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FIRMS AND CREDIT CONSTRAINTS ALONG THE GLOBAL VALUE CHAIN: PROCESSING TRADE IN CHINA

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ABSTRACT

Global supply chains allow firms in developing countries to share in the gains from trade by conducting either ordinary or processing trade. This paper examines how financial constraints affect companies' choice of trade regime and ultimately profitability. We exploit matched customs and balance sheet data from China, where processing trade is further divided into import-and-assembly (processing firm pays for imported inputs) and pure assembly (processing firm receives imported inputs for free). We establish two main results. First, profits, profitability and value added fall as exporters orient sales from ordinary towards processing trade, and from import-and-assembly towards pure assembly. Second, less financially constrained firms perform more ordinary trade relative to processing trade, and more import-and-assembly relative to pure assembly. We rationalize these patterns with a model that incorporates credit constraints and imperfect contractibility in companies' choice of trade regime. Our results imply that limited access to capital restricts firms to low value-added stages of the supply chain and precludes them from pursuing more profitable opportunities. Financial frictions thus affect the organization of production across firm and country boundaries, and inform optimal trade policy in the presence of trade in intermediates.

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1 Introduction

The decline in transportation costs and policy barriers over the last few decades have revolutionized global trade by enabling the splicing of production across borders. Firms today can choose to perform only intermediate segments of the supply chain by processing and assembling imported inputs, before re-exporting to final producers and retailers abroad. According to the International Labor Organization, 60 million workers worldwide are employed in 3,500 export processing zones spanning 130 mostly developing countries (Boyenge 2007). This phenomenon raises new questions of first-order importance to policy makers. How should trade policy be designed when different manufacturing stages occur in different nations? What are the welfare and distributional effects of processing trade and the policies that govern it? How does it shape growth and knowledge spillovers in emerging economies? What are its implications for exchange-rate pass-through and the transmission of shocks between countries?

The existing literature has sought to explain why processing trade arises from the perspective of firms in the developed North, which can offshore production to the South to minimize costs.[1] Instead, to shed light on the above questions, we shift attention to how firms in the South position themselves in the global value chain (GVC) and how this decision affects their performance.

We argue that conducting more steps of the supply chain increases not only value added, but also profits. However, it requires more working capital because it entails higher up-front costs. As a result, financial frictions restrict firms to low value-added stages of production, and preclude them from pursuing more profitable opportunities. Credit market imperfections thus affect the organization of global value chains across firms and countries. This need not mean that GVCs reinforce world inequality. In fact, by engaging in processing trade, liquidity constrained firms in developing nations can share in the gains from trade, when they could not have done so otherwise.

We use matched customs and balance-sheet data on Chinese exporters to study firms' participation in global value chains. China is ideally suited to this analysis for three reasons. First, it plays a major role in international production networks. To boost exports, in the mid 1980s China formally introduced a processing trade regime that exempts materials imported for further processing and re-exporting from import duties. By 2005, 32.7% of Chinese exporters pursued processing trade and contributed 54.6% of total exports. Second, Chinese firms choose between two operating modes within the processing regime. Under pure assembly (PA), they receive foreign inputs at no cost from the trade partner abroad to whom they also send the final product. Under processing with imports (PI),

[1] See for example Helpman (1984), Hanson et al. (2005), and Yeaple (2003).

also known as import-and-assembly, the Chinese firm instead independently sources and pays for imported parts. These institutional features introduce wedges between the costs and returns associated with ordinary trade (OT), PI and PA. Third, China's financial system is underdeveloped and segmented across provinces. It thus provides a perfect setting for exploring the link between credit constraints and GVCs.

We establish two main results. First, profitability varies systematically across trade strategies. Profits, profit-to-sales ratios and value added are higher for companies that undertake more ordinary relative to processing trade, and more import-and-assembly relative to pure assembly. Producers settling for PA or PI must therefore face some constraint that prevents them from doing OT.

Second, limited access to capital poses such a constraint and determines exporters' choice of trade regime. (i) In the cross-section of firms, financially healthier enterprises pursue more ordinary relative to processing trade, and more import-and-assembly relative to pure assembly. (ii) Across industries within firms, exporters conduct more OT than PT and more PI than PA in financially less vulnerable sectors that require less external finance. (iii) These patterns intensify in Chinese provinces with weak financial systems, where liquidity constraints are more likely to bind for the Chinese supplier. They are instead stronger for financially developed export destinations, where the foreign partner is less constrained. Since (i) may arise endogenously, we view it as a check on the internal consistency of the credit channel, and rely on (ii) and (iii) to establish causality. We provide additional corroborative evidence based on (iv) firms' use of imported inputs, (v) surviving exporters over time, and (vi) export entry in general and after the removal of MFA quotas on textiles and apparel.

To illustrate how financial frictions can affect Chinese firms' choice of trade regime and ultimately profits, we present a stylized model that incorporates credit constraints and imperfect contractibility. In the model, Chinese producers transact with a foreign buyer who is financially unconstrained and covers any cost that they don't bear. All outlays represent relationship-specific investments, which leads to hold-up problems. Trade partners hence split revenues according to Nash bargaining with their contribution to the relationship, i.e. share of total costs, as bargaining weights. The Chinese supplier's profits and working capital requirements are both highest under ordinary trade, when he pays for domestic and foreign inputs, import duties, and distribution abroad. Processing with imports entails lower profits and liquidity needs because it avoids import tariffs and marketing costs. Profits and demands for financing are lowest with pure assembly, when upfront expenses comprise only domestic inputs. Chinese firms thus sort into trade modes based on their access to credit, and this in turn pins down their profitability.

Our goal is to highlight the importance of a previously unexplored mechanism that drives firms' participation in processing trade: credit constraints. We use the stylized model to build intuition for this specific mechanism, and do not intend it as a comprehensive treatment. We also focus on the implications of financial frictions rather than their origins. Our empirical analysis however explicitly accounts for other determinants of trade activity that the prior literature has identified.[2] We show that credit constraints exert an effect independent from and economically large relative to that of firm size, productivity, and ownership structure (private vs. state, domestic vs. foreign).

Our results suggest that financial frictions influence the organization of global value chains across firm and country boundaries. The three trade regimes correspond to the integration of different GVC segments (input sourcing, processing and assembly of final goods, and distribution) under the control of the Chinese exporter. Our findings imply that credit constrained firms, and presumably financially underdeveloped countries as a whole, might be stuck in low value-added stages of the supply chain and unable to pursue more profitable opportunities. Strengthening capital markets might thus be an important prerequisite for moving into higher value-added, more profitable activities. Back-of-the-envelope calculations indicate that these effects can be sizable. Improving firms' financial health to that of the least constrained firm in the sample could increase aggregate Chinese profits by 5.5 billion RMB (1.3% of the observed level) and real value added by 15.2 billion RMB (0.7%). These are likely lower bounds and of course capture only one benefit of relaxing credit frictions.

Our analysis also illustrates how liquidity constraints shape the design of international trade contracts. Compared to OT and PI, pure assembly is a codified form of trade credit extended by the foreign buyer to the Chinese supplier for the purpose of financing imported inputs. Our paper thus adds to previous work on the use of trade credit in cross-border transactions (Antràs and Foley 2011). It also resonates with the effect of financial frictions on multinationals' decision to off-shore intra-firm or at arm's length (Antràs et al. 2009, Manova et al. 2009).

Our study provides a bridge between two active recent literatures: trade and finance, and global value chains. There is growing evidence that credit constraints impede firms' export activity and distort aggregate trade flows, both in normal times and during crisis episodes (Manova 2007, Berman and Héricourt 2010, Bricongne et al. 2012, Amiti and Weinstein 2011, Minetti and Zhu 2011, Chor and Manova 2012, Feenstra et al. 2011). We propose a novel mechanism - choice of trade regime and implicitly position along the value chain - through which liquidity constraints impact exporters'

[2] As Dai et al. (2011), we also find that processing exporters are less productive than ordinary exporters in China. Productivity might in fact determine firms' access to capital, as discussed in Manova (2007), Feenstra et al. (2011) and Section 3.6. Feenstra and Hanson (2005) and Fernandes and Tang (2012) study the prevalence of foreign ownership across different trade regimes in China.

outcomes. There has also been increased interest in international production networks and their implications for the transmission of shocks across borders during the 2008-2009 crisis (Bems et al. 2011, Levchenko et al. 2010, Baldwin 2012).[3] An important advance in this area has been the inference of domestic value added and production line position from trade flows and input-output tables at the country level (Johnson and Noguera 2012, Antràs and Chor 2011, Fally 2011). To this line of research we add one of the first micro-level studies of how and why individual firms operate at different stages along the global value chain.

Our conclusions shed light on the gains from trade and the role of trade policy in the presence of GVCs. First, our results imply that facilitating access to imported materials can boost export performance. This is particularly relevant for less advanced countries that rely on trade for growth. It is consistent with evidence that the use of foreign inputs enables manufacturers in developing nations to improve product quality and to broaden product scope, thereby enhancing export activity (Kugler and Verhoogen 2009, 2012, Goldberg et al. 2010, Manova and Zhang 2012). A promising direction for future research is the potential for firms and entire economies to grow by starting with processing trade restricted to few assembly tasks and gradually expanding along the value chain into more profitable activities. To the extent that multilateral tariff reductions can encourage trade in both intermediate and final goods, international production networks also point to possible complementarities in trade policy across countries (Antràs and Staiger 2012).

Second, our findings highlight the differential effects of trade policy and GVCs across heterogeneous firms. The processing regime in China likely allows producers that would have otherwise been unable to pursue any cross-border operations to share in the gains from trade. More liquidity constrained manufacturers might therefore benefit more from import liberalization and from the fragmentation of production across borders. Imperfect financial markets might thus provide some justification for government intervention in the regulation of international trade flows. An important caveat is that we have not examined the effect of processing trade on firms in import-competing sectors. The latter could be limited, however, if few imported inputs can be manufactured locally.

The remainder of the paper is organized as follows. We provide institutional background on China's trade regimes in the next section. After developing a stylized model in Section 3, we introduce the data in Section 4 and present the empirical results in Section 5. We quantify the aggregate distortion due to credit constraints in Section 6. The last section concludes.

[3] Kim and Shin (2012) model global supply chains with production delays and show that inventories, accounts receivable and productivity are procyclical and track financial conditions.

2 Institutional Background

For the past 30 years, China has used a variety of trade policy instruments to stimulate export activity. A particularly consequential intervention has been the exemption of imported inputs for further processing and re-exporting from import duties. In place since the mid-1980s, this provision substantially reduces the cost of foreign intermediates. This encourages local firms to engage in processing trade, as well as to manufacture new or higher-quality products requiring materials that are not available domestically. It also incentivizes overseas companies to offshore production to China.

The Chinese customs authorities distinguish between two key regimes: processing trade and ordinary trade.[4] Processing trade is officially defined as "business activities in which the operating enterprise imports all or part of the raw or ancillary materials, spare parts, components, and packaging materials, and re-exports finished products after processing or assembling these materials/parts". A processing firm can claim import duty exemption only if, at the time of importing, it shows proof of a contractual agreement with a foreign buyer to whom it will export the processed goods.

The processing trade regime comprises two sub-categories: import-and-assembly and pure assembly. The latter is also known as processing with foreign client-supplied materials. It refers to "business activities in which the operating enterprise receives materials/parts from a foreign enterprise without needing to pay foreign exchange for the import, and carries out processing or assembling with the materials/parts as per the requirements of the foreign enterprise, only charging for the processing or assembling, while any finished products are to be sold and marketed by the foreign enterprise." By contrast, import-and-assembly, also known as processing with imported materials, refers to "business activities in which the operating enterprise imports materials/parts by paying foreign exchange for their processing, and exports finished processed products for sale abroad".

In other words, under both types of processing trade, the import duty is waived, the Chinese party pays for all domestic inputs and labor, and the foreign buyer is responsible for marketing and distributing the final product abroad. However, under pure assembly, the Chinese firm does not participate in identifying appropriate foreign materials and incurs no cost for using them. By contrast, under import-and-assembly, the Chinese firm decides what intermediates to source, from which countries and at what prices. It also has to pay foreign suppliers for any imported inputs. These foreign input suppliers are typically not the same party to whom the Chinese firm ultimately exports. Whichever trade partner secures a given input preserves ownership rights over it.

[4] There are a number of other regimes that capture less than 4% of exports (e.g. warehousing trade, entrepôt trade by bonded area, international aid, barter trade). All regime definitions are from "Measures of the Customs of the People's Republic of China on the Control of Processing-Trade Goods" released in 2004 and amended in 2008 and 2010.

Ordinary Chinese imports incur regular import duties and do not receive any exemptions. They include final consumption goods and intermediates used in production for the domestic market. Ordinary exports are often manufactured exclusively with local inputs. However, firms can combine foreign and domestic materials, and sell both in China and abroad. This makes it prohibitively difficult for the Chinese Customs to ascertain what fraction of the imported goods by value will eventually be used towards production for exporting at the time of importing. This is especially true of Chinese firms exporting under their own brand. Conversely, if a Chinese manufacturer (such as a garment-maker) uses imported materials in order to sell domestically under its own brand (e.g. Youngor) and to export abroad under a foreign brand (e.g. Nike, Gap), its imports would be recorded separately and it would enjoy the tax waiver on the processing imports but not on the foreign inputs used for domestic production. Compared to processing firms, ordinary exporters using foreign inputs therefore face higher up-front production costs because they have to pay a surcharge for such inputs. They also bear the full expense of identifying input suppliers and of distribution to final buyers abroad.

The introduction of the processing trade regime has significantly contributed to the expansion in China's trade activity. In 2005, for example, 54.6% of all exports represented processing trade. While China's import duties have declined over time, the exemption for processing imports remains important: Average tariff rates dropped from 41% in 1992 to 16.8% before entry into the WTO in 2001 and reached 9% in 2005 (Lemoine and Ünal-Kesenci 2004, Yu 2011).

3 Conceptual Framework

We develop a stylized model of firms' operation decisions in the presence of the three trade regimes described above. Our goal is to highlight one particular mechanism: the effect of financial frictions on firms' position in global supply chains and ultimately profitability. In order to cleanly illustrate it and build intuition, we abstract away from other potentially important economic forces in the baseline presentation. We then discuss how incorporating a number of them into the model would modify its results. While the mechanism of interest would still be operative, its impact may be magnified or mitigated. With this in mind, we state our predictions as hypotheses that we can take to the data.

