

FIRM EXPORTS AND MULTINATIONAL ACTIVITY UNDER CREDIT CONSTRAINTS

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Abstract—We provide firm-level evidence that credit constraints restrict international trade and affect the pattern of multinational activity. We show that foreign affiliates and joint ventures in China have better export performance than private domestic firms in financially more vulnerable sectors. These results are stronger for destinations with higher trade costs and not driven by firm size or other sector characteristics. Our findings are consistent with multinational subsidiaries being less liquidity constrained because they can access foreign capital markets or funding from their parent company. They further suggest that FDI can alleviate the impact of domestic financial market imperfections on trade.

I. Introduction

GROWING evidence suggests that financial underdevelopment severely impedes countries' participation in international trade. Given the challenges of reforming financial institutions, this has raised the question whether cross-border capital flows can offset these detrimental consequences. The 2007–2009 financial crisis has renewed interest in these issues, with recent studies affirming that credit tightening was an important factor in the collapse of global trade.¹ However, firm-level evidence remains 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).

We fill this void by providing an integrated analysis of the impact of credit constraints on both firms' export activity and the pattern of foreign direct investment (FDI). Using rich customs data from China, we show that foreign affiliates and joint ventures have better export performance than private domestic firms in financially more vulnerable sectors. This is consistent with MNC subsidiaries being less credit constrained because they can tap additional funding from their parent company or access foreign capital markets. Our results imply that financial frictions hinder firms' trade flows and shape the sectoral composition of MNC

activity. More broadly, they suggest that FDI may be a powerful export engine in financially underdeveloped economies and offer new insights on the extraordinary rise of China's trade.

While it might be intuitive that multinational firms should have a comparative advantage over local producers in financially vulnerable industries, we present the first direct evidence of this phenomenon and quantify its economic significance. We estimate that wholly foreign-owned affiliates and joint ventures export 62% and 50% more than domestic firms, respectively, in sectors highly dependent on external finance relative to financially less sensitive sectors. We also show that this large effect of financial factors on MNC operations is on par with or greater than the impact of other known determinants, such as input cost minimization, contractual imperfections, and property rights protection. This has important policy implications for developing countries seeking to attract foreign direct investment.

We use data on the universe of China's international transactions in 2005 to assess the impact of credit conditions on different trade margins. We find that financial frictions restrict firm selection into exporting and limit exporters' global sales, product scope, number of destinations, and sales within each destination-product market. Foreign-owned companies, however, are less subject to such distortions and able to expand further along all of these margins. These results indicate that firms face binding liquidity constraints in the financing of both fixed and variable trade costs, since the former affect market entry while the latter influence the scale of foreign sales. This informs how constrained exporters would respond to trade reforms, exchange rate movements, and other cost or demand shocks. The evidence for firms' extensive margin also validates priors that exporting entails market-specific fixed costs of entry and that it is more sensitive to financial frictions than domestic operations are.²

To identify the effects of credit constraints, we regress firm exports by sector on the interaction of firms' ownership status and sectors' financial vulnerability. We absorb unobserved firm characteristics with firm fixed effects and thus exploit the exogenous variation in financial dependence across sectors within multisector exporters. This implicitly reflects how companies allocate their available liquid capital across industries with different credit sensitivities. This empirical strategy helps address endogeneity concerns that have posed a challenge in the prior literature. In particular, our conclusions do not require that foreign ownership be

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¹ See Chor and Manova (2012), Freund and Klapper (2009), and (on past crises) Iacovone and Zavacka (2009).

² For example, Manova (2013) shows that only 20% to 25% of the total effect of financial market imperfections on aggregate trade is due to general disruption to production, while 75% to 80% is trade specific.

exogenous to financial frictions and would in fact be reinforced by a likely form of endogeneity, in which more FDI systematically goes into financially more vulnerable sectors. We examine the distortions to firm selection into exporting by removing the firm fixed effects from the regression.

A series of robustness checks we perform suggest that our results cannot easily be attributed to sample selection or omitted variable biases. Given our difference-in-differences approach, we include two important controls: the interaction of firms' size with sectors' financial vulnerability and the interactions of firms' ownership status with sectors' R&D, contract, physical capital, and human capital intensity. The former recognizes that bigger firms might be less credit constrained and hence sell more in financially dependent industries, while the latter accounts for other likely industry-level determinants of FDI. We also establish that MNCs' comparative advantage in financially sensitive sectors is greater for exports to destinations with higher trade costs as measured by bilateral distance and bureaucratic export barriers. Finally, our findings survive various perturbations to the firm sample.

We make two contributions to the literature. First, we provide new firm-level evidence that credit constraints hinder international trade. Previous work has shown that countries with stronger financial institutions have a comparative advantage in financially more vulnerable sectors.³ Early studies at the microlevel have used credit-worthiness scores, balance sheet variables, and credit rationing surveys to link liquidity constraints to firms' export capacity.⁴ A challenge for this approach has been the endogeneity of such measures of financial health to companies' export activity.⁵ More recently, scholars have explored exogenous shocks to firms' availability of external finance to establish a causal effect of credit conditions on trade.⁶ We offer consistent support for these findings using a novel source of identification—foreign ownership status combined with the variation in financial dependence across sectors.

Our second and primary contribution is to the literature on the determinants of FDI activity, and the role of finance in particular. Evidence suggests that MNC subsidiaries use internal capital markets to overcome liquidity constraints

and react to profitable opportunities.⁷ After large real exchange rate devaluations, the affiliates of U.S. multinationals abroad expand sales and investment more than domestic companies do (Desai, Foley, & Forbes, 2008). Foreign-owned firms also fared better during the recent financial crisis relative to local establishments (Alfaro & Chen, 2012). Separately, MNCs can arise endogenously in response to credit market imperfections to relax constraints faced by input suppliers (Antràs, Desai, & Foley, 2009). To this line of work we add the first evidence and estimate of the effect of financial frictions on the sectoral composition of MNC activity. Indirectly, we also corroborate that foreign affiliates are less capital constrained than domestic enterprises using export success as a particular dimension of firm performance.

Since we examine Chinese exports, we effectively study the behavior of multinational companies pursuing vertical or export platform FDI. This complements work on the impact of credit conditions on the choice between exporting and horizontal FDI, as well as on the trade-offs between horizontal, vertical, and export platform FDI (Buch et al. 2009; Bilir, Chor, & Manova, 2013).

More generally, our results resonate with prior work on the role of foreign capital inflows in relaxing domestic firms' credit constraints (Harrison, Love, & McMillan, 2004; Héricourt & Poncet, 2009; Tong & Wei, 2010). Our findings suggest that not only foreign equity investment (Manova, 2008), but also FDI might lessen the damaging effects of domestic financial market underdevelopment on trade.

The remainder of the paper is organized as follows. The next section discusses the mechanisms through which financial frictions might affect international trade and multinational activity. We introduce the data in section III and present our empirical results in section IV. The last section concludes.

II. Motivation and Theoretical Background

A. Financial Frictions and International Trade

Almost all firms routinely rely on external capital because they incur large upfront costs that cannot be funded out of retained earnings or internal cash flows from operations. These outlays may be fixed (e.g., R&D, market research, advertising, and fixed capital equipment) or variable (e.g., intermediate input purchases, advance payments to salaried workers, and land or equipment rental fees). Exporters are believed to be even more dependent on out-

³ See Kletzer and Bardhan (1987), Beck (2002), Matsuyama (2005), Manova (2013), Chaney (2013), Ju and Wei (2005, 2010, 2011), and Becker, Chen, and Greenberg (2013) for theoretical models and Beck (2002, 2003), Svaleryd and Vlachos (2005), Hur, Raj, and Riyanto (2006), Manova (2013), and Becker et al. (2013) for empirical evidence.

⁴ See Muûls (2008) and Minetti and Zhu (2011) for evidence on Belgium and Italy, respectively, and Berman and Héricourt (2010) for a study of 5,000 firms in nine developing and emerging economies.

⁵ For example, Greenaway, Guariglia, and Kneller (2007) find that the financial health of U.K. firms improves after they start exporting, but at the time of entry into exporting, future exporters do not appear financially healthier than nonexporters.

