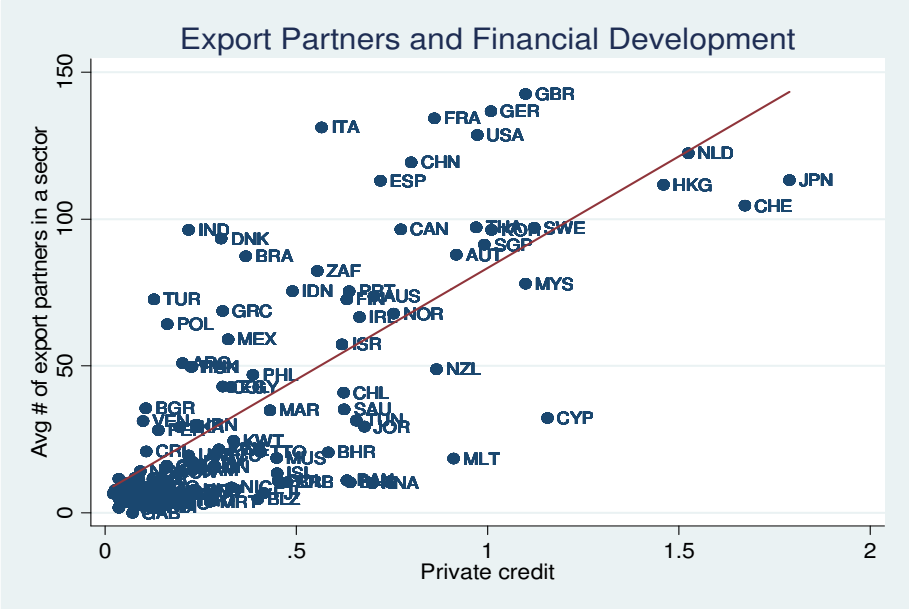

Figure 2. Bilateral Exports and Financial Development

This graph shows the relationship between the exporter's financial development and the volume of bilateral exports. Financial development is measured by private credit as in Figure 1. The y-axis gives the average (log) value of bilateral exports for each exporting country across all destinations and sectors. All data is for 1995 and reflects exporter-importer-sector triplets with positive trade. Coeff=1.87***, R-squared=0.4303.

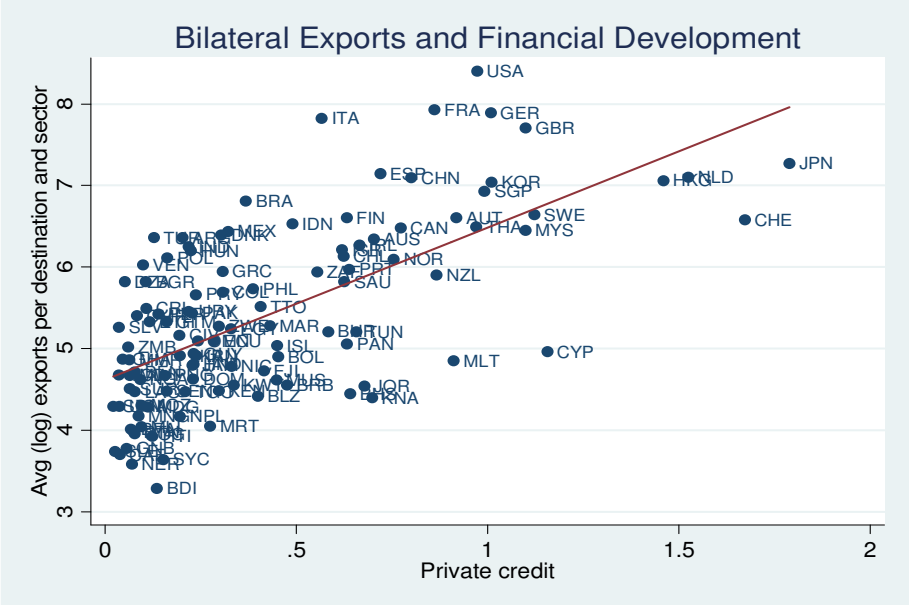

Figure 3. Export Product Variety and Financial Development

This graph shows the relationship between the variety of products countries export and the exporter's financial development. Financial development is measured by private credit as in Figure 1. The y-axis gives the average number of 4-digit products exported by each exporting country across all destinations and sectors, in the SITC industry classification. All data is for 1995 and reflects exporter-importer-sector triplets with positive trade. Coeff=3.83***, R-squared=0.5075.

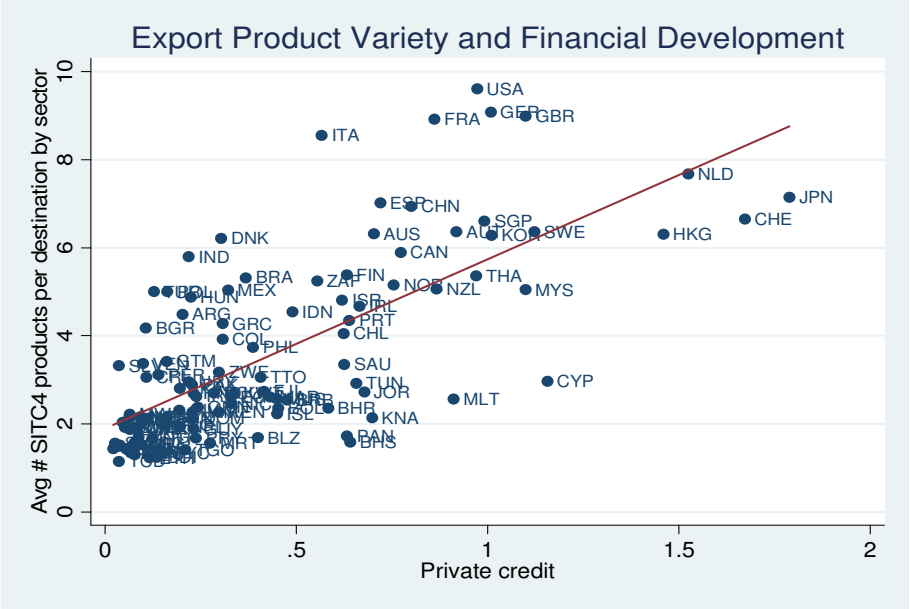

Figure 4. Product Churning and Financial Development

This graph shows the relationship between the exporter's financial development and product churning in bilateral exports. Financial development is measured by private credit as in Figure 1. The y-axis indicates the percentage share of trade value reallocated across 4-digit SITC product groups from one year to the next in the exports of country *j* to country *i* and sector *s* . This percentage has been averaged across importers, sectors, and years in the 1985-1995 period for all exporter-importer-sector triplets with positive trade. Coeff=-0.08***, R-squared=0.1413.