The model is in partial equilibrium and from the perspective of a Chinese exporter deciding what type of activity to undertake. It implicitly assumes that there is sufficient demand abroad both for final goods supplied by ordinary Chinese exporters, as well as for outsourcing production to China via processing trade. In other words, for any trade regime chosen by the Chinese firm, there will be a foreign buyer willing to enter the partnership. We believe that this assumption approximates well the

economic environment in China, and it allows us to concentrate specifically on the trade-offs faced by the Chinese entrepreneur. We revisit this in Section 3.6.

3.1 Set up

Consider a manufacturer (*M*) producing for a foreign market. Export demand is fixed and normalized to 1, such that potential revenues are *R*. Production requires the use of domestic intermediate inputs and labor worth C_D and foreign materials worth C_F. Servicing consumers abroad entails an additional outlay *F* for marketing and managing a distribution network. *M* chooses to operate under ordinary trade (*OT*), import-and-assembly (*PI*, for processing with imports), or pure assembly (*PA*). When foreign materials are imported under processing trade (*PA* or *PI*), they do not incur any customs duties. Foreign parts sourced under ordinary trade face an ad-valorem tariff τ at the time of import since border agents cannot ensure that the inputs will be processed and re-exported. For expositional simplicity, we assume that this tax is rebated once the final product is shipped abroad. Section 3.6 discusses the consequences of relaxing this assumption. All relevant characteristics of the three trade regimes are summarized in Table 1.

3.2 Firm costs

The manufacturer's choice of trade regime determines how the costs associated with the export transaction are shared between *M* and any foreign party. While ex-post total expenses are always C_D+C_F+F after any tariff rebates, *M*'s ex-ante expenses depend on the trade mode.

Under pure assembly, *M* establishes a contractual relationship with a buyer (*B*) overseas who commits to provide all foreign inputs at no charge to *M* and is responsible for marketing and distribution abroad. Since the transfer of foreign materials occurs under processing trade, it avoids import duties. The up-front costs to *M* and *B* are therefore $TC_{PA} = C_D$ and C_F+F respectively.

Under import-and-assembly, *M* enters an agreement with a foreign buyer who manages the sale of the product to consumers abroad. The manufacturer retains control over the sourcing of all production inputs and is in charge of any associated expenses. No import duties are imposed on foreign intermediates as they enter the country under the processing regime. The up-front costs to *M* and *B* are thus $TC_{PI} = C_D+C_F$ and *F* respectively.

Under ordinary trade, *M* operates completely independently and handles all aspects of the cross-border sale. The firm secures all domestic and foreign inputs, and organizes its distribution

network in the destination market. It transacts directly with final consumers abroad who bear no costs.[5] Imported parts are taxed at the time of purchase, but these duties are refunded when the transaction is complete. The up-front costs to *M* and *B* are now $TC_{OT} = C_D+(1+\tau)C_F+F$ and 0.

3.3 Firm profits

Contracts are imperfectly enforced and this exposes firms to the risk of hold-up problems once costs have been incurred. Should the relationship break-up, both parties are able to recoup their costs,[6] *M* by selling the final product to another buyer and *B* by offering its distribution services to another supplier. Trade partners therefore negotiate over the surplus from the relationship, $R-C_D-C_F-F$. They engage in Nash bargaining with bargaining weights corresponding to their contribution to the relationship. To fix ideas, we assume that these weights reflect the share of total costs borne by each side. Denoting the manufacturer's bargaining weight as β_i, his profits under trade regime *i* are therefore given by:

$$\pi_i = -TC_i + TC_i + \beta_i(R - C_D - C_F - F) = \beta_i(R - C_D - C_F - F), \qquad i \in \{PA, PI, OT\}$$

$$\text{where } \beta_{PA} = \frac{C_D}{C_D + C_F + F} < \beta_{PI} = \frac{C_D + C_F}{C_D + C_F + F} < \beta_{OT} = \frac{C_D + C_F + F}{C_D + C_F + F} = 1.$$

3.4 Credit constraints and trade regime choice

All costs associated with exporting are incurred up-front, before production takes place. All revenues and payoffs are, however, realized after trade has occurred. The foreign buyer does not face any liquidity needs and can cover his outlays with cash flows from operations or outside capital. The Chinese manufacturer, on the other hand, is unable to retain earnings from one period to the next because all profits have to be paid out as dividends to stockholders (for example due to moral hazard issues). Thus, whether *M* can engage in any trade activity and if so, under what organizational mode, depends on his ability to raise external funding. Let *M* have access to bank loans in the amount *L*, which can vary across firms.

In this stylized set-up, there is a clear ranking of *M*'s export profits and up-front costs across trade regimes: both are lowest with pure assembly, higher with import-and-assembly, and highest with ordinary trade.

Profits: $\pi_{PA} < \pi_{PI} < \pi_{OT}$

[5] Our results will be qualitatively unchanged if the firm sold to a foreign retailer who is responsible for some of the distribution costs. All that is required in that case is that those costs are incurred after the exporter has been paid. The cost *F* to the manufacturer can then be interpreted as the cost of searching and matching with this foreign retailer, which is not required under processing trade.

[6] Assuming that parties' outside option is a fraction of the cost they incurred would not affect our results qualitatively.

Liquidity needs: $TC_{PA} < TC_{PI} < TC_{OT}$

Ordinary trade would therefore be the dominant export strategy in the absence of credit constraints. With financial frictions, however, the manufacturer will pursue the most profitable trade regime he can given his available external capital *L*.

Hypothesis *Most financially constrained exporters ($C_D \leq L < C_D+C_F$) conduct pure assembly and earn low profits. Less financially constrained exporters ($C_D+C_F \leq L < C_D+(1+\tau)C_F+F$) conduct import-and-assembly and earn higher profits. Least financially constrained exporters ($L \geq C_D+(1+\tau)C_F+F$) conduct ordinary trade and earn the highest profits.*

3.5 Mixed export strategies

Strictly interpreted, this hypothesis suggests that each firm chooses a unique trade mode. If the manufacturer makes multiple products in one or more sectors, however, and if these goods have different cost and revenue structures, it can be optimal to export some merchandise via processing trade and some via ordinary trade. This decision will depend on *M*'s access to capital. While financiers fund firms and do not earmark loans to specific projects, money is fungible across projects within a firm. Companies allocate their limited financial resources to different product lines so as to maximize total profits. The most advantageous allocation will balance the trade-off between expanding product scope and pursuing higher-return transactions: On the one hand, processing trade (especially pure assembly) uses up less liquidity per product line than ordinary trade and thereby allows the firm to manufacture more goods. This tends to increase the extensive margin of firm profits. On the other hand, processing exports (especially pure assembly) generate lower revenues. This tends to decrease the intensive margin of firm profits.

While this profit-maximizing problem is complex, its solution is quite intuitive. Manufacturers will choose ordinary trade for products with relatively low up-front costs and high revenue potential. By contrast, they will opt for processing with imports for goods with intermediate cost and revenue levels. Firms will finally settle for pure assembly for articles with high liquidity requirements but limited returns. It can thus be optimal for multi-product firms to adopt mixed export strategies. In the data, multiple products map into the same sector. While we observe the importance of external finance by sector, in practice it may well vary across goods within sectors. Summing across products to the sector level, the share of exports conducted under a specific trade regime can therefore fall inside the [0,1] interval. This suggests systematic and smooth variation in companies' proclivity to adopt different trade modes across sectors.

Hypothesis 1 *Across sectors within a firm, the share of processing exports in total exports* $\left(\frac{X_{PA}+X_{PI}}{X_{PA}+X_{PI}+X_{OT}}\right)$ *and the share of pure assembly in processing exports* $\left(\frac{X_{PA}}{X_{PA}+X_{PI}}\right)$ *increase with sectors' financial dependence.*

Note that exporters with more access to finance will differ from capital-scarce firms in two respects. For any given product or sector, less constrained manufacturers will be more likely to select into ordinary trade relative to processing trade, and into import-and-assembly relative to pure assembly (as per Hypothesis 1). In addition, financially healthier producers may be able to trade in more goods, especially in sectors with higher liquidity needs. Aggregating to the firm level, this implies a "smoothed" version of our original Hypothesis.

Hypothesis 2 *Across firms, financially healthier firms have a lower share of processing exports in total exports* $\left(\frac{X_{PA}+X_{PI}}{X_{PA}+X_{PI}+X_{OT}}\right)$ *and a lower share of pure assembly in processing exports* $\left(\frac{X_{PA}}{X_{PA}+X_{PI}}\right)$.

Hypothesis 3 *Across firms, profits fall with both shares,* $\frac{X_{PA}+X_{PI}}{X_{PA}+X_{PI}+X_{OT}}$ *and* $\frac{X_{PA}}{X_{PA}+X_{PI}}$.

3.6 Discussion

Although the stylized framework above rests on a number of simplifying assumptions, we believe its main predictions would hold in a wide range of alternative set-ups. Here we discuss a few potential extensions to richer economic environments. To the extent that theoretical ambiguities might arise, which mechanisms dominate in practice is ultimately an empirical question and this would work against us finding support for Hypotheses 1-3 in the data.

Endogenous inputs and outputs

We have so far restricted firms to producing fixed output levels with fixed inputs and implicitly ruled out moral hazard. However, if parties actively choose the quantity or quality of inputs and exert effort in production, output levels and revenues would be endogenous to the trade regime choice. This would arise because of a standard agency problem from the theory of the firm (Grossman and Hart 1986, Hart and Moore 1990): While trade partners incur the full cost of a given input, they receive only a share of its marginal revenue due to imperfect contractibility and Nash bargaining. This leads to underinvestment and suboptimal output levels.

Moral hazard could play out in a number of ways in the context we consider. In all three trade regimes, the Chinese producer might need to expend effort in locating domestic materials and hiring local labor that are both well suited to the manufacturing process and at an attractive price. The same

could be true of sourcing foreign parts under ordinary exports and processing with imports (but not with pure assembly when the foreign buyer does so). *M* might also exert effort in managing plant operations and converting inputs into final products. The higher his bargaining weight, the more effort he would have the incentive to put in and the higher sales would presumably be. This would preserve the ranking of trade regimes but magnify the difference in revenues across them. Moral hazard can thus accentuate the negative impact of liquidity constraints on firms' profitability.

Ordinary trade without foreign inputs

Our baseline model assumes that all firms use domestic and foreign inputs in the same proportion regardless of their trade regime. Ordinary exporters may, however, choose to use only domestic intermediates or fewer imported parts. If local materials are cheaper, this strategy could reduce up-front costs, especially in the absence of a tariff rebate (see below). Pure assembly would remain the trade mode with the lowest liquidity requirements, but the relative ranking of total costs under ordinary exports and processing with imports would become theoretically ambiguous. It would be preserved provided that the distribution cost *F* is sufficiently large, foreign inputs sufficiently important for production, and/or Chinese materials not too cheap.

If production costs do fall but sales are not affected by the switch towards domestic parts, ordinary trade could become even more profitable relative to both processing modes. Output quality and revenues might suffer, however, if local materials are inferior to imported components and make the product less appealing to foreign consumers. This could make the profitability ranking of ordinary vs. processing trade ambiguous, though that of PA and PI would be unchanged. Such a reversal would be less likely than in the sorting by financial needs, though, because of the difference in bargaining weights across regimes. Moreover, when manufacturers' effort responds to incentives as discussed above, ordinary exporters would invest the most of all three types in identifying complimentary inputs and marketing the product. This would serve to improve firm profitability.

No tariff rebate

In reality, ordinary exporters cannot claim refunds on the import duties they pay for foreign inputs. This increases their costs and reduces expected profits. Once again, firms' sorting into the two types of processing trade is unaffected. The relative position of the ordinary trade regime in terms of working capital needs also remains the same. On the other hand, the ordering of its profitability could be overturned if import tariffs are sufficiently large. Given that they averaged 9% in 2005 (the year in our data), as well as the discussion of endogenous input choices above, this does not appear very likely.

Productivity Heterogeneity

Our stylized framework has abstracted away from firm heterogeneity along dimensions other than financial health. As is well known, however, productivity is an important determinant of export outcomes. To the extent that productivity and access to capital are imperfectly correlated, they would jointly define firms' trade regime choice in a richer model. For example, all expenses (C_D, C_F, and F) might plausibly have a fixed-cost component. In the spirit of Melitz (2003), the most productive manufacturers would then self select into ordinary trade, less productive companies would pursue processing with imports, and the least productive exporters would undertake pure assembly. Some very inefficient enterprises might be unable to engage in any form of cross-border activity. Controlling for firm productivity though, financial health would still act as in the model above.

At the same time, more productive exporters may be endogenously less credit constrained because their revenues are higher and they can provide stronger incentives to financiers to fund their operations (Manova 2013, Feenstra et al. 2011). The underlying determinant of firms' trade regime choice would then be productivity, and it would operate (at least in part) through the credit channel in our model. If so, conditioning on productivity in our empirical analysis would leave no additional explanatory power for firms' financial health per se. We explore this in Section 5.2.

Endogenous credit constraints

Another relevant possibility is that firms' access to internal and external capital might be endogenous to their trade regime. First, banks might be more willing to fund firms with higher expected profits. This would reinforce the predictions of the model because the more profitable export modes are also the ones with higher liquidity needs. We return to this point in Section 5.4.

Second, entrepreneurs might be able to retain earnings from one period to the next. Over time, it might thus be possible for firms that begin with processing trade to accumulate sufficient financial resources and move into ordinary trade. While these transitions could be important for aggregate growth, they would not affect the cross-sectional predictions of the model that we take to the data.

Finally, exporters might be able to secure trade credit from foreign buyers. Evidence suggests that such trade-credit relationships develop over time as they rest on trust and reputation (Antràs and Foley 2011). In some sense, the buyer's willingness to provide foreign inputs free of charge under PA is a form of trade credit. If firms exporting under OT or PI can also obtain trade credit, their liquidity constraint would be relaxed and our results biased downwards. Similarly, if the partnership with a foreign buyer under processing trade increases Chinese firms' credibility and hence access to capital in the local financial market, this would work against us in the empirical analysis.

Joint trade regime choice

Our modeling approach remains silent about the incentives of the foreign buyer, examining only the trade-offs faced by the Chinese manufacturer. While in reality it takes two to tango, this would not materially affect our central results. Foreign clients interested in purchasing final goods from ordinary Chinese exporters presumably differ from foreign parties looking to outsource segments of their production process to China. The sorting of foreign buyers into ordinary vs. processing trade relationships is thus arguably independent from the sorting of Chinese firms into these two modes. On the other hand, the choice between pure assembly and import-and-assembly might not be the sole prerogative of the Chinese party, but also reflect the preferences of the foreign buyer. To ensure production takes place, the latter might optimally offer PA to credit constrained Chinese manufacturers. This option would only be available to foreign buyers with sufficient access to capital of their own. This could generate negative assortative matching between Chinese and foreign parties in terms of financial health and coordinated selection into the two processing regimes, but it would not alter our predictions for the behavior of Chinese firms. We revisit this issue empirically in Section 5.3.

