Firm Exports and Multinational Activity under Credit Constraints

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Abstract. This paper provides firm-level evidence that credit constraints restrict international trade flows and affect the pattern of foreign direct investment. Using detailed data from China, we show that foreign-owned firms and joint ventures have better export performance than private domestic firms, and this advantage is systematically greater in sectors at higher levels of financial vulnerability measured in a variety of ways. This confirms that financial frictions restrict international trade and is consistent with foreign affiliates being less credit constrained because they can tap internal funding from their parent company. We also find that private Chinese firms are relatively more successful exporters than state-owned enterprises in financially dependent industries. Since SOEs enjoy easier access to lending from Chinese state-owned banks, this pattern suggests that they use resources less efficiently. Our results imply that FDI can compensate for domestic financial market imperfections and alleviate their impact on aggregate growth, trade and private sector development. Credit constraints and host-country financial institutions thus offer a new explanation for the sectoral and spatial composition of MNC activity.

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1 Introduction

A growing body of work has established that the strength of countries' financial institutions is an important determinant of the volume and sectoral composition of their international trade flows. At the same time, it has been suggested that foreign direct and portfolio investments can partially offset the detrimental consequences of local financial underdevelopment. However, direct firm-level evidence on the effect of credit constraints on export performance and the potential mitigating role of cross-border capital exchange has been limited and elusive. Moreover, the finance and trade literature has evolved largely independently of that on the optimal production and organizational decisions of multinational corporations (MNCs).

This paper fills this void by providing an integrated analysis of the role that financial frictions play in constraining firms' export participation and shaping the spatial and sectoral composition of MNC activity. Using detailed customs data from China, we show that foreign affiliates and joint ventures have better export performance than private domestic firms, and this advantage is systematically greater in sectors at higher levels of financial vulnerability measured in a variety of ways. This evidence is consistent with credit constraints limiting firms' cross-border trade and foreign firms being less constrained because they can tap internal funds from their parent company.[1] Our results thus imply that credit availability and host-country financial institutions affect the sectoral composition of MNC activity abroad, since foreign affiliates have a comparative advantage in financially dependent sectors. More broadly, FDI can compensate domestic financial market imperfections and alleviate their impact on aggregate growth, trade and private sector development.

We also document systematic differences between state-owned and privately-held Chinese firms. Although state-owned enterprises (SOEs) export more than private domestic companies on average, the latter outperform SOEs in financially more dependent industries. SOEs, however, have been shown to enjoy preferential treatment and substantially easier access to financing from Chinese state-owned banks.[2] Our results thus confirm anecdotal evidence that state ownership is associated with inferior managerial practices and less efficient use of financial resources.

Our analysis exploits recently released customs data on the universe of Chinese firms that engaged in international trade in 2005. These data report the value of all firm-level shipments by product and destination country for the universe of trade transactions, which allows us to examine the effect of credit conditions on all margins of firms' export participation. We find that financial frictions restrict exporters' product scope, number of trade partners, and volume of cross-border flows within each product-destination

[1] See Desai, Foley and Hines (2004) for evidence that MNCs employ internal capital markets opportunistically to overcome imperfections in external capital markets. The affiliates of US MNCs abroad use less external financing in countries with underdeveloped financial markets, but compensate with greater borrowing from the parent company.
[2] See, for example, Dollar and Wei (2007), Huang et al. (2008) and Poncet et al. (2008).

market. Foreign ownership, however, allows firms to expand exports along all of these margins. These results indicate that firms face binding credit constraints in the financing of both fixed and variable trade costs. They also indirectly confirm priors that companies have to incur market-specific fixed costs of entry.

While establishing causality has been a challenge in the prior literature, it does not constitute a hurdle for our analysis. First, our estimation allows for the inclusion of firm fixed effects. This controls for firm characteristics that affect export performance equally in all industries, such as its total availability of external finance, managerial competence, quality of the labor force, or access to foreign distribution networks. Our results are thus identified purely from the variation in trade outcomes across sectors within multi-sector firms, and reflect the way in which firms allocate their limited financial resources across production and exports in different industries.

Second, our results could not be attributed to multinationals choosing to integrate Chinese firms with greater export potential. While this could explain why MNC affiliates and joint ventures outperform domestic companies on average, it cannot rationalize the differential effect of foreign ownership on firm exports across sectors. Moreover, if MNC headquarters specifically target better Chinese firms in financially vulnerable industries, this would be consistent with the idea that MNCs do so precisely to exploit their comparative advantage in overcoming credit constraints.[3]

Understanding the role of financial frictions for firms' export participation has important policy implications, particularly for countries at lower levels of development that rely on extensive cross-border trade for economic growth. The rapid decline in international trade during the current global financial crisis has renewed interest in these questions, with recent studies confirming that credit tightening was an important channel through which the crisis distressed world trade.[4]

This paper contributes to the growing literature on the effects of financial frictions on international trade. This literature has established theoretically and empirically that, in the presence of credit constraints, countries with more advanced financial markets and institutions have a comparative advantage in financially vulnerable sectors.[5] Although scant, there has also been some micro-level evidence that has shed light on the mechanisms through which credit market imperfections affect aggregate trade outcomes. For example, using an indicator of firms' credit worthiness, Muûls (2008) shows that liquidity-constrained firms in Belgium are less likely to become exporters and, conditional on trading, sell less, in fewer products, to fewer destinations. Berman and Héricourt (2008) proxy firms' liquidity needs with balance-

[3] See Javorcik and Spatareanu (2009) for evidence that less credit-constrained Czech firms self-select into becoming arms-length suppliers for MNCs.

[4] See Chor and Manova (2009) and Freund and Klapper (2009) on the current crisis, and Iacovone and Zavacka (2009) and Amiti and Weinstein (2009) on past financial crisis episodes.

[5] See Kletzer and Bardhan (1987), Beck (2002), Matsuyama (2005), Becker and Greenberg (2007), Chaney (2005), Manova (2008b) and Ju and Wei (2008) for theoretical models; and Beck (2002, 2003), Becker and Greenberg (2007), Svaleryd and Vlachos (2005), Hur et al. (2006) and Manova (2008b) for empirical evidence.

sheet variables, and report similar results in a sample of 5,000 firms in 9 developing and emerging economies. A challenge for these studies has been establishing a causal effect of credit conditions on firms' export performance since the measures of financial constraints they use are endogenous to firms' international trade decisions.[6] They also implicitly explore only firms' access to external capital through local banking institutions, and do not examine the role of foreign direct and portfolio investments. Instead, we exploit the systematic variation in export outcomes across firms of different organizational structures and across sectors at different levels of financial vulnerability to more convincingly establish a causal effect of credit constraints on trade.

Our work is most closely related to a few recent papers that link MNC activity and financial frictions to firms' export performance. These papers specifically emphasize that subsidiaries of multinational companies can access internal capital markets to overcome liquidity constraints. For instance, Desai, Foley and Forbes (2008) use data on the operations of US multinationals abroad to show that foreign affiliates respond faster and more effectively to profitable export opportunities than domestic firms. Following large real exchange rate devaluations, affiliates receive more financing from their parent company which allows them to increase sales, assets and investment, while local firms contract or do not expand. Unfortunately, Desai, Foley and Forbes (2008) are not able to directly examine the consequences of these effects for firms' export levels.

More recently, Antràs, Desai and Foley (2009) propose a model which endogenizes the production location and integration decisions of multinational firms in the presence of credit constraints, relationship specific investments and contractual imperfections. In their framework, MNCs are more likely to integrate their foreign suppliers in financially less developed countries in order to incentivize local investors to finance these suppliers. Parent companies are also likely to partly fund their affiliates' operations. Using data on the activities of US multinationals abroad, Antràs, Desai and Foley (2009) find support for these predictions.[7] They do not, however, examine foreign affiliate exports, how they compare to those of domestic firms, or how they vary across sectors.

Our results are consistent with the implications of these papers that multinational firms have a comparative advantage and are more active in financially vulnerable sectors relative to domestic firms. Our contribution is thus in providing direct evidence on the extent to which credit constraints affect all margins of firms' export performance and the sectoral composition of MNC activity.

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[6] See also Greenaway et al. (2007) who find that the financial health of UK firms improves after they start exporting, although at the time of entry into exporting, future exporters do not appear financially healthier than firms serving only the domestic market.

[7] See also Bustos (2007), who shows that Argentinian firms in sectors with greater requirements for external finance are more likely to be foreign-owned and funded by their parent company. Huang et al. (2008), Héricourt and Poncet (2009) and Girma and Gorg (2009) argue that FDI helps private domestic firms in China overcome credit constraints and improve innovation activities.