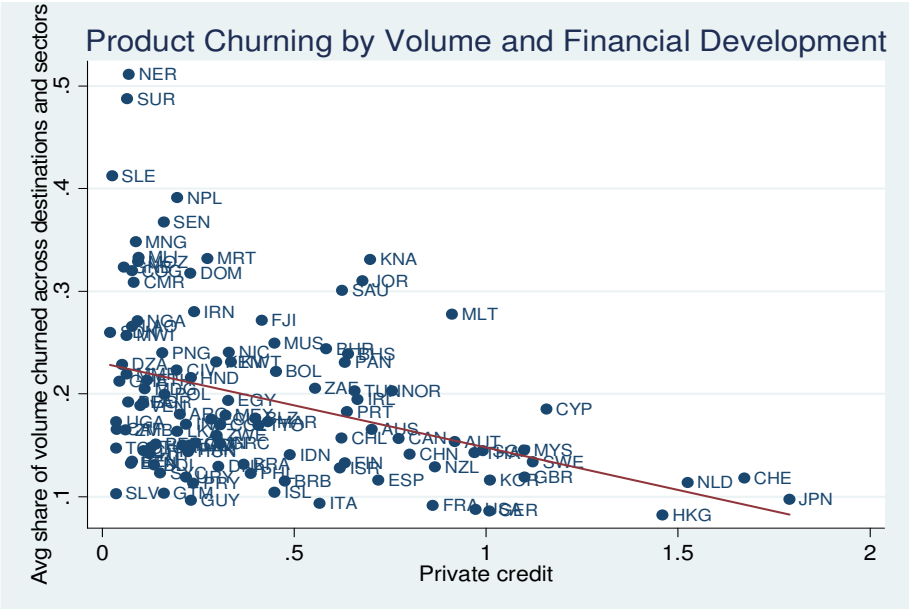

Figure 5. Italy vs. Argentina: Trade Partners

This graph compares trade partner intensity for two countries: Italy (log GDP 20.87, log per capita GDP 9.92) and Argentina (log GDP 19.69, log per capita GDP 9.24). Italy (70th percentile by private credit) is much more financially developed than Argentina (40th percentile by private credit). The graph plots the number of export destinations in each sector against the external finance dependence of the sector. All data for 1995.

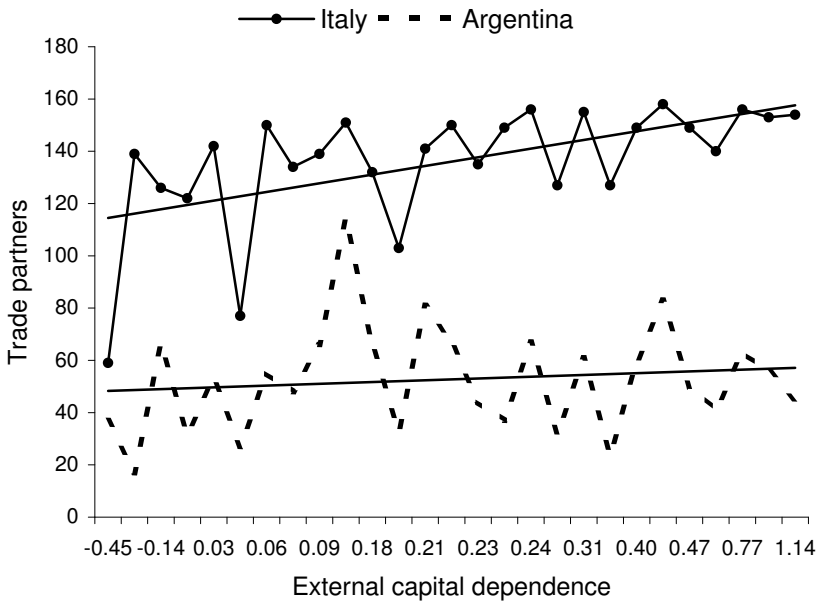

Figure 6. Italy vs. Argentina: Export Volumes

This graph compares export volumes for two countries: Italy (log GDP 20.87, log per capita GDP 9.92) and Argentina (log GDP 19.69, log per capita GDP 9.24). Italy (70th percentile by private credit) is much more financially developed than Argentina (40th percentile by private credit). The graph plots the average volume of bilateral exports by sector against the external finance dependence of the sector. All data for 1995.