⁶ For instance, Amiti and Weinstein (2011) and Paravisini et al. (2012) use matched firm-bank data and identify shocks to banks' financial health during the systemic crises in Japan in the 1990s and during the recent global crisis, respectively. Bricongne et al. (2012) study the effect of the latter on French firms.

⁷ Desai, Foley, and Hines (2004a) and Feinberg and Phillips (2004) find that MNC affiliates employ internal capital markets opportunistically to overcome frictions in external capital markets: they raise less outside finance in financially underdeveloped countries and compensate by borrowing more from the parent company. Bertrand, Mehta, and Mullainathan (2002), however, highlight the "dark side" of internal capital markets, that is, the inefficient tunneling of resources between connected firms and within conglomerates.

side financing than domestic producers for three reasons.⁸ First, entering foreign markets entails additional upfront expenses. Fixed trade costs include studying the profitability of potential markets; making market-specific investments in capacity, product customization, and regulatory compliance; and setting up and maintaining foreign distribution networks. Variable trade costs comprise transportation, duties, and freight insurance. Second, cross-border shipping and delivery typically take sixty days longer than domestic orders. This further aggravates exporters' working capital needs relative to those of domestic producers. Finally, the greater risk inherent in transnational operations requires exporters to obtain trade insurance. For these reasons, a very active market exists for the financing and insurance of international transactions, reportedly worth \$10 trillion to \$12 trillion in 2008. Up to 90% of world trade has been estimated to employ some form of trade finance (Auboin, 2009).

A number of theoretical papers have examined how credit market imperfections affect international trade. To motivate and discipline our empirical analysis, we summarize the predictions of a model that incorporates financial frictions and firm heterogeneity in the spirit of Melitz (2003) and Manova (2013).

Consider exporters that require external capital for their fixed trade costs, which they can raise in the financial market by pledging collateral. However, contracts between firms and investors are imperfectly enforced and depend on the strength of financial institutions. When a financial contract is honored, the borrower repays the investor; otherwise, the firm defaults, and the creditor seizes the collateral. While all firms with productivity above a certain cutoff become exporters, financial frictions raise this threshold above the first best. Because more efficient companies earn bigger revenues, they can offer lenders a higher return in case of repayment, and they are more likely to secure the necessary funds. Credit constraints thus preclude potentially profitable firms from exporting and reduce aggregate trade flows.

If companies face a separate fixed cost in each market they enter, tight credit conditions would also reduce their number of export destinations. While financially unconstrained firms can decide whether to serve a particular country independently of whether they supply other markets, constrained exporters would add export destinations in decreasing order of profitability until they exhaust their limited financial resources. Firms must similarly rationalize their product range if they incur good-specific fixed trade costs. While the optimal product scope might depend on importer country characteristics, exporters would offer a narrower set of products overall and ship fewer varieties to any given market if they can access less capital.

When producers rely on outside funds only for fixed trade costs, credit conditions affect their selection into

exporting and into individual destination-product markets, but not the value of their sales abroad. By contrast, if variable costs are also subject to liquidity constraints, exporters' scale of operations would be restricted as well. While the most productive (and thus least constrained) firms could still export at first-best levels, less productive exporters would be unable to obtain sufficient credit to do so and would be forced to sell lower quantities than in the first best in order to reduce their variable costs.⁹

While access to capital markets is important in all industries, sectors arguably differ in their reliance on the financial system for technological reasons inherent in the manufacturing process. The literature has proposed two key determinants of sectors' financial vulnerability that are exogenous to individual firms: (a) the requirement for external finance, arising from upfront long-term investments (such as R&D) and short-run working capital needs (such as variable inputs) and (b) the ability to raise external finance by pledging the available tangible assets used in production (such as plants and equipment) as collateral (Rajan & Zingales, 1998; Raddatz, 2006; Braun, 2003; Claessens & Laeven, 2003).

This plausibly exogenous variation across sectors has important implications that motivate our empirical design and identification strategy. In particular, the effects of credit constraints on trade are magnified in financially more vulnerable sectors that require more external capital but boast less tangible assets. Financial frictions also affect how firms active in multiple industries allocate resources across industries. *Ceteris paribus*, liquidity-constrained producers concentrate on financially less dependent activities and add sectors in increasing order of financial vulnerability until they use up their funds. This is optimal for a given level of external credit and can also incentivize financiers to provide more capital. We thus expect that less constrained enterprises would display a comparative advantage in financially sensitive sectors both in the cross-section of single-sector firms and across sectors within firms.

B. Financial Frictions and Multinational Activity

Firms may offshore (parts of) their production activities for various reasons, such as seeking market access and reducing manufacturing costs.¹⁰ Multinational companies emerge when this location decision is accompanied by the decision to integrate the production facility abroad within

⁹ Credit constraints can also limit exporters' success by curbing their investments in productivity and product quality. Girma, Gong, and Görg (2008) find that Chinese firms with foreign capital participation innovate more than domestic firms do. Separately, all predictions above continue to hold if firms require external finance for both their domestic and foreign operations. As Manova (2013) and Feenstra et al. (2014) show, credit market imperfections then raise the productivity cutoffs for both domestic production and exporting and reduce firms' sales at home and abroad.

¹⁰ See Markusen (1984), Brainard (1997), Markusen and Venables (2000), and Helpman, Melitz, and Yeaple (2004) on horizontal FDI and Helpman (1984) and Yeaple (2003) on vertical FDI.

⁸ See Feenstra, Li, and Yu (2014) for a model incorporating these three mechanisms and related evidence for China.

the boundaries of the firm.¹¹ Among other factors, financial frictions can importantly influence MNC activity because domestic enterprises typically have more limited access to capital than foreign subsidiaries do. Unlike the former, the latter are not restricted to borrowing externally in the host country (in our case, China), since they are better equipped to raise outside finance in foreign capital markets as well. They can also tap deeper internal capital markets and obtain funds directly from their parent company.

We therefore expect that, conditional on multinational presence in a given country, foreign affiliates would have a comparative advantage over domestic firms in financially more dependent industries. In addition, MNCs might endogenously select into such industries precisely because they are less credit constrained. First, when local financial institutions are weak, fewer domestic enterprises enter in financially more vulnerable sectors. Foreign affiliates might then face less competition in the host and export markets for their products or in the local market for sector-specific inputs (Bilir et al., 2013). These forces would generate relatively higher profits for multinational corporations in financially more sensitive sectors.

Second, foreign headquarters that offshore production might choose to integrate their supplier abroad in order to alleviate the latter's liquidity constraint and ensure that production takes place (Antràs et al., 2009). The headquarters then either directly fund the affiliate or monitor its operations so that host country banks are willing to finance it. Such integration incentives could rise with sectors' financial dependence.

Third, companies can become multinational by acquiring existing firms abroad. Cross-border mergers and acquisitions might create greater synergies and be more advantageous to both parties when the target operates in a financially more sensitive industry and is thus more credit constrained.¹² In practice, while joint ventures in China sometimes arise through partial foreign acquisition, most wholly owned subsidiaries are set up as de novo MNC affiliates through greenfield investment.¹³

MNC headquarters arguably have more control over subsidiaries' management and use of financial resources at higher levels of foreign ownership. Conditional on the organizational structure, headquarters might thus extend more financing to wholly owned relative to partially controlled affiliates. For the three reasons described above, headquar-

ters might also endogenously choose complete over partial ownership when host credit conditions are tighter. This suggests that we might also expect fully integrated foreign affiliates to outperform domestic firms in financially vulnerable sectors by more than joint ventures.

MNCs' hypothesized comparative advantage over domestic firms in financially dependent sectors could manifest in various ways. We examine companies' export participation in our empirical analysis. By comparing firms with different ownership structures and sectors with different financial sensitivities, we thus aim to analyze the impact of credit frictions on both international trade and multinational activity.