4 Data

4.1 Trade and balance-sheet data

Our analysis makes use of two proprietary datasets on the activities of Chinese firms in 2005. The first one comes from the Chinese Customs Office and contains detailed information about the universe of trade transactions.[7] It reports the value of firm exports (free on board) and imports (cost, insurance and freight included) in U.S. dollars by product and trade partner for 243 destination/source countries and 7,526 different products in the 8-digit Harmonized System.[8] The records also indicate whether each cross-border sale occurs under ordinary trade, processing with imports or pure assembly. It is important to note that firms can operate under multiple trade modes. The trade-regime classification thus characterizes individual transactions rather than firms. This allows us to construct continuous measures of the proclivity for using different trade regimes at the firm level.

The second database we employ is the Annual Surveys of Industrial Firms (ASIF) conducted by China's National Bureau of Statistics. It provides standard balance-sheet data for all state-owned enterprises (SOEs) and all private companies with sales above 5 million Chinese Yuan[9]. The main

[7] Manova and Zhang (2008) describe the data and stylized facts about firm heterogeneity in Chinese trade.
[8] 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 U.S.
[9] This is equivalent to 0.6 million USD based on the USD-CNY exchange rate in 2005.

variables of interest to us are measures of firm profitability and financial status, which we discuss in greater detail below. We also use information on employment, capital and material inputs to construct proxies for firm size and productivity. Firms are legally required to complete both the census and the customs declaration forms, and compliance is strictly enforced by different government agencies.[10]

Our empirical analysis critically relies on combining data from both sources. While each is organized around company registration numbers, the authorities have not released a unique firm identifier. We therefore merge the census files to the customs records based on an algorithm that matches firms' names and key contact information, including addresses and phone numbers.[11] While imperfect, this procedure generates a large and representative sample. We are able to obtain balance-sheet data for 44% of all exporters in the customs registry. As Table 2 shows, these matched exporters exhibit similar trade patterns as the full sample of exporters in the customs reports. Likewise, the balance sheets of the matched exporters are comparable to those of all exporters in the census.

Some Chinese corporations (mostly SOEs) are pure export-import companies that serve exclusively as intermediaries between domestic producers (buyers) and foreign buyers (suppliers). Following standard practice in the literature, we identify these wholesalers using keywords in firms' names and exclude them from our sample.[12] We focus on manufacturing firms that both make and sell goods since we are interested in how access to finance affects their export decisions. Intermediaries face very different choices and financing needs, whose study we leave to future work.

Table 2 illustrates the substantial variation in performance and trade activity across the 50,606 Chinese firms in our matched sample. (Log) profits and (log) value added average 7.33 and 9.23, with standard deviations of 1.95 and 1.48, respectively. The dispersion in profitability, measured by the ratio of profits to sales, is even greater with a mean of 0.03 and standard deviation of 0.20.

Our analysis examines two indicators of firms' choice over trade regimes. The first represents the share of processing exports (both pure assembly and import-and-assembly) in total exports and is labeled (PA+PI) / (PA+PI+OT). The second distinguishes between the two processing modes and gives the share of pure assembly in total processing exports, PA/(PA+PI). In Table 2, both of these ratios have been constructed based on aggregated firm sales across all destinations and product categories. As evident from the summary statistics, the trade-regime composition of export activity

[10] As in Wang and Yu (2012), the ASIF data are cleaned by excluding observations according to the following criteria: (a) firms in non-manufacturing industries (2-digit GB/T industry code >43 or <13) and tobacco (GB/T code 16); (b) observations with negative values for output, sales, exports, capital, or intermediate inputs; (c) observations with total assets less than total fixed assets or total liquid assets, or with total sales less than exports.

[11] See Wang and Yu (2012) for a detailed description of the matching procedure.

[12] We drop 29,982 wholesalers who mediate 22.3% of China's trade. Using the same data, Ahn et al. (2011) identify intermediaries in the same way in order to study wholesale activity.

varies significantly across firms in the sample. In some specifications below, we further explore the variation across countries and industries within exporters and calculate these shares for each firm-destination pair, firm-sector pair, or firm-sector-destination triplet.

While many Chinese producers operate in one unique trade mode, a sizable group transact under multiple regimes. The Venn diagram in Figure 1 shows the percentage share of firms engaged in each of 7 possible combinations of export methods (PA; PI; OT; PA and PI; PA and OT; PI and OT; PA, PI and OT). The reported percentages sum to 100%. 63.0% of all sellers ship only ordinary exports, while 2.7% and 11.0% conduct exclusively pure assembly and processing with imports, respectively. The remaining 23.3% pursue mixed trade strategies, with 3.5% undertaking some activity under all three regimes. Similar patterns obtain when we look at a finer level of disaggregation and consider firm-sector pairs instead of firms (not reported). Figure 2 replicates Figure 1, but instead of showing the percentage share of firms in a segment, it reports the percentage share of total exports captured by firms in that segment. Processing trade, especially PI, contributes substantially more to the value of Chinese exports than its number of firms would suggest. This is despite the low value added associated with processing trade (see below) and is primarily because of its high import content.

Given that manufacturers use different modes of servicing export markets, it is not surprising that they also source foreign materials in different ways. Companies exporting under more than one trade regime acquire intermediates under multiple regimes as well. Figure 3A summarizes the use of imported inputs by firms reporting any ordinary exports (left bar) or any processing exports (right bar). Ordinary exporters are significantly less prone to use foreign parts. Conditional on importing materials, they are more likely to do so under ordinary trade. These patterns are even more extreme when we focus on suppliers engaged in either ordinary or processing exports but not both (Figure 3B).

4.2 Measuring financial constraints

We use four different proxies for 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 inherent to the nature of the manufacturing process and beyond the control of individual firms. They are available for 29 ISIC 3-digit sectors, which we match to the Chinese HS 8-digit product codes in our data.[13]

There are systematic differences across sectors in firms' reliance on external capital for funding their operations. These arise because of variation in the relative importance of up-front costs

[13] The sector measures come from Kroszner et al. (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.

and the lag between the time when production expenses are incurred and the time when revenues are realized. As we explain later, it proves useful to distinguish between the financing of day-to-day activities in the short-run vs. long-run investment projects. We use the ratio of inventories to sales ($Invent_i$) to proxy the duration of the manufacturing process and the working capital firms require in order to maintain inventories and meet demand. This measure indexes producers' liquidity needs in the short run, which are associated mainly with variable costs such as the cost of intermediate inputs. We exploit two indicators of firms' funding needs for long-term investments that comprise mostly fixed costs. The classic measure is sectors' external finance dependence ($ExtFin_i$), obtained as the share of capital expenditures not financed with internal cash flows from operations. We also study the share of R&D spending in total sales (RD_i), since research and development typically occur at the beginning of a production cycle before a good can be manufactured and successfully marketed.

Sectors vary not only in firms' reliance on external finance, but also in firms' ability to raise external finance. We proxy the latter with the endowment of hard assets that companies can pledge as collateral when accessing capital markets. This is gauged by 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, these sector measures are constructed from data on all publicly traded U.S.-based companies from Compustat's annual industrial files. This approach is motivated by a number of considerations. 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 and use of external capital. Second, having the U.S. as the reference country eliminates the concern that sectors' financial vulnerability might endogenously respond to China's level of financial development. In fact, if the most financially vulnerable industries in the U.S. employ 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 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. To the extent that it doesn't, measurement error would once again bias our estimates down. Kroszner et al. (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. Consistent with this argument, the measures vary substantially more across industries than across firms within an industry, and the hierarchy of sectors is quite stable over time.

In addition to these sector indicators, we also construct two balance-sheet measures of firms' financial health that are standard in the literature. Liquidity gives the difference between current assets

and current liabilities, scaled by total assets. It captures firms' availability of liquid capital. Leverage is the ratio of short-term debt to current assets. Higher leverage signals that firms have more financial obligations outstanding in the short run and less freedom in managing their cash flows.[14] We thus expect exporters with high liquidity and low leverage to be financially healthier and less constrained.

A first glimpse at the variation in trade activity with firms' financial health and sectors' financial vulnerability reveals patterns consistent with our hypotheses. In Figure 4A, we divide firms into two subsamples with liquidity above and below the median.[15] While the average share of processing trade in total exports is 29.4% for high-liquidity firms, it is 31.2% for low-liquidity firms. The corresponding numbers are 17.7% and 19.4% for the share of pure assembly in processing exports. When we distinguish between sectors with working capital needs above and below the median, we observe substantially bigger differences. In industries with high inventory-to-sales ratios, the typical firm conducts 19.9% of its exports via processing trade and 22.7% of its processing exports via pure assembly. By contrast, these shares drop to 14.3% and 14.6% for industries with low inventory-to-sales ratio.

5 Empirical Results

The empirical analysis proceeds in three steps. We first document the relationship between exporters' profitability and type of trade regime (Hypothesis 3). We then establish the effect of financial constraints on companies' choice of export mode (Hypotheses 1 and 2). Finally, we provide additional support for the credit channel by showing that its effect is stronger in circumstances when we expect it to be stronger and by presenting consistent evidence for firms' use of imported inputs.

5.1 Trade regimes and firm profitability

We first study the link between firm performance and trading modes. According to Hypothesis 3, export profitability should increase as the composition of foreign sales shifts from pure assembly to processing with imports to ordinary trade. We therefore consider two indicators of companies' activity: the share of processing exports in total exports $\left(\frac{X_{PA}+X_{PI}}{X_{PA}+X_{PI}+X_{OT}}\right)$ and the share of pure assembly in processing exports $\left(\frac{X_{PA}}{X_{PA}+X_{PI}}\right)$. We construct these trade shares at the firm level, after summing exports

[14] See for example Whited (1992), Fazzari and Petersen (1993), Greenaway et al. (2007), and Ding et al. (2013). Our liquidity variable is consistent with the definition of liquidity constraint in our theoretical model.
[15] We control for systematic differences in liquidity across firms with different ownership structures by defining these medians separately for private domestic firms, state-owned enterprises, joint ventures and foreign affiliates.

across all destinations served and products sold. For each ratio, we estimate the following specification in the matched sample of exporters with balance-sheet data[16]:

$$Performance_f = \alpha + \beta \cdot Trade\ Share_f + \gamma \cdot \log Empl_f + \varphi_p + \varphi_i + \varphi_{own} + \varepsilon_f \qquad (1)$$

Here $Performance_f$ represents firm f's (log) profits from all domestic and foreign operations or f's profitability, i.e. its profit-to-sales ratio. The census records producers' location in China and the main sector in which they operate. This allows us to use province φ_p and industry φ_i fixed effects in order to account for systematic differences across 31 regions and 475 sectors (4-digit GBT codes) that might affect all manufacturers. These capture differences in factor costs, factor intensities, transportation costs, financial market development, institutional frictions, tax treatment, etc. that might favor one export mode over another and directly impact profitability. We additionally control for firm size, as proxied by (log) employment. We also condition on the ownership status of the firm since foreign corporations might have distinct incentives and attributes compared to local companies. In particular, we include dummies for state-owned enterprises, joint ventures, and wholly-owned multinational affiliates, the excluded category being private domestic firms. We employ Huber-White heteroskedasticity robust standard errors ε_f.

We are primarily interested in β, which reflects (the sign of) the conditional correlation between firms' profitability and choice of trade regime. This coefficient is identified from the variation across exporters within narrowly defined segments of the economy. We emphasize that we cannot and do not want to give β a causal interpretation: As illustrated in the stylized model, profits and export activity are both affected by producers' financial health and are the joint outcome of firms' maximization problem. In practice, other firm attributes outside our simple framework might also influence both variables.

The results in Columns 1 and 2 of Table 3 indicate that profitability indeed varies systematically with firms' trade strategy. Manufacturers' profits and profitability increase with the share of processing exports in total foreign sales (Panel A) and with the share of pure assembly in processing exports (Panel B). These patterns are independent of the fact that bigger firms tend to be more profitable. They are also economically significant. A 10% shift in activity from processing towards ordinary trade is associated with 1.5% higher profits. Re-allocating 10% of processing exports

[16] In unreported results available on request, we have performed the entire empirical analysis and obtained consistent results for the $\frac{X_{PA}}{X_{PA}+X_{OT}}$ and $\frac{X_{PI}}{X_{PI}+X_{OT}}$ ratios as well.

from pure-assembly to import-and-assembly is accompanied by a 2.8% rise in profits. A one-standard-deviation increase in the two trade shares corresponds to 6.5% and 10.7% higher profits respectively.

As common with balance-sheet data, Chinese firms do not report profits separately for domestic and foreign sales. To the extent that trade-regime choices affect revenues abroad but not operations at home, the results in Columns 1-2 likely underestimate the importance of the trade mode for export profitability. To shed light on this, in Columns 4-5 we focus on firms that sell exclusively in foreign markets but not domestically. While these "pure exporters" represent only about 20% of our matched sample, we can be sure that their profits capture solely cross-border activities. As anticipated, we obtain bigger point estimates in this group of producers.

In our stylized model, the value added by the Chinese manufacturer does not depend on the trade regime. It instead equals the surplus from the bilateral partnership, R-C_D-C_F-F. As discussed in Section 3.6, however, value added might vary across export modes if input and output choices are endogenous and parties exert effort according to their share of revenues. The evidence in Columns 3 and 6 lends support to this conjecture. We find that a higher share of processing exports, and of pure assembly in particular, are associated with substantially lower levels of value added. Raising $\frac{X_{PA}+X_{PI}}{X_{PA}+X_{PI}+X_{OT}}$ and $\frac{X_{PA}}{X_{PA}+X_{PI}}$ by one standard deviation entails 4.6% and 8.8% gain in value added.[17]

5.2 Trade regimes and credit constraints

Having established the variation in profitability across trade regimes, we next show that credit constraints prevent firms from pursuing more profitable regimes. The two trade shares now become the dependent variables of interest. To study the role of financial frictions, we first explore the variation in financial health across firms within a sector. We expect producers with less access to liquid capital to concentrate more on processing trade, and pure assembly in particular (Hypothesis 2). This exercise is informative and a check on the internal consistency of our argument, but potentially subject to endogeneity and reverse causality. To address this concern, we then exploit the exogenous variation in financial vulnerability across sectors within firms. This allows us to identify the impact of credit constraints from the allocation of trade strategies (and implicitly of fungible capital) across sectors within multi-sector exporters. We anticipate companies to conduct more processing trade, especially pure assembly, in financially more sensitive industries (Hypothesis 1).