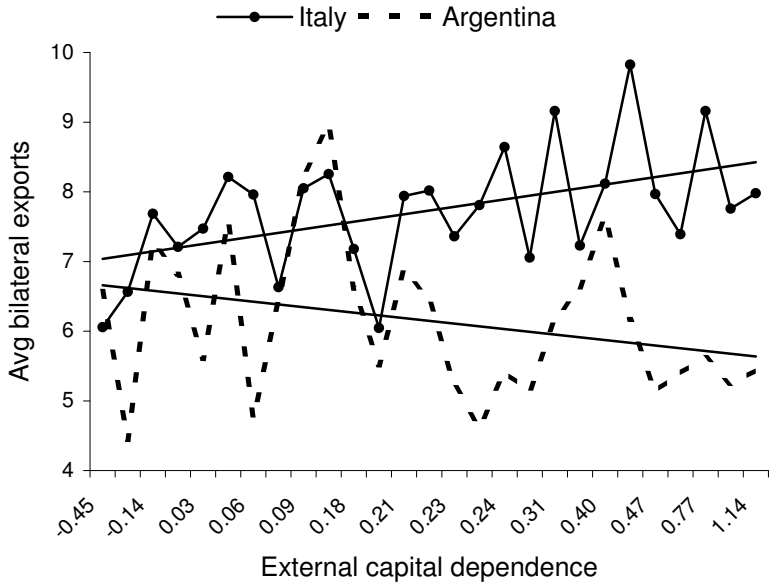

Figure 7. Italy vs. Argentina: Product Variety

This graph compares export product variety for two countries: Italy (log GDP 20.87, log per capita GDP 9.92) and Argentina (log GDP 19.69, log per capita GDP 9.24). Italy (70th percentile by private credit) is much more financially developed than Argentina (40th percentile by private credit). The graph plots the average number of products exported bilaterally in each sector against the external finance dependence of the sector. All data for 1995.

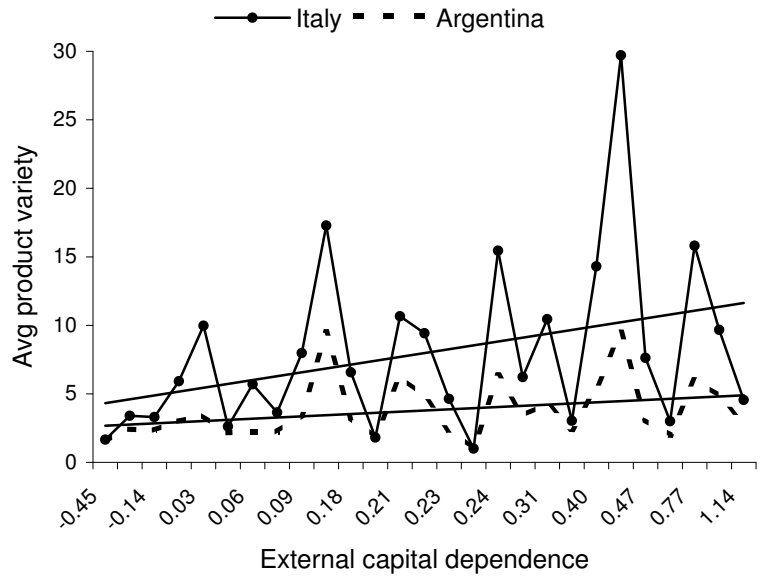

Figure 8. Italy vs. Argentina: Product Churning

This graph compares export product churning for two countries: Italy (log GDP 20.87, log per capita GDP 9.92) and Argentina (log GDP 19.69, log per capita GDP 9.24). Italy (70th percentile by private credit) is much more financially developed than Argentina (40th percentile by private credit). The graph plots the share of trade by value replaced by new products in each sector (averaged across all bilateral partners) against the external finance dependence of the sector. All data for 1995.

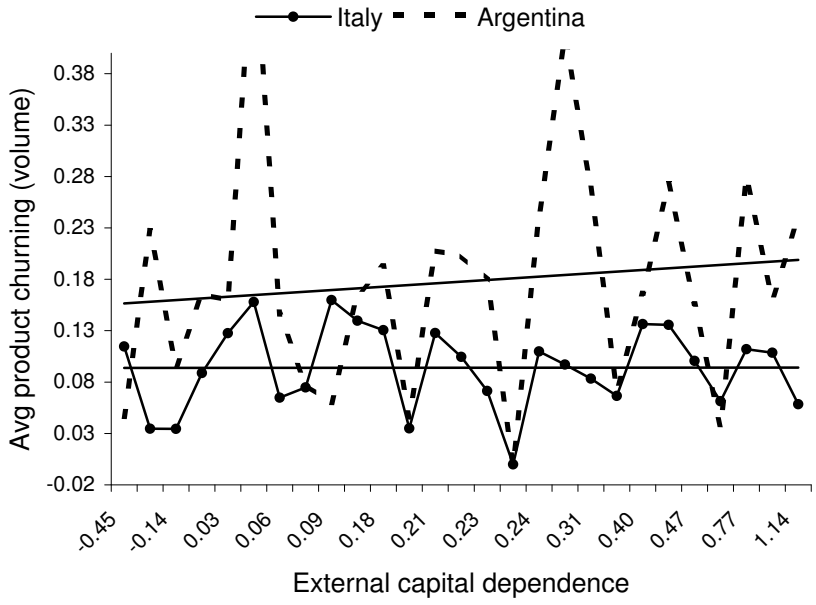

Figure 9. The Productivity Cut-off for Exporting
(Credit constraints in the financing of fixed costs only)

This graph plots profits as a function of productivity and shows the wedge between the productivity cut-offs for exporting with and without credit constraints in the financing of fixed costs.

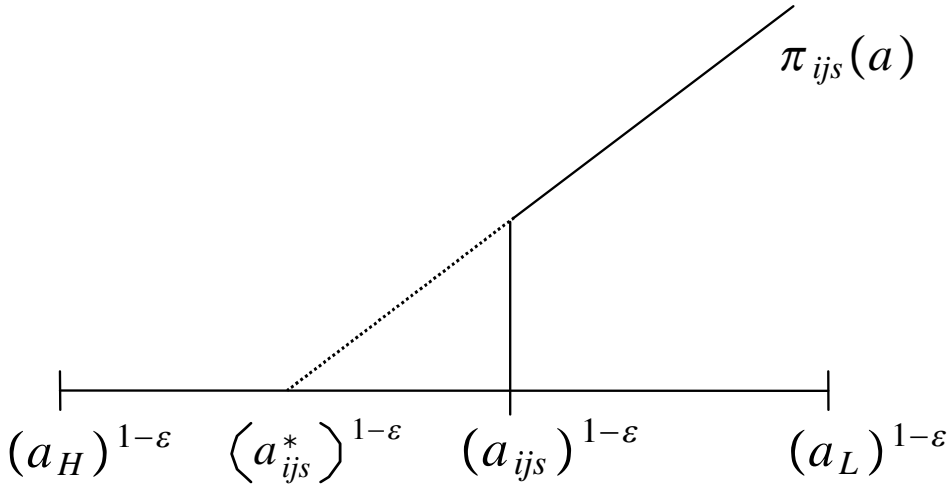

Figure 10. The Productivity Cut-off for Exporting
(Credit constraints in the financing of fixed and variable costs)

This graph plots profits as a function of productivity and shows the wedge between the productivity cut-offs for exporting with and without credit constraints in the financing of fixed and variable costs. The graph also shows the lower profits earned by firms with productivity below the cut-off for exporting at first-best levels.