III. Data

We use detailed customs data on the universe of China's international trade transactions in 2005 from the Chinese Customs Office. These data report the free-on-board value of firm exports (in U.S. dollars) by product and country for 231 destinations and 6,908 products in the eight-digit Harmonized System (HS).¹⁴ The records explicitly distinguish between state-owned enterprises (SOEs), private domestic firms (including collectively owned firms), fully foreign-owned affiliates of multinational firms, and joint ventures (foreign ownership under 100%).¹⁵ We drop SOEs from our baseline sample because we are interested in the export decisions of profit-maximizing firms that operate in a financially constrained environment. Since the Chinese government exerts considerable control over the activities of SOEs, especially with regard to which industries they are allowed to operate in, SOEs are not necessarily profit-maximizing entities. Despite their preferential access to financing from state-owned banks, they also appear less efficiently managed than private firms (Dollar & Wei, 2007; Song, Storesletten, & Zilibotti, 2011; Khandelwal, Schott, & Wei, 2013). We also exclude export-import companies that do not engage in manufacturing but serve exclusively as intermediaries between domestic producers (buyers) and foreign buyers (suppliers).¹⁶

A. Measuring Sectors' Financial Vulnerability

We use multiple measures of sectors' financial vulnerability, $FinVuln_i$, to capture different aspects of firms' sensitivity to the availability of outside capital. These variables are meant to reflect technological features of the manufac-

¹¹ See, for example, Antràs (2003), Branstetter, Fisman, and Foley (2006), and Desai, Foley, and Hines (2004b).

¹² Huang et al. (2008), Manova and Yu (2012), and Javorcik and Spatareanu (2009) show that more credit-constrained firms are more likely to be acquired by foreign firms and conduct processing trade for foreign buyers (in China), but less likely to become arm's-length suppliers for multinational corporations (in the Czech Republic). Bustos (2007) finds that FDI in Argentina is more likely to occur in financially dependent sectors. See also Poncet, Steingrass, and Vandenbussche (2010) for evidence on China.

¹³ If Chinese firms could completely overcome their credit constraint by soliciting foreign ownership, the remaining domestic firms would be unconstrained and we would not find the empirical results that we do.

¹⁴ Manova and Zhang (2009) describe the data and present stylized facts about firm heterogeneity in Chinese trade.

¹⁵ Product classification is consistent across countries at the six-digit HS level. The number of distinct product codes in the Chinese eight-digit HS classification is comparable to that in the ten-digit HS trade data for the United States.

¹⁶ Since the data do not directly flag trade intermediaries, we follow standard practice and use keywords in firm names to identify them (Ahn, Khandelwal, & Wei, 2011). We drop 23,073 wholesalers that mediate a quarter of China's trade.

turing process in a given industry that are beyond the control of individual firms. They are available for 36 ISIC three-digit sectors, which we match to Chinese HS eight-digit products (see the table appendix).

Our first two measures quantify firms' reliance on external finance. Industries are known to differ in the importance of upfront costs and the lag between the time when various expenses are incurred and the time when revenues are realized. We gauge these differences with sectors' external finance dependence ($ExtFin_i$), defined as the share of capital expenditures not financed with cash flows from operations. $ExtFin_i$ arguably identifies the outside funding that firms require for long-term investment projects and thus relates mostly to fixed costs. We also exploit the ratio of inventories to sales ($Invent_i$) to proxy the duration of the production cycle and the liquidity needed to maintain inventories and meet demand. Since $Invent_i$ signals producers' working capital needs in the short run, it is likely associated mainly with variable costs.

Our third measure of financial vulnerability recognizes that the asset structure optimal for production varies across sectors. We assess the availability of tangible assets ($Tang_i$) that firms can pledge as collateral to raise finance with the share of plant, property, and equipment in total book value assets.

Our last indicator of financial vulnerability distinguishes between different sources of external capital. On the one hand, when companies can more easily access buyer or supplier trade credit, they may be less dependent on the formal financial market. On the other hand, trade credit may be complementary to formal credit, for example, if both formal lenders and buyers and suppliers prefer more trustworthy borrowers. We remain agnostic about the net effect of these two forces, although evidence suggests that the former dominates (Chor & Manova, 2012). We use the ratio of the change in accounts payable to the change in total assets ($TrCredit_i$) to characterize the availability and frequency of trade credit in an industry.

Consistent with the idea that these sector measures reveal conceptually distinct dimensions of financial vulnerability, they are not highly correlated with each other (see appendix table 1 in the online supplement). It is thus informative to explore all of them in order to shed light on the mechanisms through which credit constraints operate. Yet $ExtFin_i$ and $Tang_i$ are the standard measures in the literature because their interpretation can most directly be linked to firms' exposure to and ability to overcome financial frictions. By contrast, the role of $TrCredit_i$ is *ex ante* ambiguous. As for $Invent_i$, some companies might flourish in an inventory-intensive sector not because they are less liquidity constrained, but because they have superior inventory management practices for reasons unconnected to finance. We therefore also compute the first principal component of external finance dependence and asset tangibility, FPC_i . It intuitively increases with $ExtFin_i$ and falls with $Tang_i$, such that industries are more financially sensitive if they require more outside funds but dispose of less collateralizable

assets. Since FPC_i aggregates the information contained in the two proxies that pertain to financial vulnerability, it will be our preferred measure in the empirical analysis.

Our $FinVuln_i$ indicators are based on Compustat data for all publicly traded U.S. companies.¹⁷ This approach is motivated by three considerations. First, the United States has one of the most advanced and sophisticated financial systems in the world. The behavior of U.S. firms thus plausibly approximates their optimal asset structure and use of external capital in the absence of binding credit constraints. Second, choosing a reference country ensures that sectors' financial vulnerability is not measured endogenously to China's financial development. Finally, identification does not require that sectors have the same financial sensitivity in the United States and China, but rather that their ranking remains relatively stable across countries. Rajan and Zingales (1998), Claessens and Laeven (2003), and Kroszner et al. (2007) have argued that $FinVuln_i$ captures a large technological component that is innate to a sector and therefore a good proxy for ranking industries in all countries. In line 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.

We aim to assess the impact of credit constraints on firm exports and MNC activity. In the case of firm exports, we would ideally observe how much companies rely on external capital for financing their export operations. By contrast, in the case of MNC activity, in principle we do not require that the $FinVuln_i$ measure be trade specific. While we study the sectoral composition of foreign affiliates' trade flows relative to that of domestic firms, the same predictions would apply to their total output as well. Note also that since money is fungible, it might not be conceptually feasible to precisely distinguish firms' use of external funds for domestic production from their use of external funds for export activities.

In practice, our sector measures reflect the overall financing practices of large U.S. companies. Although these are likely big exporters, $FinVuln_i$ cannot be computed separately for domestic and export operations because firms report consolidated balance sheets. Unfortunately, no systematic data exist on the funding of international transactions due to the wide range of participating financial institutions, including regular commercial banks, specialized export-import banks, and credit agencies. Given these data limitations, our industry indicators have been widely used in the prior literature on trade, growth, and finance, and we believe that they can be quite informative.¹⁸ Firms need to

¹⁷ $ExtFin_i$, $Invent_i$, and $Tang_i$ come directly from Kroszner, Laeven, and Klingebiel (2007), who follow the methodology of Rajan and Zingales (1998) and Claessens and Laeven (2003). They are averages over the 1980–1999 period for the median U.S. firm in each sector. $TrCredit_i$ is from Fisman and Love (2003), who base it on the same data for 1980 to 1989.

¹⁸ For example, see Beck (2003), Manova (2008, 2013), Iacovone and Zavacka (2009), Carluccio and Fally (2012), Tong and Wei (2010), Bricongne et al. (2012), and Chor and Manova (2012) for applications to trade.