Since we examine the export performance of foreign affiliates based in China, we implicitly study the behavior of foreign companies pursuing vertical or export-platform FDI. On the other hand, Buch, Kesternich, Lipponer and Schnitzer (2009) consider a model of horizontal FDI and present empirical evidence that credit conditions matter for firm's choice between directly exporting to a market and setting up a local affiliate there. In a richer framework that incorporates multinationals' complex global production strategies, Chor, Foley and Manova (2007) demonstrate that host country financial development increases the share of affiliate production meant for re-exporting back to the parent and to third-country destinations (i.e. vertical and export-platform FDI) relative to sales in the local market (i.e. horizontal FDI).[8]

This paper also complements the results in Manova (2008a), who shows that equity market liberalizations increase countries' exports disproportionately more in financially vulnerable sectors. Moreover, these effects are stronger in economies with less developed stock markets prior to reform. Our findings thus indicate that not only foreign equity flows, but also foreign direct investment can lessen the detrimental effects of financial underdevelopment on countries' trade performance.

Finally, our results add to a large literature on the role of international financial integration in promoting growth, investment and entrepreneurship in host countries. In contrast to our findings, however, prior evidence suggests that the beneficial growth effects of FDI may be stronger in economies with better developed financial markets because of their greater absorptive capacity and ability to allocate resources.[9]

The remainder of the paper is organized as follows. The next section provides theoretical background for our empirical analysis. Section 3 describes the data, while Section 4 presents our results. The last section concludes.

2 Motivation and Theoretical Background

2.1 Why exporters require external finance

Domestic producers and exporters routinely rely on external capital because they have to incur substantial upfront costs that cannot be financed out of retained earnings or internal cash flows from operations. These costs may be sunk, in the sense that they need to be paid only once upon entry into an industry, market or product line, or recurrent per-period costs. Most upfront outlays are fixed in nature and, once met, have no bearing on firms' scale of operations, such as expenditures on R&D and product development, marketing research, advertising, and investment in fixed capital equipment. In addition, some variable expenses such

[8] See Markusen (1984), Brainard (1997), Markusen and Venables (2000) and Helpman, Melitz and Yeaple (2004) for classical models of horizontal FDI, in which firms locate production in a foreign market when it is cheaper to service it that way instead of direct exporting. See Helpman (1984) and Yeaple (2003) for models of vertical FDI, in which firms move parts of the production process abroad to exploit cross-country differences in factor prices.

[9] See, for example, Alfaro and Charleton (2007) and Alfaro et al. (2009).

as intermediate input purchases, advance payments to salaried workers, and land or equipment rental fees are also typically sustained before production and sales take place.

Exporting is associated with additional upfront expenditures that make production for foreign markets even more dependent on external financing than manufacturing for the home country. Sunk and fixed costs of international trade include learning about the profitability of potential export markets; making market-specific investments in capacity, product customization and regulatory compliance; and setting up and maintaining foreign distribution networks. Variable trade costs comprise mainly shipping, duties and freight insurance. As with production, most of these expenses have to be incurred before export revenues are realized. Finally, cross-border shipping and delivery typically take 60 days longer to complete than domestic orders, which further aggravates exporters' working capital needs and requirements for outside finance relative to those of domestic producers. For these reasons, a very active market operates for the financing and insurance of international transactions, reported to be worth about $10-$12 trillion in 2008. Up to 90% of world trade has been estimated to rely on some form of trade finance.[10]

While access to external finance is important in all industries, some sectors depend considerably more on the financial system. The literature has identified two important determinants of sectors' financial vulnerability that are technologically determined, exogenous from the perspective of individual firms, and innate to the nature of the industry. First, firms in some sectors have substantially greater liquidity needs because they face bigger upfront costs and thus require more outside capital (Rajan and Zingales, 1998). In our empirical analysis, we will employ three commonly used proxies for sectors' liquidity needs: external finance dependence, R&D intensity, and the ratio of inventories to sales. Second, industries differ in their endowment of tangible assets that can be pledged as collateral (Braun 2003, Claessens and Laeven 2003). As is standard in the literature, we will measure sectors' asset tangibility with the share of plant, property and equipment in total book value assets.

2.2 Theoretical framework

The literature has offered a number of theoretical models to rationalize the consequences of financial market imperfections for international trade. An important implication of these models is that the effect of credit constraints varies across countries and sectors, such that financially developed economies have a comparative advantage in financially vulnerable industries. Here we outline a simplified framework that ignores the country dimension, which we use to guide the empirical analysis of the variation in Chinese firms' export performance across sectors. We first summarize the predictions of a model that incorporates

[10] See Auboin (2009).

financial frictions in a heterogeneous-firm world à la Melitz (2003).[11] We then use it to infer the differential effects of credit constraints on domestic firms and MNC affiliates.

In the model, exporters require external capital, which they can raise in the financial market by pledging collateral. Contracts between firms and investors are enforced with a certain probability, which in a world with multiple economies depends on the country's strength of financial institutions. When a financial contract is honored, the borrower repays the investor; otherwise, the firm defaults and the creditor claims the collateral. Industries, however, differ in their reliance on outside finance and in their availability of tangible assets, as described above. Thus, entrepreneurs find it more difficult to begin exporting in financially vulnerable sectors since they need to obtain more trade financing or potential investors expect a lower return in case of default.

In the absence of liquidity constraints, all firms with productivity above a certain cut-off level become exporters, as in Melitz (2003). Financial frictions, however, interact with firm heterogeneity and reinforce the selection of only the most productive firms into exporting: Because more efficient companies earn bigger revenues, they can offer creditors a higher return in case of repayment, and are thus more likely to secure the necessary outside capital. Importantly, the exporting cut-off varies systematically across sectors, and is higher in financially more vulnerable industries. Credit constraints thus preclude potentially profitable firms from engaging in international trade and result in inefficiently low aggregate trade flows.

When companies require outside funds only for their fixed costs of production and cross-border trade, credit conditions affect the selection of firms into exporting but not the level of their sales abroad. On the other hand, when firms face liquidity constraints in the financing of their variable costs as well, limited access to trade credit also restricts their scale of operations. While the most productive (and least constrained) exporters may still export at first-best levels, less productive firms are only able to do so if they ship lower volumes than would be optimal in the absence of financial frictions. Such firms can secure less outside credit than would be necessary to trade at first-best levels, and use it to support lower export quantities which entail lower variable costs. The extent of this distortion once again varies systematically across sectors. In particular, firms have to curtail their export volumes more if they are active in a financially vulnerable industry.

If exporters incur repeated fixed costs in every foreign market they enter, credit constraints also affect the number of firms' export destinations. In the absence of liquidity constraints, firms' decision to sell in a particular country is independent of the decision to service other markets. By contrast, when firms have limited access to financing, they optimally add export destinations in decreasing order of profitability

[11] The discussion in this section is based on the model developed in Manova (2008b). Note that Manova (2008b) focuses on single-product firms only, but we also discuss an extension to the case of multi-product firms.

until they hit their budget constraint and exhaust their resources. This implies that, conditional on firm productivity, exporters in financially vulnerable sectors transact with fewer trade partner countries.

Credit constraints have similar implications for another dimension of exporters' profile: the range of products they trade. The literature on multi-product firms has suggested that profitability varies across goods within a firm based on the efficiency level and consumer preferences specific to the firm-product pair.[12] With product-specific fixed costs and limited access to external capital, firms must rationalize their product scope. While the number of goods a firm ships may vary across destinations depending on importer characteristics, exporters offer a narrower set of products overall and sell fewer goods to any given market when they face tight credit conditions. Moreover, these effects are more pronounced in sectors with greater requirements for external capital and limited availability of collateralizable assets.

The organizational structure of a firm can importantly affect its financing decisions and access to external capital. Compared to private domestic companies, firms with partial or full foreign ownership can exploit additional sources of financing. In particular, MNC affiliates can tap deeper internal capital markets and obtain funds from their parent company.[13] In the Chinese context, state-owned enterprises are also more immune to credit constraints since they enjoy preferential treatment and access to external finance from Chinese state-owned banks. Therefore, foreign-owned firms and SOEs should have an advantage over domestic companies in overcoming binding credit constraints, which will manifest in all dimensions of firms' export activity: total sales, number of trade partners, and product scope. In addition, this advantage will be greater in sectors characterized by particularly high upfront costs and limited tangible assets.

Note that the discussion so far has assumed that firms' productivity level is fixed and predetermined by an exogenous productivity draw. Companies may, however, be able to improve their efficiency by investing in a superior production technology. This typically entails substantial fixed upfront costs. Firms may also have the capacity to upgrade product quality by employing more expensive inputs of higher quality, better skilled workers, or novel production processes. Credit constraints, however, will curb such investments in productivity and quality. Once again, these effects will be more pronounced in financially vulnerable sectors. Moreover, two firms may be born identical but have different export outcomes if one of them is foreign or state owned and thus able to upgrade its productivity or quality level. This illustrates an alternative mechanism through which financial frictions can restrict a firm's trade performance since export revenues, number of trade partners and potential product scope are increasing in production efficiency and product quality.