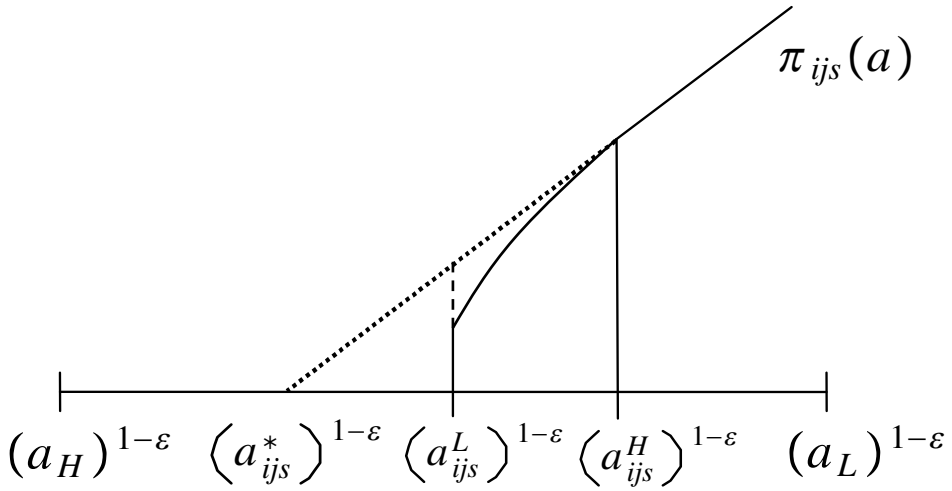

Table 1. Export Patterns in the Data

This table summarizes the variation in export behavior 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 the number of trade partners a country has in each sector; the export volumes, range of products and extent of 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 or in the 10-digit HS classification, which is only available for 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	32.354	41.145	38.050	0	163
partners>0	3,913	35.943	41.854	37.716	1	163
Bilateral exports (in logs)	137,490	6.306	2.832	1.146	0	17.723
Product variety						
SITC-4, full sample	137,490	5.342	6.614	1.965	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	0.280	0.386	0.157	0	14
SITC-4, by value	113,188	0.155	0.279	0.120	0	1
HS-10, by count	3,550	0.573	0.462	0.289	0	10
HS-10, by value	3,550	0.341	0.360	0.254	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* is the (log) number of domestic establishments in the exporting country by year and sector. I proxy for the sectoral price index in the importing country with the importer's consumer price index (CPI) and its interactions with sector dummies in Column 3; the importer's consumption by sector in Column 4; and a full set of importer-sector fixed effects in Column 5. *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 5. T-statistics in parenthesis. ***, **, and * indicate significance at the1%, 5%, and 10% level.

Financial development measure: Private credit
Dependent variable: m_{ijst}, (log) bilateral exports by 3-digit ISIC 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)***	0.225 (3.64)***	0.267 (4.54)***	0.274 (4.63)***
Fin devt x Ext fin dep	**1.752** **(43.29)***	**1.296** **(28.31)***	**1.343** **(29.01)***	**1.253** **(26.36)***	**1.318** **(31.36)***
Fin devt x Tang	**-2.624** **(-24.65)***	**-2.130** **(-16.41)***	**-2.204** **(-16.64)***	**-2.171** **(-16.45)***	**-2.159** **(-16.34)***
(Log) # Establish		0.318 (40.47)***	0.321 (39.89)***	0.323 (40.66)***	0.351 (40.90)***
p_{is} proxy			0.008 (6.86)***	0.169 (26.74)***	
LGDPE	0.957 (16.75)***	1.079 (16.17)***	1.071 (16.05)***	1.082 (16.29)***	1.128 (16.60)***
LGDPI	0.949 (16.55)***	0.980 (14.41)***	1.040 (16.36)***	0.711 (10.28)***	0.683 (40.31)***
LDIST	-1.374 (-79.05)***	-1.408 (-72.20)***	-1.418 (-70.27)***	-1.414 (-71.74)***	-1.439 (-73.98)***
Controls:					
Exporter, Year FE	Y	Y	Y	Y	Y
Importer, Sector FE	Y	Y	Y	Y	N
Importer x Sector FE	N	N	N	N	Y
R-squared	0.5664	0.5714	0.5800	0.5777	0.5970
# observations	861,380	621,333	579,485	589,205	621,333
# exporter-importer clusters	9,343	7,867	7,452	7,813	7,867
# exporters	107	95	95	95	95

Table 3. Financial Development and the Volume of Exports: 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 (log) number of domestic establishments in the exporter; the importer's CPI and its interactions with sector dummies; 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 also include a constant term, exporter, importer, sector, and year fixed effects; control for the (log) real GDP of both trade partners and the (log) distance between them; 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 3-digit ISIC sector