TABLE 1—DISTRIBUTION OF TRADE FLOWS ACROSS FIRMS AND SECTORS

Firm Type	All Firms (1)	State Owned (2)	Private Domestic (3)	Joint Ventures (4)	Foreign Owned (5)
Total exports	531.36	9.8%	12.9%	26.3%	51.0%
Classifying sectors by external finance dependence					
Low	173.47	14.9%	23.4%	29.4%	32.3%
High	357.89	7.3%	7.8%	24.8%	60.1%
Classifying sectors by inventories ratio					
Low	94.01	19.9%	18.8%	32.1%	29.2%
High	437.35	7.6%	11.6%	25.1%	55.7%
Classifying sectors by asset tangibility					
Low	423.04	6.2%	9.9%	25.9%	58.0%
High	108.32	23.8%	24.4%	28.1%	23.7%
Classifying sectors by trade credit intensity					
Low	285.63	4.9%	7.5%	24.8%	62.8%
High	245.73	15.5%	19.1%	28.1%	37.3%

This table examines the distribution of Chinese trade flows across firms with different organizational structure and across sectors with different levels of financial vulnerability in 2005. External finance dependence is the share of capital expenditures not financed with cash flows from operations. Inventories ratio is the ratio of inventories to sales. Asset tangibility is the share of plant, property, and equipment in total book value assets. Trade credit intensity is the ratio of the change in accounts payable to the change in total assets. These measures come from Kroszner et al. (2007) or Fisman and Love (2003), and are based on Compustat data for U.S. firms. The trade values in the first column are in billion U.S. dollars. The percentage shares reported in each row sum to 1.

incur the same production costs and use the same tangible assets in manufacturing for the foreign market as in manufacturing for the home country. In addition, products that entail a lot of R&D, marketing research, and distribution costs at home plausibly require similarly large trade costs of product customization, marketing, and distribution abroad. These factors suggest that whatever forces a firm in a particular industry to fund its domestic activities with outside capital will likely also force it to use external funds for its foreign sales.

In sum, we exploit a number of standard, best-practice measures of sectors' financial vulnerability. To the extent that they are imperfect proxies, measurement error would likely bias our results downward. In other words, we will be able to identify the effects of financial frictions on exports and MNC activity only if sectors' financial dependence for international activities is correlated with their financial dependence for domestic operations. Our empirical results will thus also indirectly provide support for this assumption.

B. A First Glance at the Data

Table 1 provides an overview of the distribution of Chinese trade flows across firms with different ownership structures. Two patterns in particular stand out. First, the lion's share of Chinese trade is conducted by firms with partial or full foreign ownership. Private domestic firms were responsible for 13% of China's \$531.4 billion exports in 2005. Joint ventures accounted for slightly over a quarter, and foreign affiliates contributed more than half of China's exports. These statistics illustrate the importance of multinational companies and FDI 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 fraction of Chinese trade in financially more vulnerable industries. MNC affiliates channel 60.1% of exports in sectors with

external finance dependence above the median, compared to 32.3% in sectors below the median. Private domestic firms mediate thrice as big a share of exports in sectors with limited need for outside finance, relative to sectors that rely more heavily on external capital. 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 analogous sorting behaviors when we group industries according to our other measure of firms' requirement for external funds: the inventories-to-sales ratio. Foreign affiliates account for 55.7% of exports in sectors with high liquidity needs compared to only 29.2% in sectors with limited liquidity needs. By contrast, private domestic firms carry 11.6% of trade flows in industries with high inventory ratios and 18.8% in industries with laxer credit constraints, while joint ventures conduct about a quarter of Chinese exports in all sectors. Similar patterns obtain when we distinguish between sectors with low and high levels of asset tangibility or trade credit intensity, with a greater proportion of trade performed by foreign firms relative to domestic firms in financially more vulnerable sectors.

These summary statistics are broadly consistent with our credit-constraints view of international trade and investment, and they anticipate the results from the econometric analysis in the next section.

IV. Empirical Analysis

A. Empirical Design

Our goal is twofold: to assess the effect of financial frictions on firm exports (goal 1) and on the pattern of multinational activity (goal 2). To this end, we design an estimation strategy consistent with the mechanisms outlined in section II that allows us to simultaneously address both questions. It is motivated by the prior that foreign affiliates are less credit constrained than domestic companies, and hence the

impact of sectors' financial vulnerability on firm decisions will vary across ownership types. Implicitly, this estimation approach thus also tests the validity of this prior statement.

We study the variation in trade flows across sectors and firm types with the following specification:

$$\begin{aligned} \text{LogExports}_{fi} &= \alpha + \delta \cdot \text{FinVuln}_i \cdot D_f^{\text{FOR}} \\ &\quad + \varphi_f + \varphi_i + \varepsilon_{fi} \\ &= \alpha + \beta \cdot \text{FinVuln}_i \times D_f^{\text{JV}} + \gamma \cdot \text{FinVuln}_i \cdot D_f^{\text{MNC}} \\ &\quad + \varphi_f + \varphi_i + \varepsilon_{fi}. \end{aligned} \quad (1)$$

Here Exports_{fi} give firm f 's global exports in industry i , while FinVuln_i references i 's financial vulnerability. D_f^{JV} , D_f^{MNC} , and $D_f^{\text{FOR}} = D_f^{\text{JV}} + D_f^{\text{MNC}}$ are indicator variables for joint ventures, fully foreign-owned MNC affiliates, and firms with any foreign ownership, respectively, the omitted category being domestic firms. At this level of aggregation, our sample comprises 221,801 observations spanning 88,004 companies and 36 sectors.

We employ industry fixed effects φ_i to control for systematic differences in trade activity across sectors that do not depend on firms' organizational structure. If China has a comparative advantage in textiles, for example, textile producers might earn higher export revenues than manufacturers of electrical machinery, regardless of whether they are domestic or foreign owned. Similarly, within each multisector firm, global textile sales might exceed exports of electrical machines regardless of its ownership status. The φ_i s account for various determinants of China's comparative advantage, as well as for sector-specific demand and cost shocks that affect all firms. They also absorb the level effect of FinVuln_i .

Our regression specification further includes firm fixed effects φ_f . These capture all observed and unobserved firm characteristics that affect a company's trade activity equally across sectors. These may include its size, productivity, managerial competence, labor skill composition, or access to distribution networks abroad. Since the φ_f s subsume the ownership dummies, they also pick up the average gap in export performance between firms of different ownership types in the average industry. For instance, MNC affiliates may use their parent companies' distribution network, enjoy preferential tax treatment, be more productive, have better management practices, employ more skilled workers, or offer higher-quality products relative to domestic enterprises.

The main coefficients of interest are those on the interaction terms and are identified purely from the variation across sectors within multisector exporters.¹⁹ Note that the firm fixed effects implicitly condition on firms' total finan-

cial resources, be it from banks in China, banks abroad, buyer and supplier relationships, or a foreign parent company. Through the lens of section II, β and γ should therefore reflect the profit-maximizing way in which firms allocate capital across industries: by expanding into industries in increasing order of financial vulnerability until they exhaust their resources. We also consider a baseline specification that groups partially and fully foreign-owned affiliates; the relevant coefficient then is δ .

Importantly, β and γ lend themselves to two closely related yet distinct interpretations that correspond to our two goals. On the one hand, β and γ quantify the effect of credit constraints on firm exports (goal 1). Conceptually, we want to show that firms' access to finance affects their trade activity. The former might, however, be endogenous to the latter. To help establish causality, we exploit the variation in financial conditions across sectors which is arguably exogenous to individual firms, and interact a firm measure of financial health (ownership status) with a sector measure of financial dependence. This is in the spirit of earlier work that has interacted other proxies for firms' financial health with sectors' financial vulnerability. If credit frictions restrict trade, we anticipate lower exports in financially more sensitive sectors, but this distortion should be smaller for foreign subsidiaries than for domestic firms. We thus expect that $\gamma > \beta > 0$, where the first inequality reflects the notion that fully integrated MNC affiliates might benefit from deeper internal capital markets than joint ventures.

At the same time, β and γ also indicate how financial considerations affect the pattern of multinational activity (goal 2). The interaction terms compare the sectoral composition of MNCs' sales to that of domestic firms and gauges MNCs' proclivity to operate in different industries. This is in the tradition of prior studies that interact ownership dummies with other sector characteristics. Recall from section II that multiple mechanisms can make financially vulnerable sectors relatively more attractive for foreign affiliates. Conditional on their ownership status, they might have a comparative advantage in such sectors due to their superior access to finance. In addition, foreign ownership could endogenously arise in response to credit market imperfections. Both mechanisms would be consistent with $\gamma > \beta > 0$, and we do not distinguish between them.