[17] For completeness, we have also examined how firms' total exports and domestic sales vary with their choice of trade regime (Columns 1-2 of Appendix Table 1). Unsurprisingly, firms that undertake more processing trade report lower sales in China and higher export revenues. Among processing exporters, those that pursue pure assembly tend to sell less both at home and abroad than those who conduct import and assembly.

Firms' financial health

We study the link between firms' financial health and export activity with the following specification:

$$Trade\ Share_f = \alpha + \beta \cdot Fin\ Health_f + \gamma \cdot \log Empl_f + \varphi_p + \varphi_i + \varphi_{own} + \varepsilon_f \quad (2)$$

As before, $Trade\ Share_f$ refers to one of the two trade regime shares. We proxy $Fin\ Health_f$ interchangeably with f's liquidity or leverage. We consider firms with more current availability of finance and fewer debt obligations to be less liquidity constrained. We again condition on company size, ownership type, province φ_p and industry φ_i fixed effects, and report robust standard errors.[18]

As Table 4 shows, companies' financial status indeed predicts their position in the global value chain. Consistently with Hypothesis 2, manufacturers with more liquidity and less short-term debt typically perform more ordinary trade (Column 1). They also conduct a greater portion of their processing exports with imported inputs as opposed to via pure assembly (Column 2). These findings are highly statistically significant and hold when we lag firms' financial health by a year (Columns 3-4). Since the latter is less likely to endogenously respond to current trade activity (more on this below), it is our preferred measure in the rest of the analysis. Similar results however obtain whether we use concurrent or lagged indicators.

These patterns appear economically meaningful. Improving liquidity (leverage) by one standard deviation would reduce the share of processing exports in foreign sales by 0.8% (0.5%). The contribution of pure assembly towards processing exports would also drop by 1.2% (2.8%).

These baseline results survive a series of specification checks. First, we rule out concerns with compositional effects related to firms' export markets. Trade costs, demand conditions and the broader economic environment vary across countries. Different trade regimes may thus be better suited to different markets for reasons unrelated to financial frictions. To ensure that our results are not driven by such factors, we construct exporters' trade shares separately for each of their destinations and re-estimate equation (2) adding country fixed effects. Because the unit of observation is now the firm-country pair and the error term might be correlated across markets within a supplier, we cluster errors by firm. Reassuringly, we obtain quantitatively and qualitatively similar estimates (Columns 5-6).

Second, we address similar concerns with product composition. Firms' preferred trade regime might vary across products for reasons other than credit constraints, such as China's product expertise or availability of specialized inputs. Equation (2) largely accommodates this since it conditions on companies' main industry affiliation with industry fixed effects. We have nevertheless confirmed our

[18] In all specifications, we use the same symbols for the intercept, coefficients, fixed effects and error terms as in equation (1). This is only for expositional convenience; these objects will of course differ across specifications.

results at the finest level of disaggregation available in the data: when the outcome variable is at the firm-product-destination level and we include both country dummies and 8-digit product fixed effects.

Third, we account for the fact that many exporters operate exclusively under one trade regime (Figure 1). $Trade\ Share_f$ thus frequently equals 0 or 1, and falls in between for a quarter to a third of the observations in any regression. This is consistent with our hypotheses and not consequential econometrically: Our findings remain unchanged when we replace the continuous trade share with a binary indicator set to 1 for all values above 0 (left panel of Table 6). We report point estimates only based on a linear probability model, but similar patterns emerge if we alternatively adopt Probit.

Finally, we consider the role of firm productivity. In our context, this is not an omitted variable in the classical sense. Recall from Section 3.6 that it can affect exporters' activity through two channels: directly (e.g. because of fixed costs) and/or indirectly (by determining access to finance). While the former channel is orthogonal to the credit-constraints mechanism that we emphasize, the latter is consistent with it and sheds light on how it operates. To unpack these two channels, in Columns 7-8 of Table 4 we re-estimate (2) controlling explicitly for companies' total factor productivity.[19] The coefficient on manufacturers' financial health largely retains its statistical and economic significance, while productivity enters negatively and significantly. This suggests that production efficiency is positively but imperfectly correlated with access to capital, and impacts trade-regime choices via both channels. In other words, both less productive firms and more liquidity constrained enterprises self-select into processing trade, and pure assembly in particular. Moreover, comparative statics indicate that the two firm characteristics have similar economic significance.

While the relationship between firms' financial health and choice of trade regime appears robust, it is important to assess whether it implies a causal effect of credit constraints. A priori, even if export *levels* might influence firms' access to finance, it is less obvious how the *composition* of exports would do so. We nevertheless consider two potential concerns with endogeneity and reverse causality. Both of them relate to how efficient financial markets (should) operate.

First, imagine that there are no frictions in capital markets. Manufacturers would then be free to raise all the external finance required for their optimal export strategy. Since liquidity needs decline as suppliers orient activity from ordinary trade to processing with imports to pure assembly, so would their observed use of outside capital. This would generate the correlations of liquidity and leverage with the trade shares in Table 4, but not because of credit constraints as we posit. We argue that this is

[19] We construct firms' TFP as in Levinson and Petrin (2003), by 2-digit industry and ownership type (foreign vs. domestic) using the complete ASIF panel for 2001-2006. Very similar results obtain when we instead measure productivity with value added per worker.

an unlikely explanation for two reasons. First, the results are robust to using lagged values of financial health that should be less subject to this concern. To the extent that both financial health and firms' trade shares may be slow-moving, however, this solution is not perfect. Second and more importantly, we document substantially higher profits from import-and-assembly relative to pure assembly, and even greater returns to ordinary trade. Were Chinese exporters financially unconstrained, they would have therefore pursued these more profitable regimes. That they don't is strong indication that limited access to capital indeed distorts companies' position in GVCs and ultimately performance.

The second potential concern with reverse causality is more subtle. Suppose once again that firms face no credit constraints and sort into different trade regimes for some other exogenous reason. This time imagine also that profitability falls with the share of processing exports, and pure assembly in particular. Note that this arises endogenously in our stylized model precisely because financial frictions are present, but assume that in reality it occurs due to non-finance factors. If financiers are more willing to fund more profitable ventures, exporters more active in trade regimes that happen to have lower returns would record lower liquidity and higher leverage ratios. This alternative explanation would now account for the results both in Table 4 and in Table 3. Although this rationalization requires a very special alignment of exogenous forces and thus seems difficult to believe, we do not want to discount it lightly.

To establish the credit constraints mechanism as cleanly as possible and dispel lingering doubts about causality, in the rest of the paper we therefore exploit a number of other sources of variation in the data for identification. These include the exogenous variation in financial vulnerability across sectors, in financial development across Chinese provinces, and in financial development across export destinations. We also investigate how the trade strategies of new exporters relate to their financial status before entry, as well as how continuing exporters adjust to changes in their financial health.

Sectors' financial vulnerability

We next test Hypothesis 1 and examine the variation in export activity within firms across sectors at different levels of financial vulnerability. Financial vulnerability is technologically determined and reflects industry characteristics innate to the nature of the manufacturing process. It is by construction exogenous from the perspective of individual firms and beyond their control. Hypothesis 1 thus implicitly motivates an identification strategy that allows us to establish the causal effect of financial frictions on exporters' choice of trade regime. Importantly, this empirical approach circumvents the above concerns with endogeneity and reverse causality.

We exploit the rich customs data, and construct the share of different trade regimes in firm *f*'s exports separately for each industry *i* in which it exports, $Trade\ Share_{fi}$.[20] We estimate the following specification using four alternative measures of sectors' financial vulnerability $Fin\ Vuln_i$:

$$Trade\ Share_{fi} = \alpha + \beta \cdot Fin\ Vuln_i + \gamma \cdot Ind\ Controls_i + \varphi_f + \varepsilon_{fi} \quad (3)$$

Since the unit of observation is now at the firm-industry level, we are able to include firm fixed effects φ_f. These control for a range of observed and unobserved firm characteristics that can affect trade outcomes in all sectors, including financial health, productivity, size, ownership type, familiarity with foreign markets, etc. In this stringent specification, the effect of $Fin\ Vuln_i$ is identified purely from the exogenous variation across sectors within multi-sector producers. It reflects the way in which exporters allocate their limited financial resources across trade modes and industries with different liquidity needs. Thus even if firms' total access to capital were endogenous to their trade activity, a significant β would imply that financial factors determine companies' position in GVCs. We cluster errors by firm, to account for the potential correlation in cost or demand shocks across industries within firms.[21]

We are careful to isolate the impact of financial vulnerability from that of other sector characteristics that might independently affect firms' trade regime. Specification (3) does not permit industry fixed effects. We therefore condition on sectors' physical and human capital intensity, as well as on the importance of relationship-specific investments in input production. These control variables come from Braun (2003) and Nunn (2007). We also use four different measures of sectors' financial vulnerability that are imperfectly correlated with each other. This makes it difficult for a single omitted industry characteristic to simultaneously explain the results for all four measures.

The results in Table 5 clearly indicate that exporters choose different means of servicing foreign markets based on the financial characteristics of the sector. Firms actively pursue processing trade, especially pure-assembly, in industries with high working capital requirements as proxied by the inventories-to-sales ratio (Columns 1-2 in Panel A). Increasing short-run liquidity needs by 20% would translate into a 10% rise in the share of foreign revenues generated through processing trade. It would also imply a 4% growth in the share of pure assembly in processing exports. These magnitudes are large compared to the means of the two trade shares (30% and 19% respectively).

[20] Since this analysis does not require any balance-sheet data, we are no longer restricted to the matched sample of firms with both customs and census data, but are able to include the universe of exporting firms.

[21] Moulton (1990) argues that errors should be clustered at the most aggregate level at which the relevant explanatory variable varies in the sample, which in our case is the sector. However, Angrist and Pischke (2008) show that standard error asymptotics require a sufficiently large number of groups (50), which exceeds the number of sectors in our data (29). We have nevertheless confirmed that qualitatively similar results obtain if we instead cluster by sector.

We next examine the importance of sectors' reliance on outside finance for long-term investment (i.e. capital and R&D expenditures). As expected, industries' external finance dependence and R&D intensity both affect the choice between ordinary and processing trade (Panels B and C). The trade-off between pure assembly and processing with imports, on the other hand, appears unrelated to the funding of long-run investment projects. This are consistent with the idea that the two processing regimes differ only with regard to the financing of short-run variable input costs (C_F in our stylized model). By contrast, fixed distribution costs and equipment constitute a key distinction between processing and ordinary exporting (akin to F in the model).

We finally turn to industries' asset tangibility in Panel D. While the three sector measures above capture liquidity needs, tangibility reflects the capacity to raise capital by pledging collateral. Our results confirm that exporters are indeed more likely to choose processing over ordinary exports in industries with softer assets (Column 1). As the financing of long-term investment, asset tangibility too seems unimportant for the choice between the two processing methods (Column 2).

These findings are robust to a number of specification checks similar to those in the previous subsection. Even within narrowly defined industry categories, the optimal trade strategy might respond to characteristics of the export market. To account for this possibility, we re-estimate (3) with the firm-sector-destination as the unit of observation and include country fixed effects (Columns 3-4). We also consider a binary formulation in which we set the trade share equal to 1 for all values above 0 (right panel of Table 6). In unreported regressions, we have separately confirmed that similar patterns obtain when we use the full granularity of the data and construct the outcome variable for each firm-product-destination triplet instead of at the firm-sector-destination level.

5.3 Additional corroborative evidence

While the patterns we have documented go a long way towards establishing the effect of financial constraints on firms' GVC position, further support for the credit mechanism would bolster our causal interpretation. We now offer five more pieces of evidence that exploit five independent sources of variation in the data. We believe that together they paint a consistent and convincing picture.

Financial development across Chinese provinces

The financial sector in China is known to be quite segmented, with banks typically serving firms in the same geographic region (World Bank 2005). This generates variation in the availability of external capital across Chinese provinces that is exogenous to individual producers. We thus expect the export decisions of manufacturers in financially more developed areas to be less sensitive to firms' financial

health and to sectors' financial vulnerability. In other words, companies with low liquidity should be able to conduct less processing trade (especially pure assembly) if based in financially more advanced parts of China than if based in financially less advanced regions. Similarly, across sectors within a firm, sectors with higher liquidity needs should see less processing exports (especially pure assembly) if the firm operates in a financially more developed province.

To test these hypotheses, we expand specifications (2) and (3) to include the interaction of, respectively, firm liquidity and sectors' inventory-to-sales ratio with a measure of financial development in the firms' home province. We estimate the following two regressions:

$$Trade\ Share_{fd} = \alpha + \beta \cdot Fin\ Health_f + \gamma \cdot Fin\ Health_f \cdot High\ Fin\ Devt_p + \\ + \delta \cdot \log Empl_f + \varphi_p + \varphi_i + \varphi_{own} + \varphi_d + \varepsilon_{fd} \quad (4)$$

$$Trade\ Share_{fdi} = \alpha + \beta \cdot Fin\ Vuln_i + \gamma \cdot Fin\ Vuln_i \cdot High\ Fin\ Devt_p + \\ + \delta \cdot Ind\ Controls_i + \varphi_f + \varphi_d + \varepsilon_{fdi} \quad (5)$$

Here $High\ Fin\ Devt_p$ is a dummy variable equal to 1 for provinces with financial development above the sample median and all other variables are defined as before. To exploit the granularity in the data, the unit of observation in (4) is the firm-destination pair, while that in (5) is the firm-sector-destination triplet. In keeping with our earlier specifications, we include province φ_p, industry φ_i and ownership φ_{own} fixed effects in (4) (where, as before, we use information on the firm's primary industry from the census data). By contrast, (5) exploits purely the variation across sectors within exporters by conditioning on firm fixed effects φ_f. The main effect of $High\ Fin\ Devt_p$ is subsumed by the province or firm fixed effect. Both equations include destination fixed effects φ_d to account for systematic differences across export markets. We once again cluster errors by firm to allow for correlated errors across the multiple sectors and countries in which a company conducts business.