[12] See, for example, Bernard, Redding and Schott (2009).

[13] Note that this discussion does not consider MNCs' incentives to set up an affiliate abroad. We return to this issue and specifically address concerns with endogeneity when we interpret our empirical results. See Antràs, Desai and Foley (2008) for a model that incorporates MNCs' production location, integration and financing decisions.

To summarize, we expect credit constraints to affect both the extensive margin (firm selection into exporting; firms' number of export destinations; firms' product scope) and the intensive margin (firm exports) of trade. These effects will be more pronounced in financially vulnerable sectors, but mitigated by foreign and state ownership. For convenience, we will abuse standard terminology and refer to these patterns as MNC affiliates and SOEs having a comparative advantage in financially dependent industries relative to private domestic firms.

3 Data

We use recently released data on the activity of all Chinese firms that participated in international trade over the 2003-2005 period.[14] These data have been collected by the Chinese Customs Office and cover the universe of trade transactions. They report the free-on-board value of firm exports (in US dollars) by product and trade partner for 231 destination countries and 6,908 different products in the 8-digit Harmonized System.[15] The dataset also provides information on the organizational structure of the firm, which makes it possible to distinguish between state-owned enterprises (SOEs), private domestic firms (including collectively-owned firms), fully foreign-owned affiliates of multinational firms (MNCs), and joint ventures (with foreign ownership under 100%). While the data are available at a monthly frequency, we focus on annual exports in the most recent year in the panel, 2005.

Some SOEs in China are pure export-import companies which do not engage in manufacturing and serve exclusively as intermediaries between domestic producers (buyers) and foreign buyers (suppliers). In this paper, we examine the operations of firms that both make and trade goods, and exclude wholesalers from our analysis. Since the customs data do not directly indicate these intermediaries, we use keywords in firms' names to identify them.[16]

We employ four different measures of sectors' financial vulnerability, which have been commonly used in the literature on the role of credit constraints for trade and growth. These variables are meant to reflect technologically determined characteristics of each sector that are exogenous from the perspective of individual firms. While firms in all industries may face liquidity constraints, there are systematic differences across sectors in the relative importance of up-front costs and the lag between the time production expenses are incurred and revenues are realized. We capture these differences with a measure of sectors' external finance dependence ($ExtFin_i$), constructed as the share of capital expenditures not financed with cash flows from operations. For robustness, we also use the share of R&D spending in total sales (RD_i), since research and development typically occur at the beginning of a production process before a

[14] Manova and Zhang (2008) describe the data and present stylized facts about firm heterogeneity in Chinese trade.
[15] Product classification is consistent across countries at the 6-digit HS level. The number of distinct product codes in the Chinese 8-digit HS classification is comparable to that in the 10-digit HS trade data for the United States.
[16] We drop 23,073 wholesalers which mediate a quarter of China's trade by value.

product can be manufactured and successfully marketed. As a third indicator of firms' liquidity needs, we exploit the ratio of inventories to sales ($Invent_i$) which proxies the delay between manufacturing and sales and the working capital firms require in order to maintain inventories and meet demand. Finally, sectors vary not only in firms' liquidity needs and reliance on external capital, but also in firms' endowment of tangible assets that can serve as collateral when raising outside finance. We thus use a measure of asset tangibility ($Tang_i$), defined as the share of net plant, property and equipment in total book value assets.

As is standard in the literature, our measures of sector financial vulnerability are constructed from data on all publicly traded U.S.-based companies from Compustat's annual industrial files.[17] This approach is not only motivated by the lack of data for most other countries, including China. First, the United States have one of the most advanced and sophisticated financial systems, which makes it reasonable that the behavior of U.S. companies reflects firms' optimal asset structure, demand for and use of external capital. Second, using the U.S. as the reference country eliminates the potential for the measure of sectors' financial vulnerability to endogenously respond to countries' level of financial development. In fact, if the most financially vulnerable industries in the U.S. use more internal financing and tangible assets in China because of the worse financial system there, our results would be biased downwards. Finally, what is required for identification in the empirical analysis is not that industries have the same tangibility and liquidity needs in the U.S. and China, but rather that the ranking of sectors remain relatively stable across countries. Kroszner, Laeven and Klingebiel (2007), Rajan and Zingales (1998) and Claessens and Laeven (2003), among others, argue that the measures of financial vulnerability capture a large technological component that is innate to a sector and therefore a good proxy for ranking industries in all countries. Consistently with this argument, the measures vary substantially more across sectors than across firms within a sector, and the hierarchy of sectors is quite stable over time.

The four indicators of industries' financial vulnerability are available for 29 sectors in the ISIC 3-digit classification system. In our empirical analysis, we match Chinese HS 8-digit product codes to these ISIC 3-digit sector categories.

3.1 A first glance at the data

Before proceeding to the econometric analysis, in Table 1 we document the distribution of Chinese trade flows across firms with different ownership structure. Two patterns in particular stand out.

First, the lion's share of Chinese trade is conducted by firms with partial or full foreign ownership. China's total exports to the world amounted to $531.4 billion in 2005. State-owned enterprises and private

[17] These sector measures come from Kroszner, Laeven and Klingebiel (2007), and are constructed following the methodology of Rajan and Zingales (1998) and Claessens and Laeven (2003). They are averaged over the 1980-1999 period for the median U.S. firm in each sector, and appear very stable over time.

domestic firms, however, were responsible for merely 10% and 13% of these flows, respectively. By contrast, joint ventures accounted for a quarter of all exports, while foreign affiliates sent more than half of China's exports. These statistics speak volumes about the importance of multinational companies and foreign direct investment for China's tremendous export success in the recent past.

The second pattern that emerges from Table 1 is that foreign-owned firms capture a systematically bigger share of Chinese exports in industries at higher levels of financial vulnerability. When we group sectors into three bins by external finance dependence, we find that MNC affiliates channel 52% of exports in industries at medium and high values of $ExtFin_i$, compared to 41% in industries with low values of $ExtFin_i$. On the other hand, private domestic firms mediate almost twice as big a share of exports in sectors with limited need for outside finance, relative to sectors that rely more heavily on external capital. State enterprises exhibit similar, if less pronounced patterns. Finally, the contribution of joint ventures to China's trade is more equally balanced across industries, and its distribution falls between that for fully foreign-owned and fully domestic firms.

We observe even more extreme sorting behaviors when we group sectors according to our other two measures of liquidity constraints: R&D intensity and inventories to sales ratio. Foreign affiliates account for fully 60% of exports in sectors with high liquidity needs, compared to only 30% in sectors with limited liquidity needs. On the other hand, SOEs and private domestic firms capture roughly 6%-8% of trade flows in industries with high R&D intensity and inventories ratio, and 20%-25% in industries with more severe liquidity constraints. As before, joint ventures contribute about the same share of Chinese exports in all sectors. Qualitatively and quantitatively similar patterns obtain when we distinguish between sectors with low, medium and high levels of asset tangibility, with a greater proportion of trade conducted by foreign firms in sectors with few collateralizable assets.

The evidence from these summary statistics anticipates the results from our econometric analysis in the next section. It is consistent with a credit-constraints view of international trade and investment, whereby private domestic firms are relatively more credit constrained, and thus under-represented in financially vulnerable sectors relative to foreign affiliates, joint ventures and SOEs. While private domestic firms can only borrow in the local financial market, foreign ownership provides access to internal capital from the parent company and state ownership facilitates financing from Chinese state-owned banks.

4 Empirical Results

We begin the analysis by exploring the variation in worldwide export revenues across firms with different organizational structures and across sectors at different levels of financial vulnerability. We find evidence consistent with credit constraints restricting firms' exports, foreign ownership relaxing these constraints, and state ownership being associated with inefficient use of financial resources. We then establish that

these results carry over to both the intensive and the extensive margin of trade at the firm level. We show that credit constraints limit firm exports within each sector-destination or product-destination market, as well as firms' product scope and number of export destinations.