The theoretical framework in section II implies that firm size would reflect firms' access to external finance if it is correlated with firm productivity and financiers favor more productive firms. A strict interpretation of the Manova (2013) model in fact predicts a one-to-one mapping of firm productivity, size, and financial health. This aligns with evidence in the finance literature that smaller firms tend to be more credit constrained than larger companies.²⁰ In view of goal 1, the size dispersion across firms thus provides

¹⁹ Forty-nine percent of the firms in our sample export in multiple sectors and account for 80% of the firm-sector level observations. The sector fixed effects in equation (1) are thus not a linear combination of the firm fixed effects.

²⁰ See, for example, Gertler and Gilchrist (1994), Beck et al. (2008), and Guiso, Sapienza, & Zingales (2004).

another source of variation in the data that we can exploit to identify the effect of credit frictions on firm exports. In particular, we can use firm size as an additional proxy for financial health and include its interaction with sectors' financial vulnerability in the regression, $FinVuln_i \cdot Size_f$.

As for goal 2, there are two countervailing forces to consider. On the one hand, MNC affiliates might be larger than domestic exporters for reasons unrelated to financial concerns. If bigger firms have a comparative advantage in financially sensitive sectors, β and γ might thus capture the role of firm size rather than that of foreign ownership per se. While still consistent with goal 1, this would run counter to goal 2. Controlling for the size interaction would then ensure that we isolate the response of foreign-owned firms to the variation in financial vulnerability across sectors instead of the response of bigger firms. On the other hand, MNC affiliates might be larger than domestic firms precisely because the former are less financially constrained. If so, adding size interactions to the regression could be viewed as overcontrolling and might underestimate the economic mechanism behind goal 2.

Given these considerations, we opt to include $FinVuln_i \cdot Size_f$ in specification (1) in order to be comprehensive with respect to goal 1 and conservative with respect to goal 2. To do so, we would ideally use information on firms' total output. As standard with customs data, however, we do not observe firms' sales in China. As a proxy for firm size, we instead take firms' log total exports summed across all destinations and sectors. While admittedly imperfect, this measure is motivated by robust empirical evidence in the prior literature of a strong positive correlation between firms' output and exports.²¹

As common with our difference-in-differences estimation technique, the covariance matrix of the error term ε_{fi} can be quite complex. From an economics perspective, the ε_{fi} s are likely correlated across sectors within firms due to unobserved firm characteristics. If these affect activity uniformly in all sectors, they would be captured with the firm fixed effects. Otherwise, Bertrand, Duflo, and Mullainathan (2004) advocate clustering errors by firm. In our case, this is complicated by the fact that the regression also includes industry fixed effects and errors might also be correlated across firms within sectors due to sector-level unobservables. From an econometric perspective, Moulton (1990) argues that errors should be clustered at the most aggregate level at which the relevant explanatory variable varies in the data. We study the interaction of a firm attribute with a sector

characteristic, where the latter is arguably the exogenous one. To remain conservative and consistent, we cluster standard errors by sector throughout the paper. We have confirmed that all our results become significantly stronger when we instead cluster by firm or use Hubert-White heteroskedasticity-robust errors. These approaches typically deliver t -statistics that are three to four times as big.

B. Baseline Results

Our empirical analysis proceeds in four steps. We first estimate equation (1) and document evidence consistent with our hypotheses. We then provide robustness checks indicating that our results cannot easily be attributed to confounding factors such as sample selection or other sector-level determinants of MNC activity. We next examine the impact of financial frictions on the extensive and intensive margins of firms' exports to shed light on the underlying economic mechanisms. Finally, we show that our findings are stronger for export destinations with higher trade costs, which lends further support to our interpretation.

Table 2 presents our baseline results for specification (1). Using the first principal component of external finance dependence and asset tangibility FPC_i to measure $FinVuln_i$, we see that foreign enterprises indeed export significantly more than domestic firms in financially more vulnerable sectors, relative to financially less vulnerable sectors ($\delta > 0$, column 1). When we distinguish between partially and wholly foreign-owned companies, we further observe that $\gamma > \delta > \beta > 0$ (column 2). In other words, fully integrated MNC affiliates enjoy a greater advantage over domestic producers in financially dependent industries than joint ventures do. This ranking also emerges in all other regressions: γ is either statistically higher than β , or we cannot reject their equality at standard confidence levels (10%). These results accord with our prior that (a greater degree of) foreign ownership is associated with lower financial constraints as it increases access to internal capital markets and capital markets outside China.

We corroborate these findings when we use other proxies for $FinVuln_i$ in the rest of table 2. MNC affiliates have a bigger comparative advantage over Chinese-held companies in industries with greater external finance dependence and in industries with higher inventories-to-sales ratios (columns 3 and 4). Conversely, foreign subsidiaries outperform local firms by more in industries with fewer tangible assets and in industries with scarcer trade credit (columns 5 and 6). As expected, the interaction terms switch sign in columns 5 and 6, since financially more sensitive sectors require more outside capital but dispose of less buyer-supplier trade credit and collateralizable assets. To streamline the exposition, we report estimates using only FPC_i below. Qualitatively similar patterns, however, obtain for our other sector measures too.

Our results are highly significant both statistically and economically, with the exception of those for trade credit inten-

²¹ In standard heterogeneous-firm trade models (e.g., Melitz 2003), firm size and total exports are perfectly correlated as both are driven by a single firm attribute (often interpreted as productivity). In reality, firms differ along multiple dimensions, but numerous empirical papers have documented very high correlations among productivity, size, and total exports for a wide range of developed and developing countries (see Bernard et al., 2007, for the United States). We thank Zhihong Yu at Nottingham University for confirming that in a matched sample of customs and balance sheet data for China, the correlation between firm sales and exports is 0.62 (significant at 1%) in logs and higher yet in levels.

TABLE 2—FOREIGN OWNERSHIP, FIRM SIZE, AND FIRM EXPORTS
DEPENDENT VARIABLE: (LOG) FIRM EXPORTS BY SECTOR

Financial Vulnerability Measure	First Principal Component (External Finance Dependence, Asset Tangibility)		External Finance Dependence	Inventories Ratio	Asset Tangibility	Trade Credit Intensity
	(1)	(2)	(3)	(4)	(5)	(6)
FOR × Financial Vulnerability	0.63 (6.21)***					
JV × Financial Vulnerability		0.54 (4.68)***	0.88 (4.09)***	6.76 (1.96)*	-2.94 (-3.05)***	-1.56 (-0.40)
MNC × Financial Vulnerability		0.67 (6.37)***	0.94 (3.40)***	7.20 (2.56)**	-4.18 (-4.69)***	-5.40 (-1.46)
Size × Financial Vulnerability	0.16 (3.41)***	0.16 (3.42)***	0.21 (1.84)*	2.93 (3.35)***	-1.16 (-3.96)***	-0.72 (-0.76)
Sector FE	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
R ²	0.52	0.52	0.51	0.51	0.52	0.51
Number of observations	221,801	221,801	221,801	221,801	221,801	221,801
Number of firms	88,004	88,004	88,004	88,004	88,004	88,004
Number of sectors	36	36	36	36	36	36

This table examines the effect of credit constraints on firm exports across sectors within firms. JV, MNC and FOR are indicator variables for joint ventures, fully foreign-owned MNC affiliates, and firms with any degree of foreign ownership respectively. Firm size is proxied by firms' (log) total exports. The measure of sectors' financial vulnerability in columns 3 to 6 is indicated in the column heading and defined as in table 1. In columns 1 and 2, it is the first principal component of sectors' external finance dependence and asset tangibility. All regressions include a constant term, firm fixed effects, and sector fixed effects. Standard errors clustered by sector. *T*-statistics in parentheses. Significant at *** 1%, ** 5%, * 10%.

sity, which are less precisely estimated.²² The export advantage of firms with full (partial) foreign ownership over domestic companies is 31% (29%) larger in sectors with high needs for external capital relative to sectors with low dependence on outside finance. The corresponding estimates reach 84% and 59% when comparing sectors with few collateralizable assets to sectors with high asset tangibility. Using FPC_i as a summary measure, MNC subsidiaries and joint ventures export 62% and 50% more than local firms in financially vulnerable sectors relative to financially less sensitive sectors.