Financial development measure:	Private Credit	Repudiation of Contracts	Accounting Standards	Risk of Expropriation
Fin devt	-0.019 (-0.24)			
Fin devt x Ext fin dep	**1.101** **(15.38)*****	**0.576** **(19.34)*****	**0.025** **(11.46)*****	**0.551** **(14.38)*****
Fin devt x Tang	**-1.334** **(-6.64)*****	**-1.488** **(-15.78)*****	**-0.071** **(-11.12)*****	**-1.474** **(-12.58)*****
(Log) # Establish	0.314***	0.302***	0.306***	0.305***
Importer's CPI	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	0.5947	0.5939	0.6077	0.5926
# observations	428,444	436,931	396,112	436,931
# exporter-importer clusters	4,130	4,132	3,374	4,132
# exporters	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 7 trade barrier proxies: (log) distance, indicators for at least one landlocked or island trade partner, whether the two countries share a common border, language, colonizer or past colonial relationship. All regressions include a constant term, exporter, importer, sector, and year fixed effects; the (log) number of domestic establishments in the exporter; the importer's CPI and its interactions with sector dummies; the (log) real GDP of both partners; factor endowments, institutions and GDP per capita, and their interactions with sector intensities 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 an industry

Financial development measure:	Private Credit	Repudiation of Contracts	Accounting Standards	Risk of Expropriation
Fin devt	-0.106 (-2.12)**			
Fin devt x Ext fin dep	**0.988** **(20.50)***	**0.327** **(20.96)***	**0.022** **(18.72)***	**0.438** **(22.48)***
Fin devt x Tang	**-0.829** **(-8.74)***	**-0.565** **(-15.08)***	**-0.030** **(-9.81)***	**-0.564** **(12.21)***
Importer's CPI	0.007***	0.007***	0.008***	0.007***
LGDPE	5.535***	5.800***	8.064***	5.798***
LGDPI	0.381***	0.389***	0.419***	0.390***
LDIST	-1.026***	-1.035***	-1.097***	-1.036***
Any Landlocked	0.008	-0.004	0.074	-0.012
Any Island	-0.259***	-0.253***	-0.296***	-0.254***
Common Border	-0.048	-0.046	0.003	-0.046
Common Language	0.333***	0.338***	0.322***	0.337***
Common Colony	0.121*	0.122*	0.336***	0.124*
Ever Colony	0.867***	0.840***	0.910***	0.848***
Controls:	LGDPE, LGDPI, LDIST, Exp, Imp, Year, Sector FE, CPI x Sector FE K, H, N, LGDPCE, Institutions and Interactions			
Pseudo R-squared	0.5122	0.5123	0.5177	0.5124
# observations	1,203,201	1,229,337	1,012,176	1,229,337
# exporter-importer clusters	4,464	4,464	3,678	4,464

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 control for the trade barrier proxies in Table 4 except for the indicator for at least one island country. All regressions include a constant term, exporter, importer, sector, and year fixed effects; the (log) number of domestic establishments in the exporter, the importer's CPI and its interactions with sector dummies, the (log) real GDP of both partners and the (log) distance between them. All regressions control for factor endowments, institutions and GDP per capita, and their interactions with sector intensities as in Table 3, 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 3-digit ISIC sector

Financial development measure:	Private Credit	Repudiation of Contracts	Accounting Standards	Risk of Expropriation
Panel A. Maximum Likelihood Estimation				
Fin devt	-0.007 (-0.09)			
Fin devt x Ext fin dep	**0.624** **(6.79)*** **	**0.421** **(11.93)*** **	**0.013** **(5.24)*** **	**0.337** **(7.38)*** **
Fin devt x Tang	**-0.955** **(-4.65)*** **	**-1.263** **(-12.42)*** **	**-0.053** **(-8.13)*** **	**-1.196** **(-9.85)*** **
delta (from w_{ijs})	0.556 (5.53)***	0.579 (5.55)***	0.674 (7.29)***	0.580 (5.66)***
eta_{ijs}	1.164 (12.86)***	1.130 (12.14)***	0.963 (11.86)***	1.126 (12.35)***
(Log) # Establish	0.298***	0.287***	0.291***	0.291***
Importer's CPI	0.005***	0.005***	0.006***	0.005***
Controls:	LGDPE, LGDPI, LDIST, Exp, Imp, Year, Sector FE, CPI x Sector FE K, H, N, LGDPCE, Institutions and Interactions, Barriers			
# observations	428,441	436,928	396,109	436,928
# exporter-importer clusters	4,129	4,131	3,373	4,131

Table 5. Financial Development and Firm-Level Exports (cont.)

Dependent variable: m_{ijst}, (log) bilateral exports by 3-digit ISIC 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	0.004			
	(0.05)			
Fin devt x Ext fin dep	**0.508**	**0.400**	**0.013**	**0.292**
	(5.36)* **	**(11.43)*** **	**(5.61)*** **	**(6.34)*** **
Fin devt x Tang	**-0.855**	**-1.217**	**-0.053**	**-1.124**
	(-4.15)* **	**(-12.25)*** **	**(-8.24)*** **	**(-9.39)*** **
z_{ijs}	2.935	2.887	2.500	2.870
	(13.73)***	(13.66)***	(11.82)***	(13.52)***
z_{ijs} ^2	-0.521	-0.501	-0.402	-0.499
	(-7.85)***	(-7.55)***	(-5.87)***	(-7.45)***
z_{ijs} ^3	0.033	0.030	0.022	0.030
	(4.40)***	(4.03)***	(2.95)***	(4.01)***
eta_{ijs}	1.539	1.527	1.375	1.518
	(18.08)***	(18.50)***	(17.57)***	(18.23)***
(Log) # Establish	0.300***	0.289***	0.292***	0.292***
Importer's CPI	0.005***	0.005***	0.006***	0.005***
Controls:	LGDPE, LGDPI, LDIST, Exp, Imp, Year, Sector FE, CPI x Sector FE K, H, N, LGDPCE, Institutions and Interactions, Barriers			
R-squared	0.6238	0.6233	0.6335	0.6217
# observations	428,441	436,928	396,109	436,928
# exporter-importer clusters	4,129	4,131	3,373	4,131
Panel C. Most flexible specification: OLS with 50 bins for predicted probability				
Fin devt	-0.010			
	(-0.13)			
Fin devt x Ext fin dep	**0.625**	**0.436**	**0.015**	**0.341**
	(8.54)* **	**(14.84)*** **	**(6.92)*** **	**(8.86)*** **
Fin devt x Tang	**-0.952**	**-1.279**	**-0.056**	**-1.188**
	(-4.75)* **	**(-13.61)*** **	**(-8.87)*** **	**(-10.26)*** **
(Log) # Establish	0.300***	0.289***	0.292***	0.292***
Importer's CPI	0.006***	0.006***	0.007***	0.006***
Controls:	LGDPE, LGDPI, LDIST, Exp, Imp, Year, Sector FE, CPI x Sector FE K, H, N, LGDPCE, Institutions and Interactions, Barriers			
R-squared	0.6238	0.6232	0.6335	0.6216
# observations	428,441	436,928	396,109	436,928
# exporter-importer clusters	4,129	4,131	3,373	4,131