We report our results in Table 7. Following common practice in the literature, we proxy regional financial conditions with the ratio of total credit to GDP from the Almanac of China's Finance and Banking (e.g. Héricourt and Poncet 2012). Firms' financial health and sectors' financial dependence enter with the same sign and significance as before. As anticipated, the interaction terms are significant and of the opposite sign. These patterns obtain whether we use continuous or binary trade shares as the outcome variable. Comparing the point estimates on β and γ, we conclude that the effect of firms' financial health on their proclivity for processing trade is twice as high in financially underdeveloped regions in China as it is in financially advanced provinces. Raising a sector's working

capital needs by 10% leads firms to increase processing exports by 10.3% if they face a weak banking system, but by only 3.5% if they can access strong capital markets.

We have validated the robustness of these results to a number of specification checks (available on request). First, we added industry fixed effects in (5) to absorb unobserved industry characteristics. We then identify only the interaction term, but not the main effect of $Fin\,Vuln_i$. Second, we included additional interaction terms between the financial variables (financial health or financial vulnerability) and regional income per capita. This ensures that we isolate the effect of financial development separately from that of overall economic development. Third, we conditioned on the interactions of other firm attributes (productivity, employment) and sector characteristics (physical capital, human capital and contract intensity) with financial development. Finally, we controlled for the interaction of regional capital (skill) endowment and sectors' capital (skill) intensity. Reassuringly, our findings remain qualitatively the same in these stringent robustness tests.

These results strengthen the case for a causal effect of financial frictions on firms' choice of trade regime. Concerns with the endogeneity of $Fin\,Health_f$ or even with omitted sector characteristics correlated with $Fin\,Vuln_i$ might affect how we interpret the level effects β. But they could not explain the differential impact γ in **C**hinese regions with exogenously weaker bank systems.

Financial development across export destinations

We have so far considered the optimal choice of trade regime from the exporter's point of view. As discussed in Section 3.6 however, what regime the Chinese producer is able to pursue also depends on the incentives and financial capacity of his foreign partner. All else constant, the foreign buyer would be more willing to engage in PA or PI if he has easier access to capital in his country. This implies that financial development in the destination market would have the opposite impact on the exporter's trade shares to that of financial development in his home province.

We test this hypothesis by repeating the analysis in (4) and (5), this time using interactions with a dummy equal to 1 for export destinations with financial development above the median ($High\,Fin\,Devt_d$). For consistency, we measure the latter with the amount of credit by banks and other financial intermediaries to the private sector as a share of GDP, from the World Bank's Financial Structure database. The results in Table 8 suggest that superior financial development in the destination indeed makes it more likely for exporters to choose processing trade, especially pure assembly, in sectors with higher working capital needs. The impact of increasing industries' inventory ratio on both trade shares is doubled if a firm's trade partner is based in a country with above-average private credit relative to a country with below-average private credit. On the other hand, the strength of

the financial system in the export market does not materially alter the role of firms' financial health. These results are robust to sensitivity checks similar to those described in the last subsection. They also help establish the causal effect of sectors' financial vulnerability for analogous reasons.

Relationship specificity across sectors

In our stylized model, financial constraints affect trade strategies and firm profits in part because investments are fully relationship-specific. In reality, the extent of relationship specificity varies across sectors and could affect firms' ability to raise external capital. The better a financier can ascertain investment levels, the easier it might be for him to monitor producers' effort.[22] Similarly, the higher the value of the inputs or assembly task outside the partnership, the greater the expected return to an investor in case of default as he could seize and liquidate these assets more profitably. Both of these mechanisms would increase lenders' willingness to fund the Chinese producer. This suggests that financial considerations should affect firms' choice of trade regime relatively more in industries that are more intensive in relationship-specific investments. We find results consistent with this prior when we interact firms' financial health or sectors' financial dependence with sectors' relationship specificity in Table 9. This table replicates the analysis in (4) and (5) using a dummy for industries with relationship specificity above the sample median. Once again, it would be difficult for reverse causality or omitted variable bias to generate these difference-in-difference results.

Import trade regimes

Our explanation for the effect of credit constraints on firms' export regime has testable implications for their import strategies as well. Manufacturers with higher processing (pure assembly) exports should import more foreign inputs under the processing (pure assembly) regime. Also, companies' financial health should affect export and import outcomes symmetrically. Table 10 confirms that this is indeed the case.[23] We now construct the $\frac{X_{PA}+X_{PI}}{X_{PA}+X_{PI}+X_{OT}}$ and $\frac{X_{PA}}{X_{PA}+X_{PI}}$ shares twice for each firm, once based on its exports and once based on its imports. Regressing the latter on the former, we obtain highly significant positive coefficients even conditioning on province, industry and ownership fixed effects (Column 1). Credit-constrained firms with (lagged) low liquidity and high leverage are not only more likely to export under processing trade, and pure assembly in particular (Table 4), but also more likely to import under processing trade, and pure assembly in particular (Table 10). This last result

[22] See Antràs et al. (2009) for a formal model of a similar mechanism.
[23] Firms that conduct more processing exports, and pure assembly in particular, report not just higher shares of processing imports, but also higher absolute levels of processing imports (Column 3 of Appendix Table 1).

holds controlling for firm size and productivity in addition to the fixed effects mentioned above. These findings provide a consistency check for our base premise of how different trade regimes function.

Export dynamics

Our findings suggest that credit constraints help explain the variation in trade activity across Chinese exporters in one year. We have verified that similar cross-sectional patterns hold when we study the pooled panel available for 2002-2006 and control for common shocks with year fixed effects.[24] Do financial frictions also contribute to the time-series variation in GVC participation in the data? To answer this question and shed more light on the underlying mechanisms, we now examine how export behavior evolves within firms over time.

We first explore whether changes in financial health lead exporting firms to reorient operations across trade regimes. To this end, we include firm fixed effects φ_f in a panel version of equation (2):

$$Trade\ Share_{ft} = \alpha + \beta \cdot Fin\ Health_{f,t-1} + \gamma \cdot \log Empl_{f,t-1} + \varphi_f + \varphi_t + \varepsilon_{ft} \qquad (6)$$

In addition to subsuming the role of the province, industry and ownership dummies, φ_f also control for time-invariant unobserved firm characteristics. This very stringent specification identifies β purely from adjustments across trade modes among surviving exporters. We allow for coordinated cost and demand shocks across manufacturers with year fixed effects φ_t.

As Table 11 indicates, movements in liquidity and leverage within firms over time are indeed followed by shifts in the share of activity devoted to processing trade and pure assembly. These patterns obtain controlling for changes in firm productivity over time, as well as accounting for the variation in profitability across export destinations with country fixed effects. They are typically more pronounced when we consider a binary indicator as the outcome variable rather than a continuous measure. Having said that, the point estimates are generally an order of magnitude smaller than those in Table 4 and not always precisely estimated. This suggests that continuing exporters do not rush to modify their operations on an annual basis, possibly because of sunk adjustment costs and uncertainty about future demand and credit conditions. Combined with our earlier results, this implies that financial frictions are an important determinant of the cross-sectional variation in trade participation across firms, but play a lesser role in surviving exporters' short-term dynamics. Their trade regime choice may however be more responsive over a longer time horizon than in our panel.

We next turn to first-time exporters and assess how financial factors prior to entry affect their GVC position upon entry. We postulate that if a company begins exporting in year *t*, it will be more

[24] Customs data are available 2000-2006, but the census panel begins in 2001 and we use 1-year lagged $Fin\ Health_f$.

likely to choose trade modes with lower liquidity requirements if it had access to less financial capital in year *t-1*. We test this hypothesis with the following specification:

$$Trade\ Share_{ft} = \alpha + \beta \cdot Fin\ Health_{f,t-1} + \gamma \cdot \log Empl_{f,t-1} + \varphi_p + \varphi_i + \varphi_t + \varphi_{own} + \varepsilon_{ft} \quad (7)$$

where *t* is the year in which firm *f* exports for the first time, and $Trade\ Share_{ft}$ the composition of its first trade flows.[25] As before, we control for province φ_p, industry φ_i and ownership φ_{own} fixed effects. We further include year dummies φ_t to allow for the possibility that unobserved factors might affect the regime choice of all firms that initiate cross-border sales at the same time.

As expected, we find that new exporters with less liquidity and more leverage conduct relatively more processing trade, and pure assembly in particular, in their first year of exporting. Looking at the point estimates in Table 12, the magnitude of these effects is comparable to that of financial health on trade activity in the cross-section (Table 4). In addition, their economic and statistical significance survives a number of robustness checks. We find similar results when we consider entry into individual country markets, so that the unit of observation becomes the firm-destination pair and the regression includes destination fixed effects. Since new exporters are more likely to choose a unique trade regime than continuing exporters, we also confirm our findings using binary trade shares as the outcome variable. Finally, the role of financial health appears distinct from that of firm productivity, and both qualitatively and quantitatively more important than it. The coefficient on the latter is in fact frequently insignificant in these specifications.

An important trade reform during our sample period allows us to also study how firms respond to exogenous shocks to export opportunities. On January 1, 2005, tight quotas on Chinese sales of textiles and apparel to the US, Canada and EU-25 were lifted as part of the Multi-Fiber Agreement (MFA). The WTO provides a list of products within those industries that were affected. For the US, it is also possible to determine which quotas were binding prior to 2005 (i.e. when actual quantities shipped exceeded 90% of the specified limit). Table 13 replicates the analysis in Table 12, this time focusing on Chinese firms that began exporting MFA-affected products in 2005 to the US, Canada and/or EU-25. We find patterns very similar to those for new exporters in the full panel. Consistent results obtain also when we consider new exporters of quota-bound products to the US (unreported).

To summarize, financial frictions help explain the cross-sectional variation in GVC participation across firms, as well as the behavior of first-time export entrants. They appear less

[25] We consider a firm to be a new exporter in year *t* if it did not export in years *t-1* and *t-2*. Our results are not sensitive to making this filter stricter, for example by requiring that *f* also did not export in year *t-3*, or by focusing only on entry in 2005 conditional on no exports in 2000-2004.

important for the export dynamics of surviving exporters in the very short run, although they might matter more in the medium to longer run.

Separately, the results for export entry provide further support for the causal effect of credit constraints. To the extent that lenders do not have complete information about a firm's success abroad before it begins exporting, lagged financial health is less likely to be endogenous to the trade regime choice of new exporters than of continuing exporters. This is especially true when we consider entry in response to exogenous shocks such as the MFA reform.

6 Quantifying the Aggregate Distortion

Our results indicate that credit constraints restrict firms to low value-added stages of the supply chain and thereby preclude them from pursuing more profitable opportunities. This suggests that strengthening capital markets can be instrumental in increasing aggregate value added, profits and presumably income levels in developing countries. An important policy question is the magnitude of these effects. In this section, we use our point estimates to quantify the potential gains from relaxing financial frictions in China arising from the reallocation away from processing trade.

We consider a counterfactual scenario in which the financial health of all firms in the sample were to improve to that of the least constrained company. If a producer's initial liquidity is Liq_f, it would then increase by $Liq_{MAX} - Liq_f$. As a result, the firm would reduce its share of processing exports by $\beta_{liq}^{PT} \cdot \left(Liq_{MAX} - Liq_f\right)$, where β_{liq}^{PT} is the coefficient from regressing $\frac{X_{PA}+X_{PI}}{X_{PA}+X_{PI}+X_{OT}}$ on liquidity in equation (2) and Table 4. The share of pure assembly in processing trade would decline by $\beta_{liq}^{PA} \cdot \left(Liq_{MAX} - Liq_f\right)$, where β_{liq}^{PA} is now the coefficient from regressing $\frac{X_{PA}}{X_{PA}+X_{PI}}$ on liquidity. Let the point estimates on the processing trade share in equation (1) and Table 3 be β_{PT}^{π}, $\beta_{PT}^{\pi/r}$ and β_{PT}^{VA} for the effect on log profits, profit-to-sales ratio and log value added, respectively. Denote the corresponding estimates for the share of pure assembly in processing exports as β_{PA}^{π}, $\beta_{PA}^{\pi/r}$ and β_{PA}^{VA}. The rise in aggregate Chinese profits $\Delta\Pi^{China}$ and value added ΔVA^{China} can therefore be calculated as:

$$\Delta\Pi_1^{China} = \sum_f \beta_{PT}^{\pi} \cdot \beta_{liq}^{PT} \cdot \left(Liq_{MAX} - Liq_f\right) \cdot \pi_f + \sum_{f,PT>0} \beta_{PA}^{\pi} \cdot \beta_{liq}^{PA} \cdot \left(Liq_{MAX} - Liq_f\right) \cdot \pi_f \quad (8)$$

$$\Delta\Pi_2^{China} = \sum_f \beta_{PT}^{\pi/r} \cdot \beta_{liq}^{PT} \cdot \left(Liq_{MAX} - Liq_f\right) \cdot r_f + \sum_{f,PT>0} \beta_{PA}^{\pi/r} \cdot \beta_{liq}^{PA} \cdot \left(Liq_{MAX} - Liq_f\right) \cdot r_f$$

$$\Delta\text{VA}^{China} = \sum_f \beta_{PT}^{VA} \cdot \beta_{liq}^{PT} \cdot \left(Liq_{MAX} - Liq_f\right) \cdot va_f + \sum_{f,PT>0} \beta_{PA}^{VA} \cdot \beta_{liq}^{PA} \cdot \left(Liq_{MAX} - Liq_f\right) \cdot va_f$$

The term inside each summation represents the boost to firm *f*'s profits and value added due to its enhanced access to capital. The first summation in each expression captures the improvement in firm performance associated with shifting activity away from processing trade towards ordinary exports. The second in turn reflects the gains from reallocating processing trade from pure assembly to processing with imports, for firms that report processing trade (*PT>0*). Summing across all firms in the sample delivers estimates of economy-wide outcomes.

Since value added enters the regression in log form, $\beta_i^{VA} \cdot \beta_{liq}^i \cdot \left(Liq_{MAX} - Liq_f\right)$ captures the percent change in *f*'s value added. Multiplying it by *f*'s level of value added va_f thus gives the change in absolute terms. Turning to profits, there are two ways to infer their rise. The regression for log profits motivates the first approach, $\Delta\Pi_1^{China}$, which follows the same logic as ΔVA^{China}. However, only firms with positive reported profits enter this regression. Because relaxing credit constraints can bring some companies from negative to positive profits, $\Delta\Pi_1^{China}$ is likely an underestimate. The regression for the profit-to-sales ratio, on the other hand, spans all firms in the sample and permits a more accurate calculation. Since $\beta_i^{\pi/r} \cdot \beta_{liq}^i \cdot \left(Liq_{MAX} - Liq_f\right)$ reflects the change in firm *f*'s profit-to-sales ratio, we multiply it by *f*'s observed revenues r_f to obtain the rise in its profits.