4.1 Effect of credit constraints on firms' total exports

We first examine the systematic variation in firms' worldwide export revenues across sectors and firm ownership types. To that end, we estimate the following specification:

$$\log Exports_{fi} = \alpha_0 + \alpha_1 \cdot D_{SOE} + \alpha_2 \cdot D_{JV} + \alpha_3 \cdot D_{MNC} + \beta \cdot FinVuln_i \cdot D_{SOE} + \gamma \cdot FinVuln_i \cdot D_{JV} + \delta \cdot FinVuln_i \cdot D_{MNC} + \varphi_i + \varepsilon_{fi} \quad (1)$$

Here $Exports_{fi}$ are the free-on-board export sales of firm *f* in industry *i*, pooled across all of *f*'s export destinations. D_{SOE}, D_{JV} and D_{MNC} are binary indicator variables which take the value of 1 for state-owned enterprises, joint ventures and fully foreign-owned multinational affiliates, respectively, and 0 otherwise. $FinVuln_i$ measures sector *i*'s level of financial vulnerability, which in alternative regressions we proxy with *i*'s external finance dependence, R&D intensity, inventories-to-sales ratio or asset tangibility. Finally, φ_i are industry fixed effects, and ε_{fi} is an error term. At this level of aggregation, we work with 231,908 observations covering 93,581 companies and 29 sectors.

The omitted category in this analysis is the set of private domestic firms. The main effects of the three dummies thus capture any differences in average export performance between firms of different ownership type that are invariant across sectors. For example, joint ventures and MNC affiliates may have easier access to foreign distribution networks through their parent company, enjoy preferential tax treatment, be more productive, have better managerial practices, employ more skilled workers, or offer higher quality products relative to domestic companies. If so, in any given industry, foreign firms may have superior export performance than local firms on average, and this advantage would be reflected in positive and significant point estimates for α_2 and α_3.

The industry fixed effects in this regression in turn control for systematic differences in firm exports across sectors that do not depend on the organizational structure of the company. If China has a comparative advantage in a given industry such as textiles, all textile producers may have larger export revenues than manufacturers of electrical machinery, regardless of whether the firm is domestic or foreign owned, privately held or state run. Similarly, within each firm active in multiple sectors, worldwide textile sales may exceed exports of electrical machines, irrespectively of the ownership status of the firm. The industry dummies thus explicitly account for factor endowment and Ricardian determinants of China's comparative advantage, as well as sector-specific demand shocks that affect the level of all firms' exports. The φ_i's also absorb the main effect of $FinVuln_i$.

The main coefficients of interest in (1) are those on the three interaction terms. They are identified from the variation in export sales across firms of different ownership types within a given industry. If credit constraints indeed limit firm exports, we anticipate lower worldwide sales in more financially vulnerable sectors. However, the distortionary effect of financial frictions would be mitigated in foreign-owned firms if Chinese affiliates can obtain internal funding from the parent company in addition to any credit they raise in the local financial market. We thus expect that $\delta > \gamma > 0$, where the first inequality reflects the notion that fully integrated MNC affiliates may benefit from deeper internal capital markets relative to joint ventures. This might be, for example, because the parent company has greater monitoring rights or managerial control over the activities of the affiliate at higher levels of foreign ownership. Finally, we also predict that $\beta > 0$, since state-owned enterprises in China are known to benefit from easier access to financing from local state-owned banks.

4.1.1 The role of foreign ownership

As column 1 in Table 2 shows, foreign-owned firms earn systematically higher export revenues than private domestic firms, and this lead is more pronounced in sectors with greater requirements for external capital. Moreover, relative to Chinese-held companies, MNC affiliates exhibit an even greater comparative advantage in financially dependent sectors than joint ventures. Similar results obtain when we proxy the severity of firms' liquidity constraints with sectors' R&D intensity or inventories-to-sales ratio in columns 2 and 3. Foreign-owned firms also export disproportionately more in sectors with few tangible assets relative to joint ventures, who in turn outperform local firms in those sectors (column 4). Note that the interactions of the ownership dummies with sectors' asset tangibility enter with the opposite sign to the interactions with the three measures of sectors' liquidity needs, since financially more vulnerable industries feature greater reliance on external finance and fewer hard assets that can serve as collateral.

These results are highly statistically and economically significant. While foreign affiliates export more than private domestic companies in all industries, this advantage is 20% bigger in sectors with high requirements for external capital relative to sectors with low dependence on outside finance. The corresponding number for joint ventures is 13%. Moving from a sector with few assets that can serve as collateral to a sector with high asset tangibility increases the exports of private domestic firms by fully 72% and 35% more than the exports of MNC affiliates and joint ventures, respectively.[18]

Our results strongly suggest that credit constraints restrict firms' export activity but foreign ownership alleviates the effects of financial frictions. Our analysis thus serves two purposes. First, it provides new evidence on the causal effect of credit constraints on international trade at the firm level.

[18] These comparative statics are based on columns 1 and 4 in Table 2. For these calculations, we compare sectors at the 25th and 75th percentile of the distribution of external finance dependence (asset tangibility) across sectors.

Note that potential concerns about reverse causality do not invalidate this conclusion. In particular, it is possible that multinationals intentionally choose to vertically integrate Chinese firms with greater export potential. While this could explain the positive coefficient on the foreign ownership dummies, it cannot rationalize the differential effect of foreign ownership on firm exports across sectors. Moreover, if MNC headquarters specifically target better Chinese firms in financially vulnerable sectors, this would be consistent with the idea that MNCs do so precisely to exploit their comparative advantage in overcoming credit constraints (see below). But the latter would only emerge if credit constraints indeed limit firms' export performance.

Second, our findings indicate that financial considerations affect the sectoral composition of MNC activity abroad. In the presence of imperfect capital markets in the host country, multinational companies may have an incentive to enter financially vulnerable sectors because of their comparative advantage in overcoming liquidity constraints. Two related mechanisms may drive these incentives. On the one hand, domestic firms are underrepresented in such sectors because they find it difficult to raise the necessary external finance to produce and export. In financially vulnerable industries, MNC affiliates thus face less competition in the local market for sector-specific inputs, as well as less competition from other Chinese suppliers in foreign export markets. Both of these forces would generate relatively higher profits for MNC affiliates in sectors intensive in external finance and intangible assets. Note that this explanation is based on the production location decisions of foreign companies, but remains silent about whether such production takes place within the boundaries of the firm.

An alternative, but not mutually exclusive reason why foreign affiliates and joint ventures have relatively higher exports than domestic firms in financially vulnerable industries takes into account the effects of financial frictions on MNCs' integration decisions. Imagine that foreign headquarters would like to move (parts of) production to China, and use Chinese output for exports to third destinations or back to the home country of the parent company. The local Chinese producer will find it more difficult to raise working capital if it is active in a financially vulnerable sector. To ensure production takes place, the foreign company may decide to vertically integrate the Chinese supplier so as to help finance its activities. This explanation is consistent with the results in Antràs, Desai and Foley (2009), who suggest that foreign ownership emerges endogenously to alleviate credit constraints faced by the (Chinese) producer. In their framework, MNC headquarters either directly fund their affiliate or monitor its operations so that host country banks would be willing to finance it. Given the dominance and priorities of state-owned banks in the Chinese financial market, direct lending from the parent company or access to trade financing from the parent company's bank abroad are much more likely to apply in the Chinese context.

One potential concern with the interpretation above is that factors other than credit constraints and the financial vulnerability of a sector may affect companies' incentive to move production abroad. In the

classical model of vertical FDI, foreign firms optimally splice the production chain across borders in order to exploit cross-country differences in factor prices.[19] This model, however, examines firms' production location decisions, without determining the boundaries of the firm. For example, a U.S. company may move the unskilled-labor intensive stages of its production process to China, but it may use either an integrated supplier or an unrelated input provider. Because our analysis distinguishes between domestic and foreign-owned firms as opposed to final-good and intermediate-good exporters, it is thus not obvious that the classical predictions of vertical FDI models can explain our results. However, recent work on the joint location and vertical integration decisions of MNCs does suggest that MNCs may be more active in capital intensive industries.[20] If sectors' factor intensity is systematically correlated with our four measures of financial vulnerability, our results may be spurious.

Table 3 confirms that our findings are not driven by MNCs moving production to China to exploit factor price differences across countries. We expand specification (1) to include the interaction of the three firm ownership dummies with sectors' physical and human capital intensity. We find that joint ventures and foreign affiliates export systematically more than private domestic firms in industries that employ less physical capital and more skilled workers. However, these patterns are independent of the effect of credit constraints on firms' exports and on the sectoral composition of MNC activity. The coefficient estimates for β, γ and δ remain qualitatively and quantitatively unchanged.