Separately, table 2 also confirms that bigger exporters trade relatively more in financially more dependent industries. This pattern suggests that firm size may indeed be associated with laxer credit constraints. To gauge the extent to which controlling for it might lead us to underestimate β and γ , we rerun specification (1) without the size interactions (columns 1 versus 2 in online appendix table 2). The point estimates of interest increase slightly by 9% and 15%, respectively. This indicates that foreign ownership plays an important and independent role that is not subsumed by firm size. Moreover, the effects of full and partial foreign ownership are on average 65% and 8% bigger than that of firm size in table 2.²³

Specification (1) includes firm fixed effects and identifies the impact of financial frictions on trade and MNC activity at the firm level. According to section II, credit constraints can also distort the selection of firms into exporting. To shed light on this mechanism, we reestimate equation (1) without firm fixed effects, adding the main effects of the ownership dummies. This perturbation lowers β and γ by

46% and 19% (columns 2 versus 3 in online appendix table 2), validating our predictions: now β and γ are identified from the variation across firms of different ownership types within sectors and the variation across sectors among firms of a given ownership type. They reflect the gap between the exports of the average foreign affiliate and the average domestic firm in a sector, and how this gap changes across sectors. These estimates therefore capture the combined effect of credit constraints on firm-level exports and on firm selection into exporting. If MNC subsidiaries are less credit constrained than domestic firms, they would face a lower productivity cutoff for exporting, especially in financially more vulnerable sectors. A foreign affiliate might then be able to sell abroad even when a domestic manufacturer of the same productivity level could not. Because less productive firms sell less, this would tend to reduce the average exports of foreign-owned firms relative to local companies in financially more dependent industries. This selection mechanism can thus explain why the regressions without firm fixed effects produce lower point estimates.

To summarize, our results consistently suggest that financial frictions hamper companies' export performance, but foreign-owned firms are less affected. Our analysis thus serves three purposes. First, it reinforces prior work on the detrimental consequences of capital market imperfections for firms' participation in international trade. Second, it indicates that financial considerations are an important determinant of the sectoral composition of MNC activity abroad. Third, it provides indirect evidence that multinational subsidiaries and joint ventures are less credit constrained than domestic enterprises.

C. Sensitivity Analysis

Our baseline results survive a series of sensitivity checks that alleviate concerns with potential omitted variable or

²² We report estimates based on columns 2, 3, and 5 in table 2 that compare sectors at the 25th and 75th percentiles of the distribution of the relevant measure of financial vulnerability.

²³ We compute comparative statics for each $FinVul_{it}$ measure by comparing sectors and firm sizes at the 25th and 75th percentiles of their respective distributions. We report the average comparative static across all columns in table 2.

sample selection biases (all available on request). While the regressions in table 2 include single-sector firms, identical point estimates of higher statistical significance obtain if we omit them from the sample. This is because with firm fixed effects, all coefficients are identified from the variation across industries within multisector manufacturers. The same holds for all other specifications that follow when the unit of observation is the firm-sector pair. When the outcome of interest varies by firm-sector-destination or firm-product-destination triplet, removing the single-sector sellers leads to virtually identical results of higher significance.²⁴ Our findings are also robust to adding SOEs to the sample, which do not appear systematically different from private domestic firms (column 4 of online appendix table 2).

The prior literature has highlighted a number of factors unrelated to financial frictions that influence MNC incentives. Our estimates might thus spuriously capture the role of industry characteristics other than financial vulnerability. For example, sectors' factor intensity can shape headquarters' decision to offshore manufacturing within the boundaries of the firm (Helpman, 1984; Yeaple, 2003; Antràs, 2003). In the presence of imperfect contractibility and relationship-specific investments, multinational activity is also more likely than arm's-length outsourcing in R&D- and contract-intensive sectors (Antràs, 2003). R&D-intensive companies might similarly prefer to offshore production in-house if they are concerned about the expropriation of their intellectual property (Javorcik & Wei, 2009).

Online appendix table 2 indicates that these alternative determinants of MNC activity are likely orthogonal to credit frictions. We expand specification (1) to include the interactions of firm size and the ownership dummies with sectors' physical and human capital intensity (column 5), R&D intensity (column 6), or contract intensity (column 7).²⁵ Our results for β and γ remain unchanged. Moreover, the economic effect of financial vulnerability is on par with that of human capital intensity, about three times that of physical capital intensity, and as much as ten times that of contract intensity.²⁶ These comparative statics illustrate the importance of financial factors to the operations of multinational companies.

Separately, foreign-owned firms could face either more or less severe agency problems than domestic firms. On the

one hand, MNCs from countries with stronger corporate governance institutions than China may better handle conflicts between controlling and minority shareholders, or among shareholders, managers, and other stakeholders. On the other hand, if MNCs are larger on average and have more dispersed shareholders that are less effective at monitoring managers, they may suffer worse agency problems. Our results could reflect an effect other than financial frictions if both MNCs better resolve corporate governance issues and such issues are more prevalent in financially more dependent sectors.

We perform three checks and find no support for this alternative governance explanation. First, we construct an index of industries' corporate governance intensity and find that it is not significantly correlated with industries' financial vulnerability FPC_i (correlation coefficient, 0.13; p -value, 0.60).²⁷ Second, we add interactions of firm size and ownership with sectors' governance intensity to regression (1). This not only does not affect β and γ , but also reveals no differential performance of foreign and domestic firms in governance-intensive sectors. Finally, we see no evidence that financially more vulnerable sectors attract more MNCs from countries with superior corporate governance-institutions or that MNCs from such countries enjoy a comparative advantage in financially sensitive sectors.²⁸

D. Intensive versus Extensive Margin

We next explore the mechanisms through which credit constraints affect firms' export performance and multinational activity by examining their effect on different margins of trade. As described in section IIA, frictions in the financing of variable costs would distort the intensive margin by reducing the value of firm sales to individual export markets. By contrast, frictions in the financing of fixed trade costs would curb the extensive margin by restricting the number of markets that firms enter.

We first analyze the impact of financial frictions on the intensive margin. Defining export markets at the country-sector level, we consider firm f 's exports to destination d in industry i , $Exports_{fdi}$:

$$\log Exports_{fdi} = \alpha + \beta \cdot FinVuln_i \cdot D_f^{JV} + \gamma \cdot FinVuln_i \cdot D_f^{MNC} + \varphi_f + \varphi_d + \varphi_i + \varepsilon_{fdi}. \quad (2)$$

In addition to sector and firm fixed effects, this specification allows us to control for unobserved market characteristics

²⁴ When we estimate column 3 of online appendix table 2 separately for single- and multisector exporters, we obtain lower point estimates for the former. This implies that the effect of financial frictions on selection into exporting is stronger for single-sector (and presumably most constrained) firms close to the export cutoff, consistent with section IIA. Separately, we have also found qualitatively similar patterns for new and continuing exporters.

²⁵ Data on sectors' factor, R&D and contract intensity from Braun (2003), Kroszner et al. (2007), and Nunn (2007). Since most R&D expenses are incurred upfront, high R&D intensity may generate greater needs for external finance. Controlling for R&D intensity might thus be overcontrolling and underestimate the effect of credit frictions.

²⁶ For each sector measure, we calculate the advantage that foreign affiliates enjoy over domestic firms in a sector at the 75th percentile relative to a sector at the 25th percentile. We then compare these estimates across sector measures.

²⁷ We measure sector i 's natural dependence on effective corporate governance with the average governance index across all U.S. firms in sector i using data from Gompers, Ishii, and Metrick (2003). We are able to do this for twenty industries.

²⁸ We conducted online searches to manually identify the parent country for the largest 4,557 MNC affiliates in our data based on firm names, location in China, and industry affiliation. We follow La Porta et al. (1998, 2002) in measuring the strength of countries' corporate governance institutions with a dummy for common law legal origin or a continuous index of antidirector rights.