We find that the removal of liquidity constraints would increase aggregate Chinese profits and value added by $\Delta\Pi_2^{China} = 5.5$ billion RMB and $\Delta VA^{China} = 15.2$ billion RMB as a result of changes in firms' trade activity. These magnitudes are large in absolute levels and imply that total Chinese profits and value added would grow by 1.3% and 0.7%, respectively.

While informative, this quantification is subject to some caveats. First, these estimates are based on reduced-form analysis that might not accurately capture the general equilibrium effects of financial development. If more firms undertake ordinary trade, external economies of scale could generate bigger gains, for example via access to more specialized inputs or better transportation and marketing infrastructure. On the other hand, increased competition among ordinary exporters could lower profit margins, assuming that the elasticity of substitution is higher for products produced under the same trade regime than for products made under different trade modes.

Second, our results are based on the sample of firms with matched customs and census data. Given that the matched sample appears representative and covers 44% of all companies in the customs registry, 5.5/0.44 = 12.5bil RMB and 15.2/0.44 = 34.5bil RMB might be closer to the predicted change in aggregate profits and value added in levels. On the other hand, we expect the relative change in terms of growth rates to be the same. Separately, calculation (8) ignores producers with no trade activity. Evidence in the prior literature suggests that such manufacturers might be more credit

constrained than those able to export. If financial development facilitates entry into exporting, the latter could make additional contributions to total profits and value added.

Third, the counterfactual we consider brings all firms to the financial health of the least constrained Chinese firm. Given that China's level of financial development is inferior to that in many rich countries, an overall improvement in its financial system could increase firms' access to capital to a much greater degree than that currently enjoyed by the least constrained company. This would translate into gains higher than our benchmark.

Finally, we emphasize that our estimates capture the gains from relaxing financial frictions channeled only through the reallocation of activity across trade regimes. There are of course other channels through which removing credit constraints could increase profits and value added. These might for example include improvements in productivity, worker skill or product quality. A comprehensive welfare assessment of financial reforms would take these into account as well.

7 Conclusion

This paper examines how firms position themselves in the global value chain and how this decision affects performance. We conclude that conducting more steps of the supply chain increases both value added and profits. However, it requires more working capital because it entails higher up-front costs. As a result, credit constraints restrict firms to low value-added stages of production, and preclude them from pursuing more profitable opportunities. We illustrate this mechanism with a stylized model, and provide empirical evidence using matched customs and balance-sheet data for China.

Our findings suggest that financial frictions influence the design of international trade contracts and the organization of GVCs across firm and country boundaries. We thus highlight a novel mechanism through which liquidity constraints impact firms' export outcomes and ultimately profitability. Our analysis implies that strengthening financial markets in developing countries can be instrumental in increasing aggregate value added, profits and income. A promising direction for future research is the potential for firms and entire economies to grow over time by starting with processing trade restricted to few assembly tasks and gradually expanding along the value chain into more profitable activities.

These conclusions shed light on the gains from trade in the context of global production networks and on the distributional consequences of trade policy in the presence of financial frictions. More broadly, we provide one of the first firm-level studies of processing trade and inform current discussions of the effects of global value chains on optimal trade policy, exchange-rate pass-through, and the transmission of supply and demand shocks across nations.

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Table 1. Trade Regime Characteristics

This table summarizes the costs, revenues and profits associated with different export trade regimes in the model.

	Ordinary Trade	Import & Assembly	Pure Assembly
Costs to Chinese Exporter			
Chinese Inputs	C_D	C_D	C_D
Foreign Inputs	$(1+\tau)\, C_F$	C_F	0
Distribution Network	F	0	0
Costs to Foreign Buyer			
Foreign Inputs	0	0	C_F
Distribution Network	0	F	F
Import Tariff Rebate	$\tau\, C_F$	0	0
Export Revenues	R	R	R
Surplus From Relationship	$R - C_D - C_F - F$	$R - C_D - C_F - F$	$R - C_D - C_F - F$
Exporter's Bargaining Weight	$\beta_{OT} = 1$	$\beta_{PI} = \frac{C_D + C_F}{C_D + C_F + F}$	$\beta_{PA} = \frac{C_D}{C_D + C_F + F}$
Exporter's Profits	$R - C_D - C_F - F$	$\beta_{PI}\,(R - C_D - C_F - F)$	$\beta_{PA}\,(R - C_D - C_F - F)$
Exporter's Liquidity Needs	$C_D + (1+\tau)\, C_F + F$	$C_D + C_F$	C_D

Table 2. Summary Statistics

This table provides summary statistics for all exporting firms in the matched sample (Columns 1-3), in the census data (Columns 4-6), and in the customs data (Columns 7-9). Productivity is constructed as value added per worker (VA) or according to Levinsohn-Petrin (2003) (LP). Firms' financial health is measured by liquidity = (current assets - current liability) / total assets or leverage = short-term debt / current assets. PA, PI and OT represent the value of exports under pure assembly, processing with imports, and ordinary trade respectively.

	Matched Sample of Exporters			All Exporters in Census Data			All Exporters in Customs Data		
	N	Mean	St Dev	N	Mean	St Dev	N	Mean	St Dev
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Balance Sheet Data									
(log) Sales	50,567	10.64	1.35	75,001	10.43	1.36			
(log) Employment	50,606	5.31	1.14	75,017	5.20	1.15			
(log) Profits	39,844	7.33	1.95	60,558	7.06	1.95			
Profits / Sales	50,582	0.03	0.20	75,017	0.03	0.23			
(log) Value Added	49,801	9.23	1.48	73,944	9.03	1.48			
Productivity (LP)	47,297	4.96	1.17	64,779	4.93	1.15			
Productivity (VA)	49,735	3.93	1.08	73,819	3.84	1.05			
Liquidity	50,574	0.09	0.32	74,974	0.09	0.33			
Leverage	50,567	0.99	1.28	74,957	1.01	1.41			
Customs Data: Firm Level									
(log) Total Exports	50,606	13.83	2.08				114,883	13.00	2.26
(log) Total Imports	31,551	12.65	2.90				60,330	12.21	2.84
(PA+PI) / (PA+PI+OT)	50,522	0.30	0.42				114,883	0.27	0.41
PA / (PA+PI)	22,071	0.19	0.37				42,176	0.24	0.41
Customs Data: Firm-Industry Level									
(log) Total Exports	105,895	11.47	3.56				258,658	10.96	3.22
(log) Total Imports	40,556	11.37	3.39				76,964	10.98	3.36
(PA+PI) / (PA+PI+OT)	105,895	0.23	0.40				258,658	0.18	0.37
PA / (PA+PI)	32,576	0.16	0.35				60,553	0.21	0.40

Table 3. Trade Regimes, Firm Profitability and Value Added

Notes: PA, PI and OT denote pure assembly, processing with imports, and ordinary trade, respectively. Pure exporters are firms that export only but do not sell domestically. T-statistics based on robust standard errors reported in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% level.

	All Firms			Pure Exporters		
Dep Variable:	(log) Profit	Profit/Sales	(log) Value Added	(log) Profit	Profit/Sales	(log) Value Added
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A. Processing Trade vs. Ordinary Trade						
(PA + PI) / (PA + PI + OT)	-0.151***	-0.016***	-0.108***	-0.221***	-0.023***	-0.149***
	(-5.94)	(-6.65)	(-7.19)	(-3.97)	(-5.63)	(-4.92)
(log) Employment	0.905***	0.007***	0.896***	0.808***	0.007***	0.825***
	(116.61)	(8.68)	(182.28)	(46.33)	(5.14)	(78.17)
R-squared	0.39	0.03	0.55	0.35	0.14	0.54
# observations	39,784	50,498	49,717	8,048	10,578	10,491
Panel B. Pure Assembly vs. Import & Assembly						
PA / (PA + PI)	-0.275***	-0.013***	-0.229***	-0.289***	-0.019***	-0.227***
	(-7.14)	(-3.42)	(-10.74)	(-4.05)	(-2.72)	(-6.18)
(log) Employment	0.892***	0.008***	0.909***	0.830***	0.007***	0.877***
	(77.63)	(7.81)	(125.99)	(38.10)	(4.81)	(68.80)
R-squared	0.44	0.05	0.58	0.40	0.17	0.58
# observations	16,603	22,063	21,704	4,876	6,771	6,708
Ownership FE	Y	Y	Y	Y	Y	Y
Province FE, Industry FE	Y	Y	Y	Y	Y	Y

Table 4. Trade Regimes and Firms' Financial Health

Notes: PA, PI and OT denote pure assembly, processing with imports, and ordinary trade, respectively. The unit of observation is the firm in columns 1-4 and the firm-destination in columns 5-8. T-statistics based on robust standard errors reported in parentheses in columns 1-4 and clustered by firm in columns 5-8. ***, **, and * indicate significance at the 1%, 5%, and 10% level.

	Current Fin Health		Lagged Fin Health					
Dep Variable:	$\frac{PA+PI}{PA+PI+OT}$	$\frac{PA}{PA+PI}$	$\frac{PA+PI}{PA+PI+OT}$	$\frac{PA}{PA+PI}$	$\frac{PA+PI}{PA+PI+OT}$	$\frac{PA}{PA+PI}$	$\frac{PA+PI}{PA+PI+OT}$	$\frac{PA}{PA+PI}$
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A. Liquidity = (current assets - current liability) / total assets								
Liquidity	-0.026***	-0.039***	-0.025***	-0.024***	-0.028***	-0.039***	-0.013*	-0.029**
	(-5.36)	(-4.85)	(-5.09)	(-3.15)	(-3.88)	(-3.23)	(-1.66)	(-2.24)
Productivity							-0.016***	-0.024***
							(-5.99)	(-6.77)
R-squared	0.44	0.24	0.44	0.23	0.43	0.21	0.43	0.22
# observations	50,490	22,059	46,573	20,555	409,249	135,109	380,102	126,592
Panel B. Leverage = short-term debt / current assets								
Leverage	0.004**	0.022***	0.003***	0.007**	0.005***	0.013***	0.004***	0.013***
	(2.13)	(6.85)	(3.18)	(2.05)	(3.49)	(4.21)	(2.66)	(4.04)
Productivity							-0.016***	-0.024***
							(-6.28)	(-6.74)
R-squared	0.44	0.24	0.44	0.23	0.43	0.22	0.43	0.22
# observations	50,483	22,058	46,557	20,545	409,120	135,054	380,027	126,542
Empl, Own FE	Y	Y	Y	Y	Y	Y	Y	Y
Prov FE, Ind FE	Y	Y	Y	Y	Y	Y	Y	Y
Country FE	-	-	-	-	Y	Y	Y	Y

Table 5. Trade Regimes and Sectors' Financial Vulnerability

Notes: PA, PI and OT denote pure assembly, processing with imports, and ordinary trade, respectively. The unit of observation is the firm-sector in columns 1-2 and the firm-sector-destination in columns 3-4. All regressions control for sectors' physical capital (K), human capital (H) and relationship specific (RS) intensity. T-statistics based on robust standard errors clustered by firm reported in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% level.

Dep Variable:	$\frac{PA+PI}{PA+PI+OT}$	$\frac{PA}{PA+PI}$	$\frac{PA+PI}{PA+PI+OT}$	$\frac{PA}{PA+PI}$
	(1)	(2)	(3)	(4)
Panel A. Working Capital Requirements: Inventories Ratio				
Inventories Ratio	0.497***	0.201***	0.538***	0.084**
	(23.43)	(2.77)	(20.90)	(1.99)
K intensity	-0.310***	0.151	-0.176***	0.021
H intensity	0.016***	-0.016	0.026***	-0.011
RS intensity	0.017***	-0.002	0.024***	0.024*
R-squared	0.86	0.97	0.83	0.94
Panel B. Long-Run Investment Needs: External Finance Dependence				
Ext Fin Dependence	0.050***	-0.0001	0.049***	-0.002
	(21.82)	(-0.03)	(18.23)	(-0.46)
K intensity	-0.744***	-0.052	-0.734***	-0.066
H intensity	0.019***	-0.002	0.031***	-0.004
RS intensity	0.003	-0.016	-0.002	0.017
R-squared	0.86	0.97	0.83	0.94
Panel C. Long-Run Investment Needs: R&D Intensity				
R&D Intensity	0.988***	-0.018	0.901***	-0.032
	(22.81)	(-0.24)	(16.68)	(-0.55)
K intensity	-0.601***	-0.053	-0.611***	-0.069*
H intensity	-0.009**	-0.001	0.005	-0.003
RS intensity	-0.022***	-0.015	-0.020***	0.018
R-squared	0.86	0.97	0.83	0.94
Panel D. Access to Collateral: Asset Tangibility				
Asset Tangibility	-0.208***	-0.038	-0.207***	-0.028
	(-18.05)	(-1.12)	(-15.94)	(-1.42)
K intensity	-0.036	0.083	0.026	0.029
H intensity	0.012***	-0.008	0.025***	-0.009
RS intensity	0.019***	-0.011	0.023***	0.021
R-squared	0.86	0.97	0.83	0.94
Firm FE	Y	Y	Y	Y
Country FE	-	-	Y	Y
# firms	110,018	41,041	110,018	41,041
# observations	252,296	59,263	1,142,871	264,585

Table 6. Binary Trade Regime Shares

Notes: PA, PI and OT denote pure assembly, processing with imports, and ordinary trade, respectively. The unit of observation is the firm-destination in columns 1-4 and the firm-sector-destination in columns 5-8. The outcome variable equals 1 for all values above 0. T-statistics based on robust standard errors clustered by firm reported in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% level.