4.1.2 The role of state ownership

While our results corroborate the expected advantage of foreign-owned firms over domestic companies in financially vulnerable sectors, our findings for the export performance of state-owned enterprises appear counterintuitive at first glance. We find that SOEs earn greater export revenues than privately-held domestic firms in the same sector on average (Table 2). However, this advantage is, if anything, weaker instead of stronger in financially vulnerable sectors. In other words, the point estimates on $FinVuln_i \cdot D_{SOE}$ are of the opposite sign as those on $FinVuln_i \cdot D_{JV}$ and $FinVuln_i \cdot D_{MNC}$, although $FinVuln_i \cdot D_{SOE}$ is only significant when we measure sectors' financial vulnerability with the endowment of tangible assets that can serve as collateral. Qualitatively similar results obtain in Table 3, where we control for the interaction of firm ownership dummies with sectors' physical and human capital intensity. The point estimates for $FinVuln_i \cdot D_{SOE}$ are now negative and significant when we exploit the variation in external finance dependence or R&D intensity across sectors, and statistically insignificant when we use asset tangibility or the inventories-to-sales ratio.

[19] See, for example, Helpman (1984) and Yeaple (2003).
[20] See Antras (2003).

The literature on bank financing in China has argued that SOEs receive preferential treatment from local state-owned banks relative to private firms.[21] If state companies enjoy easier access to external capital or lower interest rates on bank loans, we would expect that they would have a comparative advantage and export more than private domestic firms in sectors where credit constraints are more binding. This prediction, however, depends crucially on the assumption that firms of different ownership types are governed equally skillfully and use financial resources equally efficiently. Yet, anecdotal evidence suggests that SOEs are poorly managed and allocate capital inefficiently. If this holds in all sectors regardless of their level of financial vulnerability, it would introduce noise in the estimation and explain why we find no systematic differences in the sectoral composition of exports by state enterprises and private domestic firms. Generating a comparative *dis*advantage for SOEs in financially vulnerable sectors requires that managerial and asset allocation inefficiencies be more severe and more detrimental to export success in sectors with bigger liquidity needs and fewer collateralizable assets.

Since the Chinese government exerts considerable control over the activities of state-owned enterprises, it is likely that it has influence over the sectors in which they produce and export. Our results indirectly indicate that either relaxing credit constraints where they are most restrictive is not one of the determinants of SOE industry choices, or it is, but certain inefficiencies prevent its successful realization.

4.1.3 Controlling for firm fixed effects

The analysis so far has exploited the variation across firms of different ownership type within a given sector, as well as the variation across sectors within firms of a given ownership type. Note that among firms of a certain organizational structure, some firms may be active in one sector only, while others may produce and export in multiple industries. In our sample, about half of all firms indeed trade goods in more than one ISIC 3-digit sector.

The estimated coefficients in Tables 2 and 3 thus reflect systematic differences between the exports of the *average* firm in a given sector and ownership type relative to the exports of the *average* private domestic firm in the same sector. These estimates therefore capture the combined effect of credit constraints on firm-level exports and on the selection of firms into exporting.

We next establish that financial frictions directly constrain trade flows at the firm level. We do so by including firm fixed effects φ_f in (1) and estimating the following specification:

$$\log Exports_{fi} = \alpha_0 + \beta \cdot FinVuln_i \cdot D_{SOE} + \gamma \cdot FinVuln_i \cdot D_{JV} + \delta \cdot FinVuln_i \cdot D_{MNC} + \varphi_i + \varphi_f + \varepsilon_{fi} \quad (2)$$

[21] See, for example, Dollar and Wei (2007) and Huang et al. (2008).

The firm fixed effects in this regression subsume the three ownership dummies, and control for other firm-level characteristics that affect a company's export performance equally in all sectors. These may include the firms' managerial competence, the quality of its labor force, or its access to foreign distribution networks. Importantly, the φ_f's also capture the firm's total availability of external finance, be it from local banks or a foreign parent company. The coefficients on the three interaction terms are thus identified purely from the variation in worldwide export revenues across sectors within multi-sector firms. They implicitly reflect the way in which firms choose to allocate their limited financial resources across production and exports in different industries. This approach also ensures that our results are not driven by some endogenous sorting of single-sector firms into industries and ownership types for reasons other than credit constraints

Panel A of Table 6 confirms that credit constraints affect the sectoral composition of firms' exports. Relative to domestic companies, foreign-owned firms obtain a bigger share of their export revenues from financially vulnerable sectors that require more external finance, are more R&D intensive, have a higher inventories-to-sales ratio, and employ fewer tangible assets. The results for the industrial composition of SOEs are once again not always statistically significant, and of considerably lower economic importance relative to those for foreign ownership.

The point estimates we obtain for γ and δ are about twice as large in magnitude as those in Table 2, where firm fixed effects are excluded and the results reflect the combined effect of financial frictions on firm-level exports and firm selection into exporting. This is consistent with the predictions of the theoretical framework in Section 2. Since joint ventures and MNC affiliates are less credit constrained than private domestic firms, they face a lower productivity cut-off for exporting, and this cut-off is systematically lower in financially vulnerable sectors. Because less productive firms earn lower export revenues, this effect tends to bring down the average export sales of foreign-owned firms relative to private companies in financially vulnerable industries. This selection effect can therefore explain why the regressions that exclude firm fixed effects underestimate the impact of credit constraints on the level and sectoral composition of firms' exports.

4.2 Effect of credit constraints on the intensive margin of firms' exports

We next examine the effect of credit constraints on the intensive margin of firms' exports by exploiting the substantial level of detail in the Chinese customs data. We consider firms' bilateral export sales by sector and estimate the following specification:

$$\log Exports_{fdi} = \alpha_0 + \alpha_1 \cdot D_{SOE} + \alpha_2 \cdot D_{JV} + \alpha_3 \cdot D_{MNC} + \beta \cdot FinVuln_i \cdot D_{SOE} + \gamma \cdot FinVuln_i \cdot D_{JV} + \delta \cdot FinVuln_i \cdot D_{MNC} + \varphi_d + \varphi_i + \varepsilon_{fdi} \quad (3)$$

Here $Exports_{fdi}$ is the value of firm f's exports to destination d in industry i. As before, we include industry fixed effects φ_i to account for cross-sector differences in transportation costs, demand shocks and any other industry specific factors (including financial vulnerability) that affect all exporters. We also condition on country fixed effects φ_d to control for the variation in trade costs, market size, consumer income, the bilateral exchange rate and any other characteristics of the destination market that influence firms' export sales. At this level of aggregation, we analyze 1,080,331 observations on 93,581 companies, 231 importing countries and 29 sectors.

As Table 4 indicates, MNC affiliates have systematically higher bilateral exports in financially vulnerable industries relative to joint ventures, who in turn outperform private domestic firms in such sectors. Although state-owned enterprises export more than private Chinese companies on average, this advantage is less pronounced in financially more vulnerable industries. These results are highly statistically and economically significant, with point estimates about half of those for firms' worldwide exports in Table 2. They are also robust to allowing firms' export profile to respond to sectors' factor usage. This is illustrated in Panel B where we expand the regression to include the interactions of the ownership dummies with industries' physical and human capital intensity.

Very similar patterns obtain when we explore the full richness of the data, and define firms' intensive margin of trade as bilateral exports by HS 8-digit product (Table 5). The estimating equation remains the same as (3), but the outcome variable is now measured at the firm-product-destination level instead of at the firm-sector-destination level. This allows us to explore the systematic variation in trade flows across 93,581 firms, 231 importing countries, 29 sectors and 6,908 products, for a total of 2,140,579 observations.

Finally, we confirm the effects of credit constraints on the intensive margin of firms' exports by including firm fixed effects and identifying the three interaction terms from the variation across sectors and destinations within firms.[22] Panel B of Table 6 presents our results for firms' bilateral exports by industry, while Panel C reports those for firm's bilateral sales by product. In both cases, the point estimates for γ and δ are substantially greater than those obtained from the regressions without firm fixed effects.

These results have three implications in the context of the model discussed in Section 2. First, they indicate that firms face credit constraints in the financing of variable costs of production and exporting. If financial frictions were binding only with respect to the fixed costs of international trade, they would affect the extensive margin of firms' exports but not export revenues. Second, our findings provide further support for the idea that foreign ownership alleviates firms' credit constraints via internal capital markets.

[22] The exact specification we estimate is $\log Exports_{fdi} = \alpha_0 + \beta \cdot FinVuln_i \cdot D_{SOE} + \gamma \cdot FinVuln_i \cdot D_{JV} + \delta \cdot FinVuln_i \cdot D_{MNC} + \varphi_d + \varphi_i + \varphi_f + \varepsilon_{fdi}$.

On the other hand, while state ownership may facilitate access to bank financing within China, the patterns in the data point to SOEs allocating resources less efficiently across sectors. Finally, the difference between the results with and without firm fixed effects is consistent with credit constraints influencing both the selection of firms into exporting, as well as firm-level exports as discussed at the end of the previous subsection.