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 (log) number of domestic establishments in the exporter; 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. Dependent variable: (log) # SITC-4 products exported bilaterally within ISIC-3 sector					
Fin devt	-0.086	-0.089			
	(-3.83)***	(-3.17)***			
Fin devt x Ext fin dep	**0.405**	**0.335**	**0.176**	**0.008**	**0.190**
	(28.67)* **	**(16.37)*** **	**(18.45)*** **	**(11.74)*** **	**(16.32)*** **
Fin devt x Tang	**-0.455**	**-0.400**	**-0.272**	**-0.014**	**-0.268**
	(-10.46)* **	**(-6.07)*** **	**(-10.10)*** **	**(-7.14)*** **	**(-8.00)*** **
(Log) # Establish	0.098***	0.092***	0.090***	0.091***	0.091***
Importer's CPI	0.007***	0.008***	0.008***	0.009***	0.008***
Controls:	LGDPE, LGDPI, LDIST, Exp, Imp, Year, Sector FE, CPI x Sector FE K, H, L, LGDPCE, Institutions and Interactions				
R-squared	0.6332	0.6445	0.6432	0.6546	0.6428
# 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. Dependent variable: (log) # HS-10 products exported to the U.S. within ISIC-3 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	0.8627	0.8872	0.8882	0.8971	0.8872
# observations	9,605	5,836	5,916	4,899	5,916
# exporters	87	38	38	30	38

Table 7. Financial Development and Product Churning in Exports

This table examines the effect of credit constraints on product churning in exports. The dependent variable is the survival or entry rate of products in exports 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, wheareas 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.

Panel A. Level of disaggregation: 4-digit SITC products within 3-digit ISIC sectors

Financial development measure:	Private Credit		Repudiation of Contracts	Accounting Standards	Risk of Expropriation
Pr(Survival) = # Surviving Products / # Products Last Period , by ISIC					
Fin devt	-0.005	-0.029			
	(-0.93)	(-3.92)***			
Fin devt x Ext fin dep	0.072	0.036	0.024	0.002	0.031
	(18.78)***	(6.43)***	(8.61)***	(9.46)***	(8.83)***
Fin devt x Tang	-0.086	0.016	-0.023	-0.002	-0.033
	(-9.00)***	(1.11)	(-3.37)***	(-3.08)***	(-3.72)***
R-squared	0.1419	0.1509	0.1502	0.1596	0.1502
Pr(Entry) = # New Products / # Products Last Period , by ISIC					
Fin devt	-0.017	0.003			
	(-1.42)	(0.19)			
Fin devt x Ext fin dep	-0.129	-0.046	-0.033	-0.003	-0.053
	(-19.56)***	(-4.90)***	(-6.71)***	(-7.47)***	(-8.58)***
Fin devt x Tang	0.148	0.029	0.040	0.002	0.068
	(9.27)***	(1.20)	(3.55)***	(2.24)**	(4.51)***
R-squared	0.0865	0.0943	0.0938	0.0981	0.0939
Controls:	LGDPE, LGDPI, LDIST, Exp, Imp, Year, Sector FE, CPI, 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

Table 7. Financial Development and Product Churning in Exports (cont.)

Panel B. Level of disaggregation: 10-digit HS products within 3-digit ISIC sectors

Financial development measure:	Private Credit		Repudiation of Contracts	Accounting Standards	Risk of Expropriation
Pr(Survival) = # Surviving Products / # Products Last Period , by ISIC					
Fin devt	0.003	0.011			
	(0.07)	(0.24)			
Fin devt x Ext fin dep	0.160	0.114	0.070	0.004	0.086
	(6.48)***	(3.17)***	(5.49)***	(3.25)***	(5.03)***
Fin devt x Tang	-0.138	-0.067	-0.065	-0.006	-0.082
	(-2.16)**	(-0.84)	(-1.70)*	(-3.11)***	(-1.65)
R-squared	0.3960	0.4300	0.4320	0.4262	0.4325
Pr(Entry) = # New Products / # Products Last Period , by ISIC					
Fin devt	-0.084	-0.104			
	(-0.85)	(-0.92)			
Fin devt x Ext fin dep	-0.236	-0.126	-0.103	-0.004	-0.115
	(-6.49)***	(-2.25)**	(-3.56)***	(-2.39)**	(-3.17)***
Fin devt x Tang	0.088	0.121	0.129	0.008	0.114
	(0.93)	(1.08)	(2.27)**	(1.75)*	(1.62)
R-squared	0.1864	0.2140	0.2116	0.2336	0.2110
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 Partner Intensity

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

Dependent variable: number of countries country *j* exports to, by 3-digit ISIC sector