	Lagged Firm Fin Health				Sector Fin Vulnerability			
Dep Variable:	$\frac{PA+PI}{PA+PI+OT}$	$\frac{PA}{PA+PI}$	$\frac{PA+PI}{PA+PI+OT}$	$\frac{PA}{PA+PI}$	$\frac{PA+PI}{PA+PI+OT}$	$\frac{PA}{PA+PI}$	$\frac{PA+PI}{PA+PI+OT}$	$\frac{PA}{PA+PI}$
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Liquidity	-0.029***	-0.037***						
	(-3.94)	(-3.04)						
Leverage			0.005***	0.013***				
			(3.87)	(4.10)				
Inventories Ratio					0.675***	0.149***		
					(22.75)	(3.01)		
Ext Fin Dependence							0.060***	0.0004
							(19.40)	(0.08)
R-squared	0.39	0.23	0.39	0.23	0.77	0.92	0.77	0.92
# observations	409,249	135,109	409,120	135,054	1,142,871	264,585	1,142,871	264,585
Country FE	Y	Y	Y	Y	Y	Y	Y	Y
Empl, Own FE	Y	Y	Y	Y	-	-	-	-
Prov FE, Ind FE	Y	Y	Y	Y	-	-	-	-
Firm FE	-	-	-	-	Y	Y	Y	Y
K, H, RS intensity	-	-	-	-	Y	Y	Y	Y

Table 7. Financial Development across Chinese Provinces

Notes: PA, PI and OT denote pure assembly, processing with imports, and ordinary trade, respectively. The unit of observation is the firm-destination in columns 1-4 and the firm-sector-destination in columns 5-8. The outcome variable is continuous in columns 1-2 and 5-6, and equals 1 for all values above 0 in columns 3-4 and 7-8. High Fin Devt is a dummy set to 1 for Chinese provinces with financial development above the median. T-statistics based on robust standard errors clustered by firm reported in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% level.

	Firm Fin Health: Lagged Liguidity				Sector Fin Vulnerability: Inventories Ratio			
	Continuous Trade Share		Binary Trade Share		Continuous Trade Share		Binary Trade Share	
Dep Variable:	$\frac{PA+PI}{PA+PI+OT}$	$\frac{PA}{PA+PI}$	$\frac{PA+PI}{PA+PI+OT}$	$\frac{PA}{PA+PI}$	$\frac{PA+PI}{PA+PI+OT}$	$\frac{PA}{PA+PI}$	$\frac{PA+PI}{PA+PI+OT}$	$\frac{PA}{PA+PI}$
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Firm Fin Health	-0.039***	-0.085***	-0.041***	-0.081***				
	(-3.70)	(-3.29)	(-3.87)	(-3.17)				
Firm Fin Health x High Fin Devt	0.017*	0.069**	0.019*	0.066**				
	(1.72)	(2.45)	(1.84)	(2.37)				
Sector Fin Vuln					1.028***	0.151	1.252***	0.324**
					(15.98)	(1.19)	(17.77)	(2.13)
Sector Fin Vuln x High Fin Devt					-0.670***	-0.084*	-0.787***	-0.220**
					(-9.92)	(-1.70)	(-10.51)	(-2.11)
R-squared	0.43	0.21	0.39	0.23	0.83	0.94	0.77	0.92
# observations	409,249	135,109	409,249	135,109	1,142,871	264,585	1,142,871	264,585
Country FE	Y	Y	Y	Y	Y	Y	Y	Y
Empl, Own FE	Y	Y	Y	Y	-	-	-	-
Prov FE, Ind FE	Y	Y	Y	Y	-	-	-	-
Firm FE	-	-	-	-	Y	Y	Y	Y
K, H, RS intensity	-	-	-	-	Y	Y	Y	Y

Table 8. Financial Development across Export Destinations

Notes: PA, PI and OT denote pure assembly, processing with imports, and ordinary trade, respectively. The unit of observation is the firm-destination in columns 1-4 and the firm-sector-destination in columns 5-8. The outcome variable is continuous in columns 1-2 and 5-6, and equals 1 for all values above 0 in columns 3-4 and 7-8. High Dest Fin Devt is a dummy set to 1 for export destinations with financial development above the median. T-statistics based on robust standard errors clustered by firm reported in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% level.

	Firm Fin Health: Lagged Liguidity				Sector Fin Vulnerability: Inventories Ratio			
	Continuous Trade Share		Binary Trade Share		Continuous Trade Share		Binary Trade Share	
Dep Variable:	$\frac{PA+PI}{PA+PI+OT}$	$\frac{PA}{PA+PI}$	$\frac{PA+PI}{PA+PI+OT}$	$\frac{PA}{PA+PI}$	$\frac{PA+PI}{PA+PI+OT}$	$\frac{PA}{PA+PI}$	$\frac{PA+PI}{PA+PI+OT}$	$\frac{PA}{PA+PI}$
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Firm Fin Health	-0.037***	-0.034*	-0.039***	-0.031*				
	(-3.80)	(-1.82)	(-3.84)	(-1.65)				
Firm Fin Health x	0.010	-0.006	0.012	-0.007				
High Dest Fin Devt	(1.60)	(-0.51)	(1.62)	(-0.57)				
Sector Fin Vuln					0.360***	0.044	0.401***	0.054
					(12.04)	(1.33)	(11.69)	(1.35)
Sector Fin Vuln x					0.212***	0.044*	0.331***	0.111***
High Dest Fin Devt					(11.44)	(1.71)	(15.29)	(3.20)
R-squared	0.43	0.21	0.39	0.23	0.83	0.94	0.77	0.92
# observations	405,051	134,015	405,051	134,015	1,056,976	247,427	1,056,976	247,427
Country FE	Y	Y	Y	Y	Y	Y	Y	Y
Empl, Own FE	Y	Y	Y	Y	-	-	-	-
Prov FE, Ind FE	Y	Y	Y	Y	-	-	-	-
Firm FE	-	-	-	-	Y	Y	Y	Y
K, H, RS intensity	-	-	-	-	Y	Y	Y	Y

Table 9. Relationship Specificity across Sectors

Notes: PA, PI and OT denote pure assembly, processing with imports, and ordinary trade, respectively. The unit of observation is the firm-destination in columns 1-4 and the firm-sector-destination in columns 5-8. The outcome variable is continuous in columns 1-2 and 5-6, and equals 1 for all values above 0 in columns 3-4 and 7-8. High RS intensity is a dummy set to 1 for sectors with relationship specificity above the median. T-statistics based on robust standard errors clustered by firm reported in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% level.

	Firm Fin Health: Lagged Liguidity				Sector Fin Vulnerability: Inventories Ratio			
	Continuous Trade Share		Binary Trade Share		Continuous Trade Share		Binary Trade Share	
Dep Variable:	$\frac{PA+PI}{PA+PI+OT}$	$\frac{PA}{PA+PI}$	$\frac{PA+PI}{PA+PI+OT}$	$\frac{PA}{PA+PI}$	$\frac{PA+PI}{PA+PI+OT}$	$\frac{PA}{PA+PI}$	$\frac{PA+PI}{PA+PI+OT}$	$\frac{PA}{PA+PI}$
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Firm Fin Health	-0.003	-0.023	-0.008	-0.020				
	(-0.24)	(-1.14)	(-0.75)	(-0.97)				
Firm Fin Health x	-0.046***	-0.025	-0.038***	-0.026				
High RS Intensity	(-3.27)	(-0.99)	(-2.63)	(-1.04)				
Sector Fin Vuln					0.516***	0.083*	0.645***	0.131***
					(20.63)	(1.88)	(22.27)	(2.80)
Sector Fin Vuln x					0.118***	0.005	0.165***	0.026*
High RS Intensity					(9.37)	(0.27)	(11.12)	(1.71)
R-squared	0.43	0.21	0.40	0.23	0.83	0.94	0.77	0.92
# observations	400,859	132,753	400,859	132,753	1,142,871	264,585	1,142,871	264,585
Country FE	Y	Y	Y	Y	Y	Y	Y	Y
Empl, Own FE	Y	Y	Y	Y	-	-	-	-
Prov FE, Ind FE	Y	Y	Y	Y	-	-	-	-
Firm FE	-	-	-	-	Y	Y	Y	Y
K, H, RS intensity	-	-	-	-	Y	Y	Y	Y

Table 10. Import Trade Regimes and Firms' Financial Health

Notes: PA, PI and OT denote export flows under pure assembly, processing with imports, and ordinary trade, respectively. IPA, IPI and IOT denote import flows under pure assembly, processing with imports, and ordinary trade, respectively. T-statistics based on robust standard errors reported in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% level.

	(1)	(2)	(3)	(4)	(5)
Panel A. Dep. Variable: (IPA + IPI) / (IPA + IPI + IOT)					
(PA + PI) / (PA + PI + OT)	0.603***				
	(111.97)				
Lag Liquidity		-0.026***	-0.014**		
		(-4.51)	(-2.33)		
Lag Leverage				0.002*	0.001
				(1.95)	(0.92)
Lag Productivity			-0.028***		-0.029***
			(-12.00)		(-12.54)
R-squared	0.58	0.40	0.40	0.40	0.40
# observations	30,274	32,530	30,167	32,518	30,159
Panel B. Dep. Variable: IPA / (IPA + IPI)					
PA / (PA + PI)	0.946***				
	(294.23)				
Lag Liquidity		-0.021***	-0.015*		
		(-2.86)	(-1.94)		
Lag Leverage				0.007**	0.007*
				(2.02)	(1.86)
Lag Productivity			-0.017***		-0.016***
			(-6.33)		(-6.12)
R-squared	0.93	0.21	0.21	0.21	0.22
# observations	20,483	20,952	19,505	20,944	19,500
Ownership FE	Y	Y	Y	Y	Y
Province FE, Industry FE	Y	Y	Y	Y	Y
Employment	N	Y	Y	Y	Y

Table 11. Trade Regimes and Export Dynamics in the Panel

Notes: PA, PI and OT denote pure assembly, processing with imports, and ordinary trade, respectively. The unit of observation is the firm-year in columns 1-2 and the firm-year-destination in columns 3-6, for the 2002-2006 panel. The outcome variable is continuous in columns 1-4, and equals 1 for all values above 0 in columns 5-6. T-statistics based on robust standard errors reported in parentheses in columns 1-2 and clustered by firm in columns 3-6. ***, **, and * indicate significance at the 1%, 5%, and 10% level.

Dep Variable:	Continuous Trade Share				Binary Trade Share	
	$\frac{PA+PI}{PA+PI+OT}$	$\frac{PA}{PA+PI}$	$\frac{PA+PI}{PA+PI+OT}$	$\frac{PA}{PA+PI}$	$\frac{PA+PI}{PA+PI+OT}$	$\frac{PA}{PA+PI}$
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A. Liquidity = (current assets - current liability) / total assets						
Lag Liquidity	-0.010***	-0.002	-0.006**	-0.005*	-0.008***	-0.008***
	(-3.93)	(-0.48)	(-2.47)	(-1.95)	(-2.66)	(-2.93)
Lag Productivity	0.004***	-0.003***	0.003***	-0.001**	0.003***	-0.002***
	(5.04)	(-3.46)	(4.32)	(-2.46)	(4.21)	(-3.27)
R-squared	0.94	0.93	0.82	0.89	0.75	0.85
# observations	165,942	77,803	1,428,075	507,811	1,428,075	507,811
Panel B. Leverage = short-term debt / current assets						
Lag Leverage	0.0002	0.0001	0.0003*	0.0004**	0.0006**	0.0003**
	(0.91)	(1.31)	(1.71)	(2.20)	(2.21)	(2.07)
Lag Productivity	0.003***	-0.003***	0.003***	-0.002**	0.003***	-0.002***
	(4.69)	(-3.50)	(4.09)	(-2.57)	(3.98)	(-3.46)
R-squared	0.94	0.93	0.82	0.89	0.75	0.85
# observations	165,919	77,788	1,427,972	507,748	1,427,972	507,748
Employment	Y	Y	Y	Y	Y	Y
Firm FE	Y	Y	Y	Y	Y	Y
Year FE	Y	Y	Y	Y	Y	Y
Country FE	-	-	Y	Y	Y	Y

Table 12. Trade Regimes and Export Entry in the Panel

Notes: PA, PI and OT denote pure assembly, processing with imports, and ordinary trade, respectively. The unit of observation is the firm-year in columns 1-2 and the firm-year-destination in columns 3-8, for the 2002-2006 panel. Only firms that exported in year t but not in the previous two years are included. The outcome variable is continuous in columns 1-6, and equals 1 for all values above 0 in columns 7-8. T-statistics based on robust standard errors reported in parentheses in columns 1-2 and clustered by firm in columns 3-8. ***, **, and * indicate significance at the 1%, 5%, and 10% level.

	Continuous Trade Share						Binary Trade Share	
Dep Variable:	$\frac{PA+PI}{PA+PI+OT}$	$\frac{PA}{PA+PI}$	$\frac{PA+PI}{PA+PI+OT}$	$\frac{PA}{PA+PI}$	$\frac{PA+PI}{PA+PI+OT}$	$\frac{PA}{PA+PI}$	$\frac{PA+PI}{PA+PI+OT}$	$\frac{PA}{PA+PI}$
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A. Liquidity = (current assets - current liability) / total assets								
Lag Liquidity	-0.025***	-0.070***	-0.032***	-0.067**	-0.034***	-0.065**	-0.036**	-0.063**
	(-3.27)	(-2.75)	(-2.60)	(-2.37)	(-2.59)	(-2.34)	(-2.53)	(-2.25)
Lag Productivity					-0.005	-0.006	-0.004	-0.005
					(-1.33)	(-0.49)	(-0.97)	(-0.37)
R-squared	0.26	0.32	0.35	0.40	0.35	0.40	0.33	0.41
# observations	18,144	3,554	83,647	14,278	78,275	13,477	78,275	13,477
Panel B. Leverage = short-term debt / current assets								
Lag Leverage	0.003*	0.018***	0.006**	0.026***	0.007**	0.024***	0.007**	0.022***
	(1.67)	(3.07)	(2.05)	(2.97)	(2.22)	(3.03)	(2.12)	(2.62)
Lag Productivity					-0.006*	-0.005	-0.005	-0.004
					(-1.67)	(-0.47)	(-1.33)	(-0.37)
R-squared	0.26	0.32	0.35	0.41	0.35	0.40	0.33	0.41
# observations	18,140	3,553	83,634	14,275	78,262	13,474	78,262	13,474
Empl, Own FE	Y	Y	Y	Y	Y	Y	Y	Y
Prov FE, Ind FE	Y	Y	Y	Y	Y	Y	Y	Y
Year FE	Y	Y	Y	Y	Y	Y	Y	Y
Country FE	-	-	Y	Y	Y	Y	Y	Y

Table 13. Trade Regimes and Export Entry after MFA Reform

Notes: PA, PI and OT denote pure assembly, processing with imports, and ordinary trade, respectively. The unit of observation is the firm-year in columns 1-2 and the firm-year-destination in columns 3-8. Only firms that export affected products to the US, Canada and/or EU-25 in 2005 after the MFA reform but not in the previous two years are included. The outcome variable is continuous in columns 1-6, and equals 1 for all values above 0 in columns 7-8. T-statistics based on robust standard errors reported in parentheses in columns 1-2 and clustered by firm in columns 3-8. ***, **, and * indicate significance at the 1%, 5%, and 10% level.