4.3 Effect of credit constraints on the extensive margin of firms' exports

The last question we address is the effect of credit constraints on the extensive margin of firms' exports. In particular, we document how financial considerations influence firms' export product scope, number of export destinations, and total number of product-trade partner relationships. We use the following specifications to explore how these three extensive margins vary across firms of different organizational structure and across sectors at different levels of financial vulnerability:

$$\log \#Products_{fi} = \alpha_0 + \beta \cdot FinVuln_i \cdot D_{SOE} + \gamma \cdot FinVuln_i \cdot D_{JV} + \delta \cdot FinVuln_i \cdot D_{MNC} + \varphi_i + \varphi_f + \varepsilon_{fi} \quad (4)$$

$$\log \#Dest_{fi} = \alpha_0 + \beta \cdot FinVuln_i \cdot D_{SOE} + \gamma \cdot FinVuln_i \cdot D_{JV} + \delta \cdot FinVuln_i \cdot D_{MNC} + \varphi_i + \varphi_f + \varepsilon_{fi} \quad (5)$$

$$\log \#ProdDest_{fi} = \alpha_0 + \beta \cdot FinVuln_i \cdot D_{SOE} + \gamma \cdot FinVuln_i \cdot D_{JV} + \delta \cdot FinVuln_i \cdot D_{MNC} + \varphi_i + \varphi_f + \varepsilon_{fi} \quad (6)$$

$\#Products_{fi}$ is defined as the number of HS-8 products that firm *f* exports to at least one market in industry *i*. $\#Dest_{fi}$ gives the number of destination countries, to which firm *f* exports at least one product in sector *i*. Finally, $\#ProdDest_{fi}$ represents the total number of product-importer trading relationships firm *f* maintains in industry *i*. It is given by the sum of the number of bilaterally traded products to country *d* ($\#Products_{fdi}$) across all destinations *d*, or $\#ProdDest_{fi} = \sum_d \#Products_{fdi}$. In all regressions we include firm fixed effects to identify the coefficients of interest purely from the variation within firms across sectors.[23]

The evidence in Table 7 strongly suggests that MNC affiliates and joint ventures offer a broader range of products to more countries in financially vulnerable sectors relative to private domestic firms. These results are robust to the choice of sector measure for the number of export destinations and number of product-trade partner relationships (Panels B and C), but somewhat mixed for firms' overall product scope (Panel A). The role of state ownership is more difficult to interpret. Compared to private Chinese companies, SOEs enter more destination-product markets in financially vulnerable sectors, but do not

[23] Since the unit of observation is a firm-sector pair, the sample size is 213,896 observations as in Table 2.

necessarily have a wider product range or more trade partners in general. We attribute this ambiguity to the counteracting effects of SOEs having easier access to bank financing and poorer financial management.

Finally, we directly analyze how credit constraints affect the number of products firms export bilaterally. The advantage of this approach is that it allows us to include both firm and destination fixed effects to control for unobserved importer characteristics that determine firms' optimal export product scope:

$$\log \#Products_{fdi} = \alpha_0 + \beta \cdot FinVuln_i \cdot D_{SOE} + \gamma \cdot FinVuln_i \cdot D_{JV} + \delta \cdot FinVuln_i \cdot D_{MNC} + \varphi_d + \varphi_i + \varphi_f + \varepsilon_{fi} \quad (4)$$

We continue to observe that foreign affiliates and joint ventures export a broader range of products in financially vulnerable sectors relative to private domestic firms (Table 8). Moreover, state ownership also appears to be associated with wider product scope in such industries, compared to private Chinese firms.

In symmetry with the effects of financial frictions on firms' intensive margin of trade, these findings, too, have three important implications in view of the theoretical framework above. First, they indicate that credit constraints severely impact firms' ability to enter more markets and expand the range of products they sell there. This means that firms face binding constraints in the financing of fixed export costs, since variable costs alone would not generate such large movements in firms' extensive margin. Second, foreign ownership, and possibly state ownership, can significantly relax these constraints. Finally, the evidence indirectly confirms earlier results in the literature that firms face repeated costs of exporting in each destination-product market they enter. If the fixed trade cost were instead market specific but invariant with product scope, or were at the product level regardless of the number of export destinations, credit constraints would have affected either only $\#Dest_{fi}$ or $\#Products_{fi}$, but not $\#ProdDest_{fi}$ or $\#Products_{fdi}$.

5 Conclusion

This paper provides micro-level evidence on the important consequences of financial market imperfections for firms' ability to engage in international trade. We show that credit constraints severely restrict companies' overall export sales, hamper their capacity to enter more destination markets, and limit the range of products they trade.

We also demonstrate that MNC affiliates and joint ventures in China have superior export performance compared to private domestic firms, and this advantage is systematically higher in sectors that require more external finance and rely on fewer collateralizable assets. These results are consistent with foreign affiliates accessing internal capital markets in order to overcome

binding credit constraints, thereby having a comparative advantage in financially vulnerable industries. Our findings thus highlight the importance of credit conditions in determining the organizational and financing activities of multinational corporations.

Despite their preferential treatment by domestic state-owned banks and facilitated access to external financing, Chinese state-owned companies underperform privately-held firms in financially more dependent industries. This evidence suggests that managerial competence may be poorer and the allocation of financial resources less efficient in SOEs.

One broader implication of our results is that foreign direct investment can mitigate the detrimental effects of credit market frictions on growth, trade and private sector development in financially underdeveloped economies. On the other hand, the current global crisis has raised concerns about the spread of financial shocks across countries via the financing and production decisions of multinational companies. Whether MNC activity and foreign capital flows improve steady-state credit conditions in host countries at the expense of greater volatility and exposure to world crises constitutes a fruitful area for future research.

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Table 1. Distribution of Trade Flows across Firms and Sectors

This table examines the distribution of 2005 trade flows across firm with different ownership structure and across sectors with different levels of financial vulnerability. All sectoral measures come from KLK and are based on 1980-1999 Compustat data for U.S. firms. External finance dependence is the share of capital expenditures not financed with cash flows from operations. Asset tangibility is the share of net plant, property and equipment in total book value assets. R&D intensity is the share of R&D expenditures in total sales. Liquidity needs is the ratio of inventories to sales. The trade values in the first column are in billion US Dollars. The percentage shares reported in each row sum to 1.

Firm Type	All Firms	State-Owned	Private Domestic	Joint Ventures	Foreign-Owned
Total Exports	531.36	9.8%	12.9%	26.3%	51.0%
Panel A. Classifying sectors by external finance dependence					
Low	58.88	10.7%	21.1%	27.6%	40.6%
Medium	234.09	11.8%	12.0%	24.1%	52.1%
High	238.38	7.6%	11.6%	28.2%	52.6%
Panel B. Classifying sectors by R&D intensity					
Low	156.18	18.1%	23.1%	28.4%	30.4%
High	375.18	6.3%	8.6%	25.4%	59.6%
Panel C. Classifying sectors by inventories-to-sales ratio					
Low	52.55	22.4%	21.2%	28.7%	27.6%
Medium	95.89	19.2%	25.2%	27.7%	27.9%
High	382.91	5.7%	8.6%	25.6%	60.0%
Panel D. Classifying sectors by asset tangibility					
Low	384.20	5.7%	8.6%	25.6%	60.1%
Medium	91.07	15.6%	25.8%	28.5%	30.1%
High	56.09	28.4%	20.8%	27.6%	23.2%

Table 2. Firm-Level Exports by Sector

This table examines the effect of credit constraints on (log) firm-level exports by 3-digit ISIC sector in 2005. Each column reports results using a different measure of sector financial vulnerability. All measures come from KLK and are based on 1980-1999 Compustat data for U.S. firms. External finance dependence is the share of capital expenditures not financed with cash flows from operations. Asset tangibility is the share of net plant, property and equipment in total book value assets. R&D intensity is the share of R&D expenditures in total sales. Liquidity needs is the ratio of inventories to sales. All regressions include a constant term and sector fixed effects. T-statistics in parenthesis. ***, **, and * indicate significance at the 1%, 5%, and 10% level.