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

Table 9. Financial Development and the Market Size of Export Destinations

This table examines the effect of credit constraints on the market size of countries' trading partners. In Panel A the dependent variable is the (log) GDP of the largest export partner of country *j* in sector *s* and year *t*, 1985-1995. In Panels B and C the dependent variable is the (log) GDP of the country at the 10th percentile of the market size distribution across country *j*'s export partners in a 3-digit ISIC sector *s* and year *t*, 1985-1995. The sample is restricted to exporter-sector-year observations with more than 5 trade partners. The measure of financial development is indicated by the column heading. External finance dependence *Ext fin dep* and asset tangibility *Tang* are defined in the text. All regressions include a constant term, exporter, sector, and year fixed effects, and cluster errors by exporter. Columns 2-5 control for factor endowments, institutions, GDP per capita, and their relevant interactions as in Table 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. Largest export partner					
Dep variable: maximum (log) GDP across export partners, by 3-digit ISIC sector					
Fin devt	-0.007	0.103			
	(-0.09)	(1.67)			
Fin devt x Ext fin dep	**-0.059**	**0.078**	**-0.027**	**-0.002**	**-0.046**
	(-1.15)	**(0.86)**	**(-0.57)**	**(-1.76)***	**(-1.01)**
Fin devt x Tang	**0.446**	**-0.251**	**0.060**	**0.005**	**0.246**
	(3.06)***	**(-1.01)**	**(0.47)**	**(0.91)**	**(1.77)***
LRGDPE	-0.173	1.518	1.472	0.486	1.458
	(-1.68)*	(3.64)***	(3.56)***	(1.46)	(3.57)***
Controls:		Exporter, Year and Sector Fixed Effects			
		K, H, N, LGDPCE, Institutions and Interactions			
R-squared	0.2719	0.3370	0.3356	0.4562	0.3377
# observations	20,991	11,819	12,089	9,961	12,089
# exporters	107	42	42	34	42
Panel B. Smallest export partner					
Dep variable: 10th percentile of the distribution of export partners' (log) GDP, by 3-digit ISIC sector					
Fin devt	-0.313	-0.102			
	(-1.60)	(-0.45)			
Fin devt x Ext fin dep	**-0.335**	**-0.465**	**-0.172**	**-0.015**	**-0.184**
	(-3.54)***	**(-3.51)*****	**(-2.52)****	**(-3.32)*****	**(-1.74)***
Fin devt x Tang	**0.740**	**1.141**	**0.477**	**0.028**	**0.672**
	(2.75)***	**(2.23)****	**(3.35)*****	**(2.31)****	**(3.37)*****
LRGDPE	-0.495	-3.469	-3.610	-3.594	-3.644
	(-2.20)**	(-2.06)**	(-2.24)**	(-2.35)**	(-2.28)**
Controls:		Exporter, Year and Sector Fixed Effects			
		K, H, N, LGDPCE, Institutions and Interactions			
R-squared	0.5351	0.4933	0.4926	0.5314	0.4930
# observations	20,991	11,819	12,089	9,961	12,089
# exporters	107	42	42	34	42

Table 9. Financial Development and the Market Size of Export Destinations (cont.)

Financial development measure:	Private Credit		Repudiation of Contracts	Accounting Standards	Risk of Expropriation
Panel C. Smallest export partner					
Dep variable: 10th percentile of the distribution of export partners' (log) GDP, by 3-digit ISIC sector					
Fin devt	-0.387	-0.115			
	(-2.35)***	(-0.60)			
Fin devt x Ext fin dep	**0.258**	**-0.115**	**-0.028**	**-0.007**	**0.006**
	(3.03)* **	**(-1.03)**	**(-0.59)**	**(-1.81)***	**(0.07)**
Fin devt x Tang	**0.511**	**0.762**	**0.237**	**0.014**	**0.394**
	(2.49) **	**(2.08)** **	**(2.04)** **	**(1.23)**	**(2.47)** **
# Partners	-0.015	-0.015	-0.015	-0.014	-0.015
	(-13.30)***	(-15.10)***	(-15.19)***	(-15.16)***	(-15.71)***
LRGDPE	-0.122	-1.672	-1.738	-0.345	-1.761
	(-0.67)	(-1.08)	(-1.16)	(-0.28)	(-1.19)
Controls:	Exporter, Year and Sector Fixed Effects				
	K, H, N, LGDPCE, Institutions and Interactions				
R-squared	0.5738	0.5841	0.5820	0.6207	0.5826
# observations	20,991	11,819	12,089	9,961	12,089
# exporters	107	42	42	34	42

Table 10. Extensive vs. Intensive Margin and Importer's Market Size

This table examines the relative effect of credit constraints on the extensive and intensive margins of trade depending on the market size of the destination country, 1985-1995. The table reports the ratio of the coefficient on the interaction of financial development with external finance dependence (asset tangibility) from a product variety regression as in Table 6 to the same coefficient from a bilateral export volumes regression as in Table 3. This statistic is reported for each of four subsamples based on the market size of the destination country in that year, as indicated in the column heading. All regressions include a constant term, exporter, importer, sector, and year fixed effects, and cluster errors by exporter-importer pair. All regressions control for the exporter's (log) number of establishments by sector; factor endowments, institutions, GDP per capita, and their relevant interactions as in Table 3; and the importer's CPI and its interactions with sector fixed effects. Entries in bold indicate that the ratio was taken from statistically significant coefficients.