	Continuous Trade Share						Binary Trade Share	
Dep Variable:	$\frac{PA+PI}{PA+PI+OT}$	$\frac{PA}{PA+PI}$	$\frac{PA+PI}{PA+PI+OT}$	$\frac{PA}{PA+PI}$	$\frac{PA+PI}{PA+PI+OT}$	$\frac{PA}{PA+PI}$	$\frac{PA+PI}{PA+PI+OT}$	$\frac{PA}{PA+PI}$
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A. Liquidity = (current assets - current liability) / total assets								
Lag Liquidity	-0.066***	-0.091**	-0.064**	-0.081	-0.038*	-0.088*	-0.060*	-0.076*
	(-2.94)	(-2.35)	(-2.09)	(-1.55)	(-1.75)	(-1.66)	(-1.91)	(-1.69)
Lag Productivity					-0.036**	-0.002	-0.036**	-0.004
					(-2.13)	(-0.12)	(-2.22)	(-0.21)
R-squared	0.43	0.35	0.41	0.39	0.43	0.39	0.44	0.39
# observations	1,809	866	4,099	1,453	3,731	1,339	3,731	1,339
Panel B. Leverage = short-term debt / current assets								
Lag Leverage	0.008***	0.013***	0.008***	0.014***	0.007***	0.013***	0.006***	0.013***
	(3.92)	(2.77)	(4.05)	(3.28)	(4.04)	(3.25)	(3.29)	(2.86)
Lag Productivity					-0.038**	-0.003	-0.040**	-0.004
					(-2.25)	(-0.14)	(-2.46)	(-0.20)
R-squared	0.43	0.35	0.41	0.40	0.43	0.40	0.44	0.40
# observations	1,809	866	4,099	1,453	3,731	1,339	3,731	1,339
Empl, Own FE	Y	Y	Y	Y	Y	Y	Y	Y
Prov FE, Ind FE	Y	Y	Y	Y	Y	Y	Y	Y
Country FE	-	-	Y	Y	Y	Y	Y	Y

Figure 1. The Distribution of Firms Across Trade Regimes

This figure summarizes the composition of firms' trade activity in 2005. Each segment gives the percentage share of firms active in a given set of export trade regimes. Firms in the red circle are engaged in ordinary trade (OT); in the blue circle - in pure assembly (PA); and in the yellow circle - in import and assembly (PI). Firms in overlapping segments of the three circles export under multiple trade regimes. The percentages reported sum to 100%.

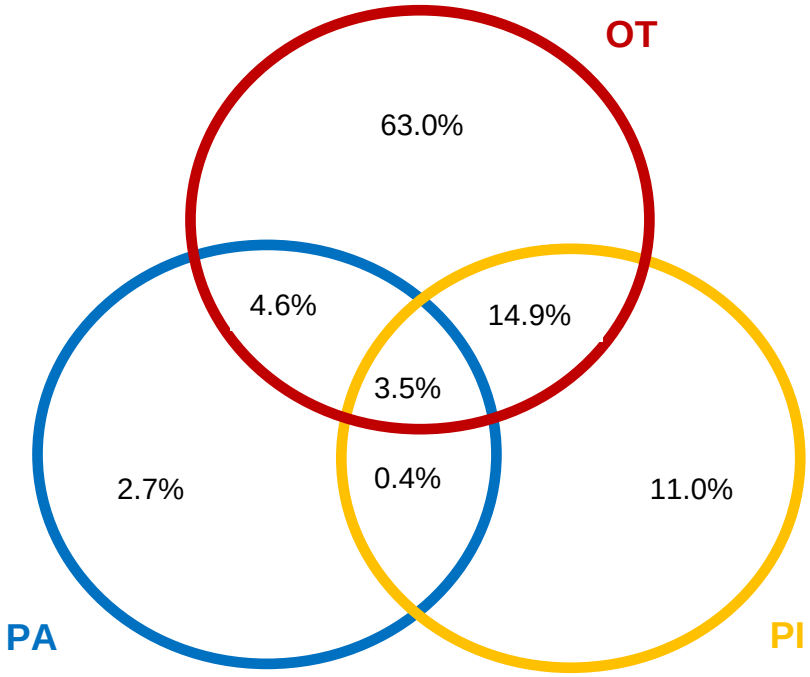


Figure 2. The Distribution of Export Value Across Trade Regimes

This figure replicates Figure 1, but instead of showing the percentage share of firms in a segment, it reports the percentage share of total exports captured by firms in that segment.

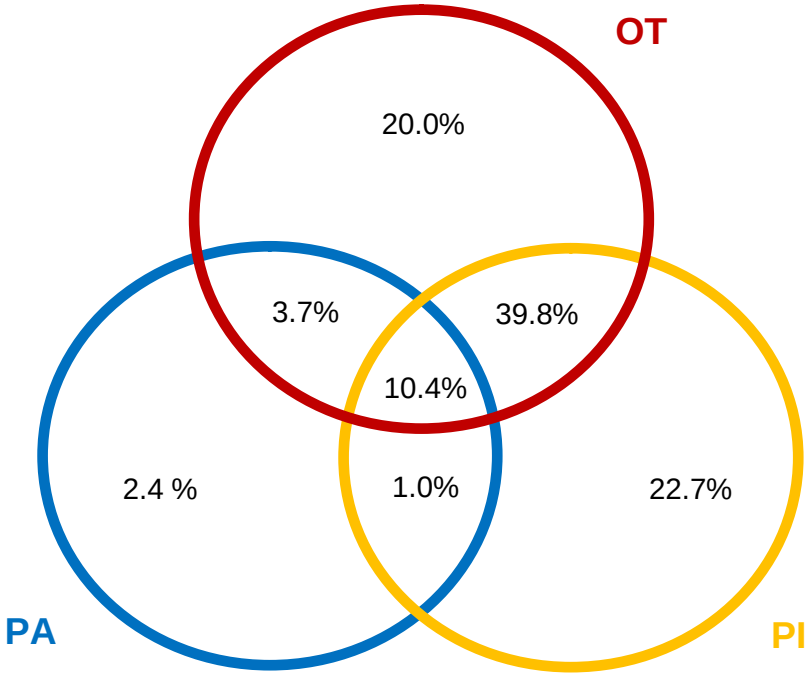


Figure 3. Input Sourcing Strategies Across Firms

This figure summarizes the use of imported inputs by firms reporting ordinary exports (left bar) and firms reporting processing exports (right bar) in 2005. Each segment gives the percentage share of firms using no imported inputs (grey), inputs imported under processing trade (yellow), inputs imported under ordinary trade (blue), and inputs imported under both regimes (red). The percentages reported in each bar sum to 100%.

Figure 3A. Firms reporting both ordinary and processing exports enter both bars

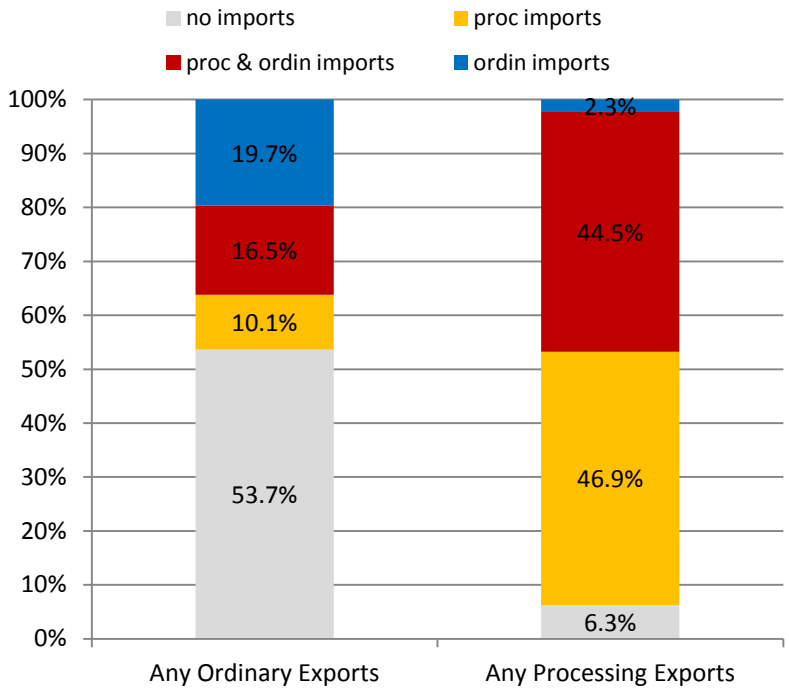


Figure 3B. Firms reporting both ordinary and processing exports are excluded

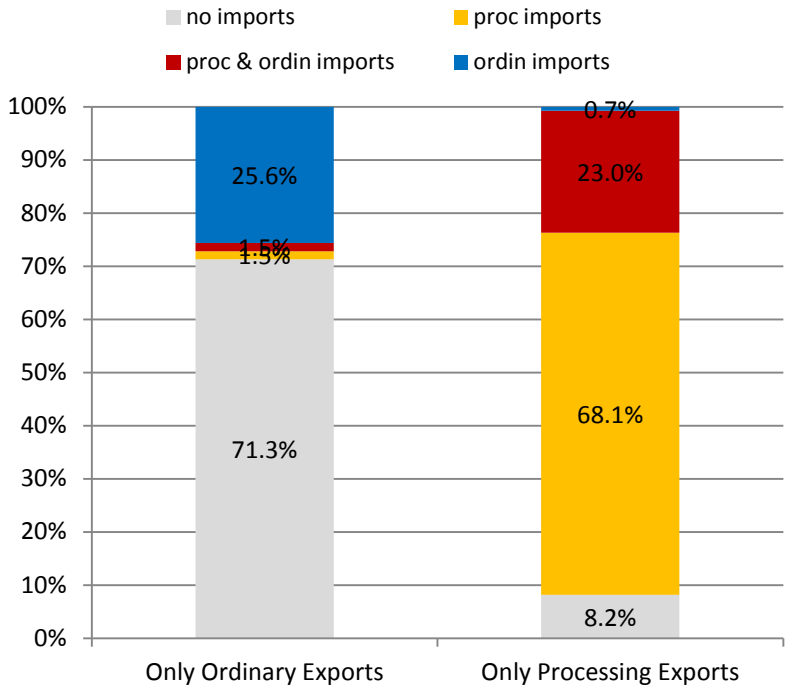


Figure 4. Trade Shares Across Firms and Sectors

This figure shows how the propensity for firms to pursue different trade regimes varies with firms' financial health (Figure 4A) and with sectors' working capital requirements (Figure 4B) in 2005. In Figure 4A, firms are split into two subsamples with liquidity above or below the sample median. In Figure 4B, sectors are split into sectors with inventory ratios above and below the median. The left bars (red) report the average share of processing trade in total exports, (PA+PI)/(PA+PI+OT), across firms in a sample. The right bars (yellow) report the average share of pure assembly in processing trade, PA/(PA+PI), across firms in a sample.

Figure 4A. Firms' financial health

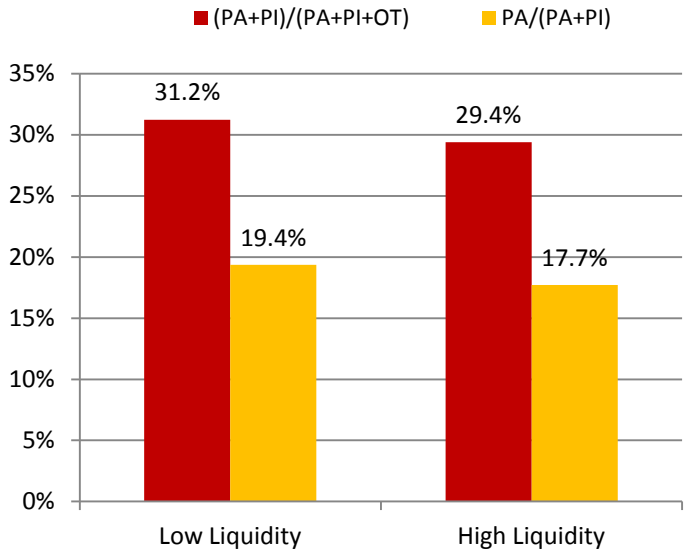
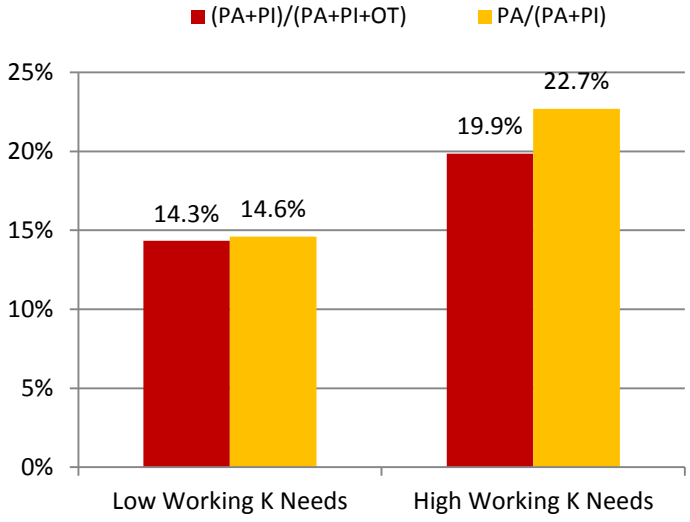


Figure 4B. Sectors' working capital requirement



Appendix Table 1. Total Exports, Domestic Sales and Processing Imports

Notes: PA, PI and OT denote pure assembly, processing with imports, and ordinary trade, respectively. T-statistics based on robust standard errors reported in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% level.

Dep Variable:	(log) Dom Sales	(log) Exports	(log) Proc Imports
	(1)	(2)	(3)
Panel A. Processing Trade vs. Ordinary Trade			
(PA + PI) / (PA + PI + OT)	-1.850***	0.960***	3.073***
	(-34.52)	(38.61)	(80.01)
(log) Employment	0.701***	0.743***	0.802***
	(42.81)	(90.90)	(73.88)
R-squared	0.33	0.31	0.53
# observations	50,507	50,522	21,611
Panel B. Pure Assembly vs. Import & Assembly			
PA / (PA + PI)	-0.149*	-0.259***	0.072*
	(-1.75)	(-8.59)	(1.77)
(log) Employment	0.514***	0.918***	0.857***
	(18.47)	(92.73)	(69.53)
R-squared	0.29	0.43	0.36
# observations	22,064	22,071	20,483
Ownership FE	Y	Y	Y
Province FE, Industry FE	Y	Y	Y