Dependent variable: (log) firm-level exports by 3-digit ISIC sector

Sector measure of financial vulnerability:	External Finance Dependence	R&D Intensity	Inventories Ratio	Asset Tangibility
State owned	0.400 (17.16)***	0.422 (13.18)***	0.528 (4.99)***	0.080 (1.18)***
Joint venture	0.529 (28.84)***	0.348 (14.24)***	-0.280 (-3.41)***	1.022 (19.66)***
Foreign owned	0.327 (21.28)***	-0.024 (-1.13)	-0.893 (-12.58)***	1.328 (29.88)***
State owned x Financial vulnerability	**-0.021** **(-0.28)**	**-0.577** **(-0.54)**	**-0.830** **(-1.32)**	**1.040** **(4.81)***
Joint venture x Financial vulnerability	**0.345** **(5.86)***	**7.285** **(8.64)***	**4.661** **(9.67)***	**-1.858** **(-10.64)***
Foreign owned x Financial vulnerability	**0.531** **(10.94)***	**14.072** **(20.47)***	**7.016** **(16.91)***	**-3.769** **(-25.06)***
Controls:		Sector F.E.		
R-squared	0.145	0.146	0.146	0.147
# observations	231,908	231,908	231,908	231,908
# firms	93,581	93,581	93,581	93,581
# sectors	29	29	29	29

Table 3. Firm-Level Exports by Sector: Robustness

This table tests the robustness of the effect of credit constraints on (log) firm-level exports by 3-digit ISIC sector in 2005. Each column reports results using a different measure of sector financial vulnerability. All measures come from KLK and are based on 1980-1999 Compustat data for U.S. firms. External finance dependence is the share of capital expenditures not financed with cash flows from operations. Asset tangibility is the share of net plant, property and equipment in total book value assets. R&D intensity is the share of R&D expenditures in total sales. Liquidity needs is the ratio of inventories to sales. Physical (K) and human (H) capital intensity come form Braun (2003) and are based on 1985-1995 U.S. data. All regressions include a constant term and sector fixed effects. T-statistics in parenthesis. ***, **, and * indicate significance at the 1%, 5%, and 10% level.

Dependent variable: (log) firm-level exports by 3-digit ISIC sector

Sector measure of financial vulnerability:	External Finance Dependence	R&D Intensity	Inventories Ratio	Asset Tangibility
State owned	-0.661 (-6.72)***	-0.617 (-6.57)***	-0.695 (-4.15)***	-0.603 (-5.39)***
Joint venture	0.616 (8.33)***	0.578 (8.08)***	0.225 (1.68)*	0.445 (5.19)***
Foreign owned	0.593 (8.99)***	0.666 (10.48)***	0.003 (0.03)	0.810 (10.68)***
State owned x Financial vulnerability	**-0.251** **(-3.17)***	**-5.857** **(-4.84)***	**0.785** **(1.02)**	**0.296** **(0.79)**
Joint venture x Financial vulnerability	**0.359** **(5.85)***	**6.829** **(6.93)***	**1.243** **(2.06)***	**0.091** **(0.29)**
Foreign owned x Financial vulnerability	**0.565** **(11.06)***	**15.725** **(19.59)***	**1.687** **(3.22)***	**-2.939** **(-10.92)***
State owned x Industry K intensity	-0.122 (-0.12)	-1.497 (-1.39)	1.102 (0.89)	-0.636 (-0.39)
Joint venture x Industry K intensity	-11.53 (-14.08)***	-10.34 (-12.34)***	-10.57 (-10.68)***	-12.01 (-8.89)***
Foreign owned x Industry K intensity	-16.31 (-23.53)***	-13.61 (-19.17)***	-15.16 (-17.79)***	-6.65 (-5.76)***
State owned x Industry H intensity	1.061 (8.35)***	1.265 (9.10)***	0.901 (7.08)***	0.972 (7.48)***
Joint venture x Industry H intensity	0.724 (7.25)***	0.495 (4.44)***	0.815 (8.15)***	0.881 (8.53)***
Foreign owned x Industry H intensity	0.867 (10.11)***	0.176 (1.85)*	1.065 (12.44)***	0.774 (8.74)***
Controls:		Sector F.E.		
R-squared	0.147	0.148	0.146	0.146
# observations	225,898	225,898	225,898	225,898
# firms	92,829	92,829	92,829	92,829
# sectors	28	28	28	28

Table 4. Firm-Level Exports by Sector and Destination

This table examines the effect of credit constraints on (log) firm-level exports by 3-digit ISIC sector and destination in 2005. Each column reports results using a different measure of sector financial vulnerability. All measures come from KLK and are based on 1980-1999 Compustat data for U.S. firms. External finance dependence is the share of capital expenditures not financed with cash flows from operations. Asset tangibility is the share of net plant, property and equipment in total book value assets. R&D intensity is the share of R&D expenditures in total sales. Liquidity needs is the ratio of inventories to sales. All regressions include a constant term, sector fixed effects and destination fixed effects. The regressions in Panel B also control for sector factor intensities and their interactions with firm ownership dummies. Physical (K) and human (H) capital intensity come form Braun (2003) and are based on 1985-1995 U.S. data. T-statistics in parenthesis. ***, **, and * indicate significance at the 1%, 5%, and 10% level.

Dependent variable: (log) firm-level exports by 3-digit ISIC sector and destination

Sector measure of financial vulnerability:	External Finance Dependence	R&D Intensity	Inventories Ratio	Asset Tangibility
Panel A. Basic specification: 93,581 firms, 231 destinations, 29 sectors				
State owned	0.441 (54.95)***	0.510 (45.71)***	0.355 (8.73)***	0.320 (13.82)***
Joint venture	0.636 (96.81)***	0.522 (57.45)***	0.128 (3.75)***	0.857 (44.43)***
Foreign owned	0.370 (61.88)***	0.168 (20.23)***	-0.707 (-23.17)***	1.022 (59.20)***
State owned x Financial vulnerability	**-0.103** **(-3.95)***	**-2.544** **(-7.01)***	**0.546** **(2.31)***	**0.440** **(5.69)***
Joint venture x Financial vulnerability	**0.169** **(7.85)***	**4.687** **(16.11)***	**2.899** **(14.82)***	**-0.851** **(-12.67)***
Foreign owned x Financial vulnerability	**0.279** **(15.12)***	**7.901** **(31.10)***	**6.126** **(35.35)***	**-2.551** **(-41.52)***
Controls:	Destination F.E., Sector F.E.			
R-squared	0.116	0.117	0.117	0.117
# observations	1,080,331	1,080,331	1,080,331	1,080,331
Panel B. Controlling for sector factor intensities: 92,829 firms, 231 destinations, 28 sectors				
State owned x Financial vulnerability	**-0.173** **(-6.42)***	**-5.318** **(-12.76)***	**2.435** **(7.78)***	**0.238** **(1.68)***
Joint venture x Financial vulnerability	**0.114** **(5.07)***	**3.306** **(9.69)***	**2.218** **(8.51)***	**-0.627** **(-5.19)***
Foreign owned x Financial vulnerability	**0.231** **(11.87)***	**7.358** **(24.60)***	**2.861** **(12.20)***	**-2.093** **(-19.07)***
Controls:	Ownership Dummies and Interactions with H, K Intensity, Destination F.E., Sector F.E.			
R-squared	0.119	0.120	0.119	0.119
# observations	1,063,605	1,063,605	1,063,605	1,063,605

Table 5. Firm-Level Exports by Product and Destination

This table examines the effect of credit constraints on (log) firm-level exports by 8-digit HS product and destination in 2005. HS-8 products have been matched to 3-digit ISIC sectors. Each column reports results using a different measure of sector financial vulnerability. All measures come from KLK and are based on 1980-1999 Compustat data for U.S. firms. External finance dependence is the share of capital expenditures not financed with cash flows from operations. Asset tangibility is the share of net plant, property and equipment in total book value assets. R&D intensity is the share of R&D expenditures in total sales. Liquidity needs is the ratio of inventories to sales. All regressions include a constant term, sector fixed effects and destination fixed effects. The regressions in Panel B also control for sector factor intensities and their interactions with firm ownership dummies. Physical (K) and human (H) capital intensity come form Braun (2003) and are based on 1985-1995 U.S. data. T-statistics in parenthesis. ***, **, and * indicate significance at the 1%, 5%, and 10% level.