TABLE 3—EXTENSIVE AND INTENSIVE MARGINS OF FIRM EXPORTS

Dependent Variable	Intensive Margin		Extensive Margin			
	(log) Exports by Firm-Sector-Destination (1)	(log) Exports by Firm-Product-Destination (2)	(log) # Destination-Products by Firm-Sector (3)	(log) # Destinations by Firm-Sector (4)	(log) # Products by Firm-Sector (5)	(log) # Products by Firm-Sector-Destination (6)
JV × Financial Vulnerability	0.47 (5.09)***	0.41 (4.56)***	0.11 (1.93)*	0.11 (2.41)**	0.02 (0.36)	0.03 (1.50)
MNC × Financial Vulnerability	0.62 (7.49)***	0.54 (6.60)***	0.12 (2.00)*	0.10 (2.33)**	0.02 (0.45)	0.04 (1.78)*
Size × Financial Vulnerability	0.14 (3.98)***	0.09 (3.71)***	0.04 (2.84)***	0.03 (3.02)***	0.03 (2.49)**	0.02 (3.32)***
Firm FE, sector FE	Yes	Yes	Yes	Yes	Yes	Yes
Destination FE	Yes	Yes	—	—	—	Yes
R^2	0.37	0.34	0.52	0.55	0.57	0.35
Number of observations	978,140	1,824,950	221,801	221,801	221,801	978,140
Number of firms	88,004	88,004	88,004	88,004	88,004	88,004
Number of sectors	36	36	36	36	36	36
Number of destinations	231	231	—	—	—	231

This table examines the effect of credit constraints on the extensive and intensive margins of firm exports. The dependent variable is indicated in the column heading. Financial vulnerability is measured by the first principal component of external finance dependence and asset tangibility. All other variables are defined as in table 2. All regressions include a constant term, firm fixed effects, and sector fixed effects. Columns 1, 2, and 6 also include destination fixed effects. Standard errors clustered by sector. T -statistics in parentheses. Significant at *** 1%, ** 5%, * 10%.

with country fixed effects in order to more cleanly isolate the impact of credit constraints. For example, the ϕ_d s account for the cross-country variation in market size, consumer income, exchange rates, and trade costs (e.g., tariff and non-tariff barriers, quality of ports and other infrastructures). With this exhaustive set of fixed effects, the coefficients on the interaction terms are identified from the variation in financial vulnerability across sectors and in ownership types across firms within destination markets, and from the variation across sectors and destinations within firms. At this level of disaggregation, 978,140 observations span 88,004 companies, 231 importing countries, and 36 sectors.

MNC affiliates and joint ventures have systematically higher bilateral exports in financially more vulnerable industries than private domestic firms (column 1 of table 3). Bigger sellers also conduct more bilateral trade in financially more sensitive sectors. These results are highly statistically and economically significant, with point estimates about 90% as large as those for firms' global exports in table 2. Similar patterns obtain when we explore the full dimensionality of the data and examine firms' bilateral exports by HS eight-digit product, for a sample of 1,824,950 observations (column 2).²⁹

We next evaluate the consequences of financial market imperfections for the extensive margin of firm exports. The granularity of the data allows us to define this margin in different ways. This has the advantage that we do not have to take a stance on the specific level at which firms incur fixed trade costs or enjoy cost synergies across destina-

tions within a product or across products within a destination.

We first consider three measures of the extensive margin at the firm-sector level and reestimate specification (1) using each of them as the outcome variable. Exporters' product scope ($\log\#Products_{fi}$) counts the number of HS8 products that firm f sells to at least one market in industry i . The number of destinations ($\log\#Dest_{fi}$) gives the number of countries that f serves with at least one product in sector i . The number of destination-product markets ($\log\#ProdDest_{fi} = \log(\sum_d \#Products_{fdi})$) represents all of f 's trading relationships in industry i by summing the number of bilaterally traded products to country d across destinations d . Finally, we use $\log\#Products_{fdi}$ itself as a fourth indicator of firms' extensive margin and as the outcome variable in equation (2). This allows us to include destination fixed effects ϕ_d to control for unobserved importer characteristics that might affect exporters' optimal product scope in d .

The evidence in table 3 suggests that in financially more vulnerable sectors, bigger and foreign-owned firms tend to serve more destinations than domestic enterprises (column 4). They usually also export a broader range of products in the markets they enter (column 6). As a result, they establish more trading relationships in total (column 3). On the other hand, exporters' overall product scope appears less responsive to the variation in financial conditions across sectors (column 5).³⁰ These regressions impose a specific functional form by applying OLS to logged dependent variables. If we instead adopt the negative binomial model or if

²⁹ Decomposing bilateral sales by product into unit values and quantities traded, we have found that foreign firms export larger quantities than domestic firms in financially more sensitive sectors. This suggests that financial frictions prevent firms from operating at their full export potential. The evidence for export prices is mixed, indicating that credit constraints might curtail companies' export potential by limiting both productivity and quality improvements.

³⁰ The results for the extensive margin hold when we consider the reliance on external finance for fixed costs ($ExtFin_i$), but only the size interaction enters significantly when we focus on the financing of variable costs ($Invent_i$), consistent with the idea that fixed costs are more relevant to firms' extensive-margin decisions than variable costs.

we cluster by firm, significant coefficients obtain for all extensive margins.³¹

These patterns imply that credit constraints restrict firms' ability to enter more markets, widen their product scope, and expand their trade volumes. This has three implications in view of the theory in section IIA. First, our results are consistent with firms facing constraints in the financing of both fixed and variable export costs, as reflected in the distortions to the extensive and the intensive margins, respectively. Financial frictions appear to operate mainly through the intensive margin (average bilateral exports by product, 80%), with a more modest effect on the extensive margin (number of destination-product markets, 20%): the point estimates for $\#ProdDest_{fi}$ are about 20% of those for total exports in table 2.³²

Second, our findings indirectly support priors that firms face a fixed export entry cost in each destination-product market. If these costs were instead market specific but independent of product scope or were constant at the product level regardless of the number of destinations, credit constraints would have affected either only $\#Dest_{fi}$ or $\#Products_{fi}$, but not both $\#ProdDest_{fi}$ and $\#Products_{fi}$.

Finally, the results for exporters' extensive margin suggest that financial frictions distort trade flows above and beyond firms' domestic production. If cross-border sales were only as sensitive to credit constraints as domestic activities, distortions to trade volumes would be proportional to distortions to total production, but there would be no adjustments along the extensive margin of trade. Our findings are thus aligned with earlier evidence that exporters are more reliant on external finance than domestic producers are.

E. Additional Evidence

We have argued that financial frictions restrict cross-border trade because firms are unable to cover upfront expenses associated with exporting. Were these expenses negligible or not borne upfront, access to finance would be irrelevant and credit constraints not binding. As further evidence for the credit mechanism, we show that foreign affiliates outperform domestic companies not just in financially more vulnerable sectors in general, but specifically when firms face higher export costs. We exploit the fact that some destinations are costlier to serve than others. The availability of outside capital will be more important when both a

market entails higher trade costs and exporters require more external finance to meet these costs. We therefore construct a finer indicator of the credit conditions pertinent to firms in sector i selling to country d as the product of two variables, $TradeCost_d \cdot FinVuln_i$. Using this measure in place of $FinVuln_i$, we estimate a modified version of specification (2) for firms' bilateral exports by industry:

$$\begin{aligned} \log Exports_{fdi} = & \alpha + \beta \cdot (TradeCost_d \cdot FinVuln_i) \cdot D_f^{JV} \\ & + \gamma \cdot (TradeCost_d \cdot FinVuln_i) \cdot D_f^{MNC} \\ & + \delta \cdot (TradeCost_d \cdot FinVuln_i) \\ & + \varphi_f + \varphi_d + \varphi_i + \varepsilon_{fdi}. \end{aligned} \quad (3)$$

As before, we include firm, sector, and destination fixed effects. These still subsume the main effects of the ownership dummies D_f^{JV} and D_f^{MNC} , but not that of $TradeCost_d \cdot FinVuln_i$.

We employ four common proxies for $TradeCost_d$. Log bilateral distance to China reflects the variable transportation costs associated with trade transactions. It might also correlate with taste similarity across borders and hence the cost of product customization. For the fixed costs of shipping, setting up, and maintaining foreign distribution networks, we use three estimates from the World Bank's *Doing Business Report*: the log nominal cost (per shipping container), the log number of days, and the log number of documents required to export to destination d . These four variables deliver sharp results consistent with our conclusion that financial frictions distort international trade flows and affect the sectoral composition of MNC activity (table 4). In financially more vulnerable industries, bigger and foreign-owned firms export more than smaller domestic companies to countries associated with higher trade costs.