Financial contractibility measure:	Bottom Quartile	2nd Quartile	3rd Quartile	Top Quartile
Private Credit				
Fin devt x Ext fin dep	**63.56%**	**42.13%**	**32.01%**	**17.02%**
Fin devt x Tang	207.13%	**108.88%**	**34.31%**	8.35%
Repudiation of Contracts				
Fin devt x Ext fin dep	**74.77%**	**43.12%**	**31.81%**	**20.13%**
Fin devt x Tang	**35.71%**	**24.34%**	**22.32%**	**14.09%**
Accounting Standards				
Fin devt x Ext fin dep	**46.88%**	**38.41%**	**29.61%**	**27.14%**
Fin devt x Tang	**22.83%**	**23.36%**	**18.57%**	**18.51%**
Risk of Expropriation				
Fin devt x Ext fin dep	240.25%	**47.86%**	**37.99%**	**22.50%**
Fin devt x Tang	7.89%	**21.83%**	**25.00%**	**13.59%**
Controls	LGDPE, LGDPI, LDIST, Exp, Imp, Year, Sector FE, Establish CPI, CPI x Sector FE, K, H, L, LGDPCE, Institutions and Interactions			

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 edxpropriation, 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	Average	St Dev	Country	Average	St Dev	Country	Average	St Dev
Algeria	0.3524	0.2220	Germany	0.9324	0.0400	Nigeria	0.1415	0.0359
Argentina	0.1413	0.0299	Ghana	0.0374	0.0081	Norway	0.8691	0.1010
Australia	0.5398	0.1394	Greece	0.3662	0.0707	Pakistan	0.2437	0.0204
Austria	0.8707	0.0577	Guatemala	0.1424	0.0193	Panama	0.4729	0.0731
Bangladesh	0.1512		Guinea-Bissau[1]	0.0280	0.0209	Papua New Guinea	0.2335	0.0505
Barbados	0.4188	0.0451	Guyana	0.2317		Paraguay	0.1603	0.0495
Belize	0.3652	0.0312	Haiti	0.1081	0.0186	Peru	0.0898	0.0306
Benin	0.1075	0.0269	Honduras	0.2887	0.0414	Philippines[2]	0.2263	0.0807
Bolivia	0.2413	0.1405	Hong Kong	1.3529	0.0924	Poland	0.1070	0.0760
Brazil[3]	0.2436	0.0811	Hungary	0.3320	0.1058	Portugal[4]	0.5793	0.0901
Bulgaria	0.0588	0.0336	Iceland	0.3979	0.0566	Rwanda	0.0867	0.0167
Burkina Faso	0.1342	0.0327	India	0.2563	0.0353	Senegal	0.2711	0.0451
Burundi	0.0860	0.0333	Indonesia	0.3323	0.1291	Seychelles	0.1031	0.0203
Cameroon	0.2011	0.0735	Iran	0.2860	0.0303	Sierra Leone	0.0287	0.0031
Canada	0.7345	0.0571	Ireland	0.6313	0.0195	Singapore	0.9510	0.0578
Centr Afr Rep	0.0707	0.0236	Israel	0.5329	0.0532	South Africa	0.5038	0.0305
Chad	0.0955	0.0485	Italy	0.5380	0.0486	South Korea	0.7989	0.1325
Chile	0.5064	0.0719	Jamaica	0.2629	0.0415	Spain	0.7653	0.0506
China	0.7840	0.0448	Japan[5]	1.6269	0.1618	Sri Lanka	0.1569	0.0480
Colombia	0.2398	0.0744	Jordan	0.6658	0.0457	St Kitts and Nevis	0.5399	0.1095
Congo	0.1188	0.0402	Kenya	0.2938	0.0185	Sweden	1.1508	0.1675
Costa Rica	0.1410	0.0283	Madagascar	0.1522	0.0192	Switzerland	1.5535	0.1123
Cote d'Ivoire	0.3282	0.0613	Malawi	0.1032	0.0205	Syrian Arab Rep	0.0763	0.0123
Cyprus	0.8688	0.2281	Malaysia	0.8455	0.1727	Thailand	0.6429	0.1784
Denmark	0.4340	0.0757	Mali	0.1212	0.0159	Togo	0.2376	0.0263
Dominican Rep	0.2376	0.0258	Malta	0.7165	0.1495	Trinidad & Tobago	0.4813	0.0469
Ecuador	0.1842	0.0515	Mauritania	0.3334	0.0618	Tunisia	0.5648	0.0710
Egypt	0.2928	0.0308	Mauritius	0.3229	0.0679	Turkey	0.1403	0.0116
El Salvador	0.0424	0.0229	Mexico	0.1867	0.0936	Uganda	0.0227	0.0093
Equator Guinea	0.1802	0.0692	Morocco	0.2547	0.1306	United Kingdom	0.9492	0.2265
Ethiopia	0.1551	0.0342	Mozambique	0.1038	0.0127	United States	0.9057	0.0453
Fiji	0.3345	0.0580	Nepal	0.1205	0.0325	Uruguay	0.2516	0.0505
Finland	0.7424	0.1297	Netherlands	1.2910	0.1821	Venezuela	0.3079	0.1446
France	0.8632	0.0772	New Zealand	0.6318	0.2377	Zambia	0.0598	0.0154
Gabon	0.1530	0.0590	Nicaragua	0.1808	0.1251	Zimbabwe	0.2015	0.0561
Gambia	0.1331	0.0417	Niger	0.1336	0.0351			
Average in the cross-section:		0.3885				Average in the panel:		0.3970
Standard deviation in the cross-section:		0.3414				Standard deviation in the panel:		0.3486

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 sectoral 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 the corresponding firm-level exports regression in Table 5 to the coefficient on the same interaction in a regression of sector level exports with the same controls (not reported), 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 sectoral export volumes

Financial development measure:	Private Credit	Repudiation of Contracts	Accounting Standards	Risk of Expropriation
Panel A. Maximum Likelihood Estimation				
Fin devt x Ext fin dep	57%	73%	51%	61%
Fin devt x Tang	72%	84%	74%	80%
Panel B. More flexible specification: OLS with polynomial in z_{ijs}				
Fin devt x Ext fin dep	47%	69%	53%	53%
Fin devt x Tang	65%	81%	74%	76%
Panel C. Most flexible specification: OLS with 50 bins for predicted probability				
Fin devt x Ext fin dep	57%	76%	61%	61%
Fin devt x Tang	72%	85%	78%	80%
Controls: LGDPE, LGDPI, LDIST, Exp, Imp, Year, Sector FE, CPI, CPI x Sector FE, Barriers Establish, K, H, N, LGDPCE, Institutions and Interactions				
Average across all specifications				
Fin devt x Ext fin dep	60%			
Fin devt x Tang	77%			