Dependent variable: (log) firm-level exports by 8-digit HS product and destination

Sector measure of financial vulnerability:	External Finance Dependence	R&D Intensity	Inventories Ratio	Asset Tangibility
Panel A. Basic specification: 93,581 firms, 231 destinations, 29 sectors				
State owned	0.347 (65.53)***	0.431 (62.39)***	0.393 (13.58)***	0.300 (20.53)***
Joint venture	0.780 (159.44)***	0.741 (117.01)***	0.620 (23.55)***	0.821 (60.58)***
Foreign owned	0.552 (125.74)***	0.477 (83.07)***	-0.076 (-3.21)***	0.873 (71.67)***
State owned x Financial vulnerability	**-0.238** **(012.90)***	**-3.183** **(-13.73)***	**-0.141** **(-0.87)***	**0.261** **(4.99)***
Joint venture x Financial vulnerability	**0.108** **(6.43)***	**1.544** **(7.42)***	**0.868** **(5.92)***	**-0.182** **(3.63)***
Foreign owned x Financial vulnerability	**0.235** **(16.68)***	**2.635** **(14.70)***	**3.425** **(26.29)***	**-1.380** **(-30.04)***
Controls:	Destination F.E., Sector F.E.			
R-squared # observations	0.086 2,140,579	0.086 2,140,579	0.086 2,140,579	0.087 2,140,579
Panel B. Controlling for sector factor intensities: 92,829 firms, 231 destinations, 28 sectors				
State owned x Financial vulnerability	**-0.271** **(-14.14)***	**-5.328** **(-19.00)***	**0.097** **(0.42)**	**0.797** **(7.82)***
Joint venture x Financial vulnerability	**0.073** **(4.08)***	**0.383** **(1.49)**	**0.300** **(1.46)**	**0.322** **(3.41)***
Foreign owned x Financial vulnerability	**0.214** **(14.16)***	**1.579** **(7.07)***	**0.270** **(1.46)**	**-0.159** **(-1.89)***
Controls:	Ownership Dummies and Interactions with H, K Intensity, Destination F.E., Sector F.E.			
R-squared # observations	0.088 2,119,410	0.088 2,119,410	0.088 2,119,410	0.088 2,119,410

note: results for liquidity needs robust if using 1980s value instead of 1980-1999

Table 6. Variation in Exports within Firms across Sectors and Destinations

This table identifies the effect of credit constraints on firm-level exports based on the within-firm variation across sectors and destinations. The dependent variable is (log) firm-level exports by 3-digit ISIC sector in Panel A, (log) firm-level exports by 3-digit ISIC sector and destination in Panel B, and (log) firm-level exports by 8-digit HS product and destination in Panel C. Each column reports results using a different measure of sector financial vulnerability. All measures come from KLK and are based on 1980-1999 Compustat data for U.S. firms. External finance dependence is the share of capital expenditures not financed with cash flows from operations. Asset tangibility is the share of net plant, property and equipment in total book value assets. R&D intensity is the share of R&D expenditures in total sales. Liquidity needs is the ratio of inventories to sales. All regressions include a constant term, firm fixed effects and sector fixed effects. Panels B and C also include destination fixed effects. T-statistics in parenthesis. ***, **, and * indicate significance at the 1%, 5%, and 10% level.

Sector measure of financial vulnerability:	External Finance Dependence	R&D Intensity	Inventories Ratio	Asset Tangibility
Panel A. Dep. variable: (log) firm-level exports by 3-digit ISIC sector				
State owned x Financial vulnerability	0.133	-0.367	1.189	0.695
	(1.63)	(-0.30)	(1.68)*	(2.84)***
Joint venture x Financial vulnerability	0.799	13.659	8.524	-3.146
	(10.83)***	(11.63)***	(13.17)***	(-13.42)***
Foreign owned x Financial vulnerability	0.780	17.397	8.471	-4.031
	(13.16)***	(19.17)***	(16.10)***	(-21.10)***
Controls:	Firm F.E., Sector F.E.			
R-squared	0.519	0.520	0.519	0.520
# observations	231,896	231,896	231,896	231,896
Panel B. Dep. variable: (log) firm-level exports by 3-digit ISIC sector and destination				
State owned x Financial vulnerability	-0.019	-2.897	1.728	0.218
	(-0.71)	(-7.14)***	(6.87)***	(2.52)**
Joint venture x Financial vulnerability	0.783	12.784	10.160	-3.264
	(27.59)***	(28.49)***	(38.28)***	(-34.05)***
Foreign owned x Financial vulnerability	0.716	12.687	11.608	-4.341
	(31.11)***	(35.65)***	(53.93)***	(-54.98)***
Controls:	Firm F.E., Destination F.E., Sector F.E.			
R-squared	0.361	0.361	0.362	0.362
# observations	1,080,081	1,080,081	1,080,081	1,080,081
Panel C. Dep. variable: (log) firm-level exports by 8-digit HS product and destination				
State owned x Financial vulnerability	-0.070	-2.676	-0.214	0.407
	(-3.77)***	(-10.31)***	(-1.24)	(6.98)***
Joint venture x Financial vulnerability	0.706	8.430	9.075	-2.857
	(30.95)***	(24.45)***	(42.00)***	(-36.79)***
Foreign owned x Financial vulnerability	0.652	6.166	11.025	-3.792
	(35.95)***	(23.28)***	(64.34)***	(-60.48)***
Controls:	Firm F.E., Destination F.E., Sector F.E.			
R-squared	0.319	0.319	0.320	0.320
# observations	2,139,664	2,139,664	2,139,664	2,139,664

Table 7. Firm-Level # Products Exported and # Destinations by Sector

This table examines the effect of credit constraints on firms' extensive margin of exporting. In Panel A, the dependent variable is the (log) number of 8-digit HS products firms export to at least one country, by 3-digit ISIC sector. In Panel B, it is the (log) number of destinations firms export to, by 3-digit ISIC sector. In Panel C, the dependent variable is the (log) number of destination-HS-8 product markets firms enter, by 3-digit ISIC sector. Each column reports results using a different measure of sector financial vulnerability. All measures come from KLK and are based on 1980-1999 Compustat data for U.S. firms. External finance dependence is the share of capital expenditures not financed with cash flows from operations. Asset tangibility is the share of net plant, property and equipment in total book value assets. R&D intensity is the share of R&D expenditures in total sales. Liquidity needs is the ratio of inventories to sales. All regressions include a constant term, firm fixed effects and sector fixed effects. T-statistics in parenthesis. ***, **, and * indicate significance at the 1%, 5%, and 10% level.

Sector measure of financial vulnerability:	External Finance Dependence	R&D Intensity	Inventories Ratio	Asset Tangibility
Panel A. Dep variable: (log) firm-level # HS-8 products exported by 3-digit ISIC sector				
State owned x Financial vulnerability	0.138***	0.982***	1.513***	-0.118*
Joint venture x Financial vulnerability	-0.033*	1.208***	-0.448***	-0.054
Foreign owned x Financial vulnerability	-0.081***	2.252***	-0.746***	-0.119**
R-squared	0.589	0.589	0.589	0.589
Panel B. Dep variable: (log) firm-level # destinations by 3-digit ISIC sector				
State owned x Financial vulnerability	0.067***	0.571	0.352	0.135*
Joint venture x Financial vulnerability	0.181***	3.667***	1.020***	-0.424***
Foreign owned x Financial vulnerability	0.102***	3.122***	0.241	-0.333***
R-squared	0.564	0.564	0.564	0.564
Panel C. Dep variable: (log) firm-level # destinations-product pairs by 3-digit ISIC sector				
State owned x Financial vulnerability	0.097***	0.787*	1.376***	-0.041
Joint venture x Financial vulnerability	0.165***	3.885***	0.982***	-0.488***
Foreign owned x Financial vulnerability	0.058***	4.151***	0.301	-0.536***
R-squared	0.533	0.533	0.533	0.533
Controls:	Firm F.E., Sector F.E.			
# observations, # firms, # sectors	231,896 observations, 93,581 firms, 29 sectors			

Table 8. Firm-Level # Products Exported by Sector and Destination

This table examines the effect of credit constraints on the (log) number of 8-digit HS products firms export by 3-digit ISIC sector and destination in 2005. Each column reports results using a different measure of sector financial vulnerability. All measures come from KLK and are based on 1980-1999 Compustat data for U.S. firms. External finance dependence is the share of capital expenditures not financed with cash flows from operations. Asset tangibility is the share of net plant, property and equipment in total book value assets. R&D intensity is the share of R&D expenditures in total sales. Liquidity needs is the ratio of inventories to sales. All regressions include a constant term, sector fixed effects, destination fixed effects and firm fixed effects. T-statistics in parenthesis. ***, **, and * indicate significance at the 1%, 5%, and 10% level.

Dependent variable: (log) firm-level # HS-8 products exported by 3-digit ISIC sector and destination

Sector measure of financial vulnerability:	External Finance Dependence	R&D Intensity	Inventories Ratio	Asset Tangibility
State owned x Financial vulnerability	**0.026**	**0.010**	**1.300**	**-0.348**
	(3.91)* **	**(0.10)**	**(20.82)*** **	**(-16.17)*** **
Joint venture x Financial vulnerability	**-0.002**	**1.156**	**0.613**	**-0.317**
	(-0.35)	**(10.38)*** **	**(9.29)*** **	**(-13.30)*** **
Foreign owned x Financial vulnerability	**-0.046**	**1.582**	**0.736**	**-0.477**
	(-8.10)* **	**(17.90)*** **	**(13.76)*** **	**(-24.35)*** **
Controls:	Firm F.E., Destination F.E., Sector F.E.			
R-squared	0.341	0.342	0.342	0.342
# observations	1,080,081	1,080,081	1,080,081	1,080,081