In the working paper version of this paper (Manova, Wei, & Zhang, 2011), we also study the variation in financial conditions across Chinese provinces in terms of bank credit availability. It is in principle ambiguous whether domestic firms face fewer credit constraints than foreign subsidiaries in financially more developed regions. This ambiguity arises because MNC affiliates can potentially raise capital from multiple sources (banks in China, banks in other countries, and parent companies), but these alternative sources of funding could be substitutes or complements. Moreover, it is not obvious how domestic and foreign firms interact in the Chinese capital market and how local banks allocate resources among them. We find some suggestive but inconclusive evidence that MNC affiliates export relatively more than domestic companies in financially more vulnerable sectors when they are based in financially less developed provinces.³³ Local financial develop-

³¹ NBM allows the dispersion parameter for the distribution of the outcome variable to vary across firms. However, it is not a linear estimator and does not permit firm fixed effects. In OLS, these act as slope-preserving shifts in the intercept and allow us to estimate and naturally interpret the effect of credit constraints across sectors within firms.

³² Note that $\log(Exports_{fi}) = \log(\#ProdDest_{fi}) + \log\left(\frac{\sum_d Exports_{fdi}}{\#ProdDest_{fi}}\right) \neq \sum_d \log(Exports_{fdi})$. By comparing the estimates from running equation (1) for $\log(Exports_{fi})$ and $\log(\#ProdDest_{fi})$, we can decompose the effect of financial frictions on total firm exports into extensive and intensive margins, where the latter is defined as average bilateral exports per destination-product market. Specification (2) instead considers $\log(Exports_{fdi})$.

³³ Similar patterns emerge if we aggregate the data and study total exports by province, sector, and ownership type. This is consistent with subsequent evidence in Jarreau and Poncet (2012).

TABLE 4—TRADE COSTS ACROSS EXPORT DESTINATIONS
DEPENDENT VARIABLE: (LOG) FIRM EXPORTS BY SECTOR AND DESTINATION

Trade Cost Measure	(log) Distance (1)	(log) Import Cost (2)	(log) Import Docs (3)	(log) Import Days (4)
Cost × Financial Vulnerability	−0.30 (−3.34)***	−0.38 (−3.17)***	−1.25 (−4.28)***	−0.83 (−4.29)***
JV × Cost × × Financial Vulnerability	0.05 (5.06)***	0.07 (5.10)***	0.23 (4.47)***	0.15 (4.13)***
MNC × Cost × × Financial Vulnerability	0.07 (7.42)***	0.09 (7.61)***	0.29 (6.41)***	0.18 (5.28)***
Size × Cost × × Financial Vulnerability	0.02 (3.91)***	0.02 (3.97)***	0.06 (3.94)***	0.04 (3.88)***
Firm FE, sector FE	Yes	Yes	Yes	Yes
Destination FE	Yes	Yes	Yes	Yes
R ²	0.37	0.37	0.37	0.37
Number of observations	977,119	956,320	956,320	956,320
Number of firms	88,001	87,640	87,640	87,640
Number of sectors	36	36	36	36
Number of destinations	210	171	171	171

This table examines the effect of credit constraints on firm exports across destinations with different trade costs. Trade costs (Cost) are measured by log bilateral distance, the log nominal cost of importing per shipping container, the log number of required import documents, or the log number of days necessary for import procedures as indicated in the column heading. These measures come from CEPII and the World Bank's *Doing Business Report*. All other variables are defined as in table 3. All regressions include a constant term, firm fixed effects, sector fixed effects, and destination fixed effects. Standard errors clustered by sector. T-statistics in parentheses. Significant at *** 1%, ** 5%, * 10%.

ment, however, does not fully compensate for domestic firms' relatively worse access to banks abroad and to deeper internal capital markets. Were that the case, we would not find our baseline results that MNCs have a comparative advantage in financially vulnerable sectors.³⁴

V. Conclusion

This paper provides microlevel evidence on the harmful consequences of financial market imperfections for firms' ability to engage in international trade. We show that credit constraints restrict companies' total exports, prevent them from entering more markets, and limit their export product range.

We also demonstrate that foreign subsidiaries and joint ventures in China have superior export performance in financially more vulnerable sectors relative to private domestic firms. This comparative advantage is consistent with MNC affiliates being less credit constrained due to their access to deeper internal capital markets and external capital markets abroad. Our findings thus highlight the importance of credit conditions in determining the organizational and production activities of multinational corporations.

More broadly, our results suggest that FDI might alleviate the effects of credit frictions on growth, trade, and private sector development in financially immature economies. Yet the 2007–2009 global crisis has raised concerns about the spread of financial shocks via MNCs' network of affiliates. Whether multinational activity and foreign capital flows improve steady-state credit conditions in host coun-

tries at the expense of greater volatility and exposure to world crises is a fruitful area for future research.

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³⁴ We have also found that provincial financial development supports more SOEs relative to private domestic firms in financially more vulnerable sectors, but not higher SOE firm-level exports. This suggests that state-owned banks might favor SOEs, but SOEs do not optimally allocate resources in response to sectors' financial vulnerability.

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APPENDIX TABLE

Industry Characteristics

This table lists the different sector measures of financial vulnerability used in the empirical analysis, as defined in Table 1. The bottom two rows

of the table report the mean and standard deviation of these measures across the 36 sectors.

ISIC	Industry	External Finance Dependence	Inventory Ratio	Asset Tangibility	Trade Credit Intensity
311	Food products	-0.15	0.10	0.37	0.06
313	Beverages	0.03	0.10	0.40	0.05
314	Tobacco	-1.14	0.28	0.19	0.04
321	Textiles	0.01	0.17	0.31	0.08
322	Apparel	-0.21	0.21	0.15	0.08
323	Leather products	-0.95	0.23	0.12	0.02
324	Footwear	-0.74	0.22	0.13	0.04
331	Wood products	0.05	0.11	0.32	0.08
332	Furniture	-0.38	0.15	0.28	0.05
341	Paper products	-0.35	0.13	0.42	0.06
342	Printing and publishing	-0.42	0.07	0.21	0.05
352	Other chemical products	-0.30	0.15	0.27	0.07
353	Petroleum refineries	-0.02	0.07	0.62	0.22
354	Petroleum and coal products	0.13	0.12	0.46	0.07
355	Rubber products	-0.02	0.15	0.36	0.13
356	Plastic products	-0.02	0.13	0.38	0.10
361	Pottery, china, earthenware	-0.41	0.17	0.28	0.03
362	Glass products	0.03	0.15	0.42	0.04
369	Non-metallic products	-0.29	0.15	0.48	0.07
371	Iron and steel	0.05	0.17	0.44	0.09
372	Non-ferrous metals	-0.12	0.16	0.32	0.08
381	Fabricated metal products	-0.25	0.17	0.28	0.08
382	Machinery, except electrical	-0.04	0.20	0.22	0.09
383	Electrical machinery	0.24	0.18	0.21	0.08
384	Transport equipment	-0.08	0.18	0.23	0.06
385	Prof and scient equipment	0.72	0.21	0.16	0.05
390	Other manufactured products	0.28	0.20	0.18	0.08
3211	Spinning	-0.05	0.16	0.38	0.18
3411	Pulp and paper	-0.07	0.12	0.60	0.06
3511	Industrial chemicals	-0.19	0.14	0.43	0.06
3513	Synthetic resins	0.03	0.13	0.40	0.07
3522	Drugs	2.43	0.13	0.16	0.03
3825	Office and computing	0.54	0.17	0.14	0.06
3832	Radio products	0.70	0.19	0.14	0.07
3841	Ship building	0.38	0.15	0.28	0.08
3843	Motor vehicles	0.06	0.14	0.28	0.10
Average across Industries		-0.01	0.16	0.31	0.07
Standard Deviation across Industries		0.57	0.04	0.13	0.04